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DOE/EV-0057/2- Volume 2 (of 2)

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Inventory of

Federal Energy-Related Environment and Safety Research for FY 1979

Volume II- Project Listings and Indexes

Published: December 1980

U.S. Department of Energy
Assistant Secretary for Environment
Office of Program Coordination
Washington, D.C. 20545

Technical Information Center
Oak Ridge, Tennessee 37830

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Distr. Category UC-11,41

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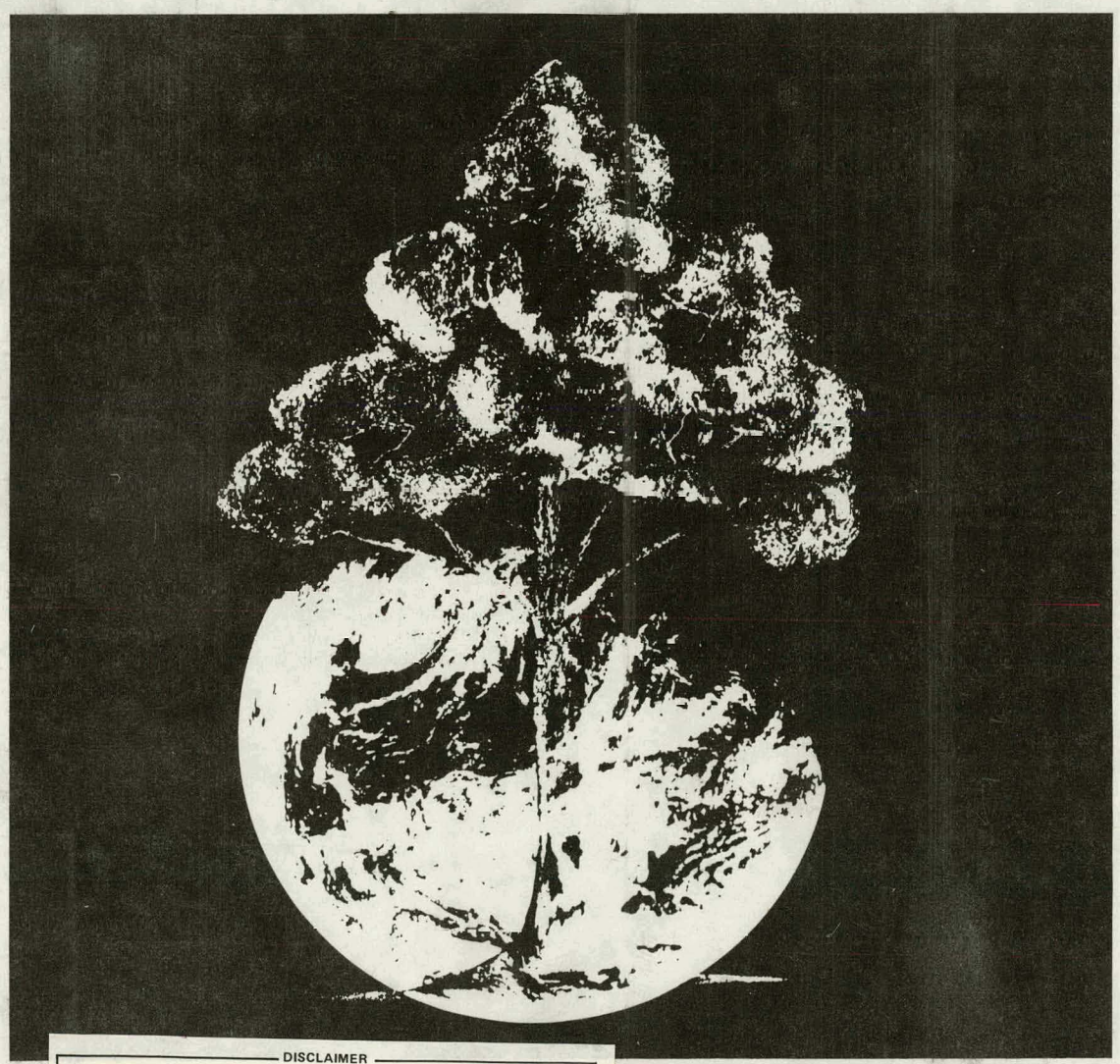

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PREFACE

This volume contains summaries of FY-1979 government-sponsored environment and safety research related to energy. Project summaries were collected by Science Applications, Inc. (SAI), under contract with the U. S. Department of Energy, Office of Program Coordination, under the Assistant Secretary for Environment. The summaries and other information relating to the projects were edited, categorized, indexed, and input to a computer file by the U. S. Department of Energy Technical Information Center in Oak Ridge, Tenn. The summary listings in this volume were photocomposed at GPO using a computer tape generated at the Technical Information Center.

The file is available for on-line searching via the Department of Energy RECON system. DOE/RECON is an interactive on-line information retrieval system developed to provide rapid and easy access to energy-related data bases produced or obtained by the U. S. Department of Energy (DOE) Technical Information Center (TIC). DOE/RECON is operated for TIC at the Oak Ridge National Laboratory (ORNL) by Union Carbide Corporation Nuclear Division. The acronym RECON stands for REmote CONsole, signifying the system can be accessed by users located at various sites across the United States. Users may access the system through telephone hookups with Teletype-compatible terminals, by dialing directly or by using the TELENET network. Access to the DOE/RECON system is granted by Charles E. Spath, Assistant Manager for Information Services of the Technical Information Center. Access is considered on the receipt of a letter request to: Thomas D. Sample, Chief, Technical Services Branch, U. S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830

The FY-1979 Federal Inventory data base is also maintained on the VAX 11/780 computer at Science Applications, Inc. (SAI), Oak Ridge, Tennessee. SAI will provide information from the data base by two methods. First, SAI will provide a response service to persons interested in obtaining data about specific research projects or groups of projects. Requests for Inventory information will be answered by searches of the data base by SAI personnel.

Summaries are arranged in this publication by log number, which groups the projects by reporting agency. The log number is a unique number assigned to each project from a block of numbers set aside for each agency. The association of agencies with blocks of log numbers is shown in the following table.

Department of Agriculture	1–9,999
Department of Commerce	10,000–19,999
Department of Defense	20,000–29,999
Department of Health, Education and Welfare	30,000–39,999
Department of Housing and Urban Development	40,000–49,999
Department of the Interior	50,000–59,999
Department of Transportation	60,000–69,999
Environmental Protection Agency	70,000–99,999
Department of Energy	100,000–129,999
National Science Foundation	130,000–139,999
National Aeronautics & Space Administration	140,000–149,999
Tennessee Valley Authority	150,000–159,999
Nuclear Regulatory Commission	160,000–169,999
Council on Environmental Quality	170,000–179,999
Office of Technology Assessment	180,000–189,999
Department of Labor	190,000–199,999

Information about the projects is included in the summary listings. This includes the project title, principal investigators, research organization, project number, contract number, supporting organization, funding level if known, related energy sources with numbers indicating percentages of effort devoted to each, and R & D categories. A brief description of each project is given, and this is followed by subject index terms that were assigned for computer searching and for generating the printed subject index in the back of this volume.

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DEPARTMENT OF AGRICULTURE

1 Alder for Mined-Land Restoration in Cold-Dominated Climates. McKendrick, J.D. (Univ. of Alaska, Fairbanks, AK, 99701). **Project number:** ALK05909. **Contract:** ALK05909. **Supported by:** Alaska Univ., Fairbanks (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$6,000.
Related energy source: Coal(100)

The principal objective of the study includes means of evaluating the cultural practices and uses of Alnus sp. (alder) in rehabilitating drastically disturbed sites such as coal-mine spoils. Specific objectives include the determination of seed availabilities of alder on disturbed sites, the examination of soil conditions favorable or inhibitory to alder establishment, and the documentation of physical and chemical soil changes occurring as the result of alder invasion. Research plots will be established to evaluated physical and cultural aspects of alder establishment on two Alaskan mine spoils. Stratified seed will be used as a seed source. Germination and growth characteristics will be monitored. In another study, alder stands of varying age will be evaluated in relation to soil and plant properties, thus documenting beneficial contributions of alder in a cold-dominated climate.
Keywords: trees; cultivation techniques; coal mines; spoil banks; land reclamation; soil chemistry; alaska; seeds; growth; arctic regions; revegetation.

2 Solar Heated Septic Tanks for Dead Poultry Disposal. Mote, C.R.; Holbrook, W. (Univ. of Arkansas, Fayetteville, AR, 72701). **Project number:** ARK00935. **Contract:** ARK00935. **Supported by:** Arkansas Univ., Fayetteville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$6,000.
Related energy source: solar(100)

The research objectives are to: demonstrate the use of septic tank-filter field systems for poultry disposal; demonstrate the effects of heating and agitation on the efficiency of septic tanks for poultry disposal; investigate overall energy efficiency of solar heated septic tanks; and investigate the economic incentives for using heated septic tank-filter field systems for dead poultry disposal. Two solar heated septic tank systems with one control system will be located on the University of Arkansas Main Experiment Station, Fayetteville, Arkansas. Water samples will be collected monthly from each septic tank's effluent and from two well points installed below each filter field. Water samples will be analyzed for concentration of total solids, suspended solids, volatile solids, etc. Two solar collector systems will maintain optimum biological temperatures in the septic tanks. The relative economics of heated septic tank systems for dead chicken disposal will be determined by comparing the construction and operating costs of the research units with other disposal methods.
Keywords: chickens; waste disposal; solar heating; economics; arkansas; sampling; solar collectors; biodegradation; filters; tanks; efficiency; solar process heat.

3 Reclamation and Water Reactions of Strip Mine Spoils in Northern Arizona. Jordan, G.L.; Day, D. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** ARZT-101751-68-208. **Contract:** ARZT-101751-68-208. **Supported by:** Arizona Univ., Tucson (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$247,000.
Related energy source: Coal(100)

The objectives are to: (1) identify plant species adapted for revegetating and stabilizing strip mine spoils; (2) test cultural and soil treatments for establishing and maintaining adapted species; (3) determine the effects of plantings and cultural treatments on the hydrologic regime of mine spoil; and (4) develop and test mathematical simulations of the hydrologic behavior of mine spoils under alternative treatments. Characteristics of seed germination need to be known for productive and effective field planting. Lab and greenhouse studies are very helpful but actual field studies are necessary. Each species has its own temperature range for germination which restricts its response in the environment. Fifteen native species will be tested. Supplemental irrigation will be used in field trials. Runoff and sedimentation from plots will be measured.
Keywords: arizona; spoil banks; coal mines; surface mining; land reclamation; revegetation; plants; cultivation techniques; mathematical models; germination; seeds; irrigation; runoff; sediments; sampling.

4 Plants for Pollution and Erosion Control, Beautification and Browse. Jordan, G.L. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** ARZT170389-68-14. **Contract:** ARZT170389-68-14. **Supported by:** Arizona Univ., Tucson (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: Coal(100)

This study will determine the potential for germination and survival of selected native and introduced shrubs for critical area stabilization and range plantings. Laboratory studies will be continued on germination characteristics including rates, energy requirements, and breaking of dormancy on selected native and introduced shrubs. Species showing highest germination rates will be field tested in accordance with their temperature and energy requirements on critical areas. Selection of species and planting procedures will emphasize drought tolerance and moisture-conserving practices for establishment.
Keywords: plants; erosion; pollution control; control; shrubs; germination; land reclamation; revegetation; preferred species; soil conservation; control; coal mining; waste management.

5 Adding Market Value to Harvested Vegetables and Grain by Processing with Solar Energy. Foster, R.E. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** ARZT172381-56-14. **Contract:** ARZT172381-56-14. **Supported by:** Arizona Univ., Tucson (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$6,000.
Related energy source: solar(100)

The objectives are to: (1) utilize surplus vegetables by dehydrating completely; (2) improve shipping ability of Arizona vegetables and reduce transit costs and handling losses by removing small amounts of moisture at origin and restoring it at destination; (3) permit early grain harvest by artificially drying immature grain; and (4) accomplish all of the above through the use of solar energy. The approach is to: (1) use fossil fuel to simulate solar powered dehydrator; (2) establish machine requirements and develop methods; (3) obtain harvested produce, apply drying treatments, store, restore to original form, and evaluate by appropriate comparisons; (4) compare artificially dried grain with full term grain; and (5) determine proper timing by comparing different ages.
Keywords: vegetables; solar drying; dehydration; simulation; storage; evaluation; cereals; research programs; transport; cost.

6 Mined Land Reclamation Planning in the Pinyon-Juniper Ecosystem. Thames, J.L. (Univ. of Arizona, Tucson, AZ, 857221). **Project number:** ARZT2014-416837. **Contract:** ARZT2014-416837. **Supported by:** Arizona Univ., Tucson (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: Coal(100)

This study will develop methods for comprehensive mining-reclamation planning using hydrologic simulation, computerized mapping and systems analysis. The factors, slope length, slope inclination, aspect, topographic alignment and configuration, are dependent upon the mining operation and subsequent regrading of the spoil. They are not mutually exclusive. The approach will be to achieve the most favorable balance of these factors with the least amount of earth moving. This will require a systems analysis framework with

primary input from the hydrologic synthesis and assumptions on plant response. Climatic and hydrologic data will also be required and are presently being collected. Information on the mining operation such as depth of overburden, present overburden removal methods, hauling routes, power supply routes, and regarding facilities will be obtained.
Keywords: surface mining; land reclamation; optimization; spoil banks; climates; hydrology; plants; systems analysis.

7 Utilization of Animal, Crop, and Processing Residues. Hills, D.J.; Miller, G.E. (Univ. of California, Davis, CA, 95616). **Project number:** CA-D-AER-2971-H. **Contract:** CA-D-AER-2971-H. **Supported by:** California Univ., Davis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$8,000.
Related energy source: conservation(100)

The objective is to investigate means and processes for obtaining greater utilization of animal, crop and food processing plant wastes by recycling, conversion and energy recovery techniques. Control and reduction of air, water, and soil pollution will be a basic consideration. Laboratory and field studies will be conducted on open field burning of crop residues and pyrolysis and incineration for any recovery. Animal and food processing wastes will be examined for recycling to animal feeds. All types of wastes will be studied in soil plots for recovery of nutrients and encouragement of soil bacteria conversion to useable plant nutrients.
Keywords: manures; agricultural wastes; recycling; incinerators; pyrolysis; animal feeds; materials recovery; nutrients; waste management; conversion; technology assessment.

8 Yolk Deposition in Birds Subjected to Environmental Contaminants. Graw, C.R. (Univ. of California, Davis, CA, 95616). **Project number:** CAD-AVS2990-H. **Contract:** CAD-AVS2990-H. **Supported by:** California Univ., Davis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$4,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This study will determine the significance of yolk deposition rate as a factor in contamination of eggs of birds exposed to pesticides, toxic metals, oil-soluble pollutants or other similar hazards. Through recently developed staining techniques, yolk rings can be revealed which probably correspond to feeding and activity variation in the female's environment. Thus, rings in an egg of a wild bird can be used to determine the recent history of her environment during the period of yolk formation. Until now there were no methods to determine the time required for yolk formation. Eggs of representative wild birds will be studied in cooperation with State and Federal agencies. Acute exposure over a period of from several hours to a few days will be used to determine the transfer of pesticides, oil-spill pollutants, and toxic metals to particular rings of yolk laid down during short periods of contamination.
Keywords: birds; eggs; contamination; pesticides; metals; petroleum; age estimation; wild animals; oil spills; bioassay; toxicity; biological effects.

9 Improved Greenhouse Production Systems. Kohl, H.C. Jr. (Univ. of California, Davis, CA, 95616). **Project number:** CAD-EHT3334-H. **Contract:** CAD-EHT3334-H. **Supported by:** California Univ., Davis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(50); geothermal(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Study will devise a greenhouse system oriented to the use of geothermal energy and thermal polluted water, coolant from nuclear power generating reactors and to the special problems of arid climates, and devise greenhouse production systems oriented to the needs of the amateur plant grower. Cultivars of ornamental plants will be indexed according to maximum, minimum and optimum temperature requirements in order to provide information for development of energy conserving modifications of current greenhouse growing systems. Crop production systems will be designed which utilize multiple layers of plants (particularly at night) to make most efficient use of heated space. A greenhouse system oriented to the use of geothermal energy and thermal polluting water, nuclear power generating reactors and to special problems of arid climates will be designed. Greenhouse production systems oriented to the needs of the amateur plant grower will be devised.
Keywords: greenhouses; geothermal energy; thermal effluents; nuclear power plants; optimization; waste heat utilization; design; ornamental plants; energy conservation; plants; systems analysis.

10 Bioconversion of Distillery and Winery Waste. Williams, L.A. (Univ. of California, Davis, CA, 95616). **Project number:** CA-D-VIT-3841-H. **Contract:** CA-D-VIT-3841-H. **Supported by:** California Univ., Davis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop bioconversion processes based on winery and distillery wastes which allow economic recovery of by-products or energy while reducing pollution problems. The approach is to: (1) survey and chemically characterize winery and distillery waste streams; (2) survey and screen for organisms which perform interesting bioconversions of waste or its major components; (3) determine important bioconversion process parameters such as kinetic constants, yield factors, temperature limits, etc. in laboratory scale equipment; and (4) perform economic analysis to determine desirability of pilot scale experiments.
Keywords: bioconversion; distillation; liquid wastes; beverages; food industry; chemical properties; microorganisms; materials recovery; chemical reaction yield; bench-scale experiments; waste management.

11 Oxidative Utilization of Wood and Other Lignocellulosic Materials. Brink, D.L. (Univ. of California, Berkeley, CA, 94720). **Project number:** CA-F-FPL-2910-MS. **Contract:** CA-F-FPL-2910-MS. **Supported by:** California Univ., Berkeley (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$9,000.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Based upon oxidative reactions, technically and economically feasible and environmentally compatible processes utilizing wood and other lignocellulosic materials will be developed. The lignocellulosic moiety in wood and residuals of forestry and agriculture will be modified using oxidizing agents to produce products of commercial value.
Keywords: wood; cellulose; lignin; oxidation; agricultural wastes; wood wastes; synthesis; chemical feedstocks.

12 Radioecological Investigations of Uranium Mill Sites. Whicker, F.W. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COL000164. **Contract:** COL000164. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objectives are to survey abandoned and active uranium mill tailings sites for radiation levels; and to investigate the integrity of the radionuclides associated with tailings and the potential for spread of radionuclides by physical and biological mechanisms. Several sites in Colorado and Wyoming will be investigated. Measurements of radiation levels will be made with a pressurized ionization chamber. Selected soil, plant and animal samples will be collected for radionuclide assay. Visual reconaissance of sites for potential radioecological problems will be undertaken.
Keywords: radioecology; feed materials plants; mill tailings; radiation monitoring; radionuclide migration; environmental transport; colorado; wyoming; soils; plants; animals; radioecological concentration; radionuclide kinetics.

13 Vegetable Stabilization of Drastically Disturbed Lands. Berg, W.A. (Colorado State Univ., Ft. Collins, CO, 80521). **Project number:** COL00020. **Contract:** COL00020. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$63,000.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant monitoring.

The objectives are to: (1) determine soil treatment longevity and plant species adaptability in stabilization of mine wastes and mill tailings; (2) investigate surface stability of spent oil shales and soil-covered spent shales; and (3) determine methods for establishment of shrubs on topsoiled and coal-mined land in northwestern Colorado. The approach consists of: (1) evaluation of field plots established over the past 8 years on cultural treatments and species trials on mine wastes; (2) field and laboratory work with spent oil shales ranging in physical and chemical characteristics; and (3) field study on seeding and planting of native shrubs on topsoiled area as influenced by herbaceous species competition and cultural treatments.
Keywords: coal mines; oil shale mining; land reclamation; revegetation; spent shales; colorado; cultivation techniques; plants.

14 Development and Evaluation of Vegetation Sampling on Areas Subject to Open-Pit Mining. Bonham, C.D. (Colorado State Univ., Ft. Collins, CO, 80521). **Project number:** COL00190. **Contract:** COL00190. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$74,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are to: (1) determine vegetation measures for pre-mining conditions; (2) determine appropriate methods for obtaining measurements from vegetation types for pre-mining conditions; and (3) develop methods for determining important changes in vegetation characteristics after surface mining and reclamation have occurred. An analysis of the literature will be conducted to select those techniques which have been used to obtain specific data on vegetation. A partial literature review currently indicates that numerous studies will be conducted on sample unit, size, shape, and

number with respect to efficiency in gaining precision (with reference to variability and resources). A complete review, plus evaluation, will be completed.
Keywords: surface mining; ecology; terrestrial ecosystems; coal mines; data analysis; data compilation; environmental impacts.

15 Systems Analysis for Cost-Effective Adaptation of Precipitation Management to Mine Spoil Reclamation. Smith, G.L. (Colorado State Univ., Ft. Collins, CO, 80521). **Project number:** COL01404. **Contract:** COL01404. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$25,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a rapid means for estimating the optimal design of precipitation management systems for enhancing the revegetation of mine spoils in western semi-arid and arid climates and for estimating the probabilities of success or failure of such systems for the plant species, soil, and climate factors involved. This goal is accomplished through the development of an integrated set of suitable system simulation models reflecting the essential interactions of location, climate, plants, and soil moisture including, but not necessarily limited to: simulation of equally likely rainfall sequences over time, simulation of the mini-micro watershed partitioning of the rainfall, simulation of both moisture dynamics, and prediction of the plant responses to the soil moisture-climate regemes simulated. Simulation models will in part be analytical and in part experimental and descriptive.
Keywords: spoil banks; revegetation; arid lands; plants; soils; simulation; rain; moisture; mathematical models; coal mines; cost benefit analysis.

16 Selection of Superior Tree Ecotype-Mycorrhizal Fungi Associations for Mineland Revegetation. Reid, C.P. (Colorado State Univ., Ft. Collins, CO, 80521). **Project number:** COL01405. **Contract:** COL01405. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$23,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to select superior tree planting stock for revegetation of mining wastes through intraspecific selection of tree ecotypes, selection of specific mycorrhizal fungi associates, and formation of mycorrhizae. Tree seedlings from 4 to 5 ecotypes of four tree species (Pinus ponderosa, P. edulis, P. flexilis, and Juniperus scopulorum) will be grown with four different mycorrhizal fungi (Pisolithus tinctorius, Cenococcum graniforme, Syllus granulatus, and Glomus mossea) under greenhouse conditions to assess the growth performance and mycorrhizal formation success of the various tree ecotype-fungal species interactions. After one growing season in the greenhouse, seedlings from the 3 best performing ecotypes of each tree species will be placed in microplots containing mining waste material from two sources, oil shale and coal spoil. The microplot substrate will be fertilized with N and P to a uniform minimal amount equivalent to a final level in the microplots of ca. 40 lbs/acre. Bi-weekly records of mortality, height growth, and stem diameter will be maintained through one growing season. The microplot study will be of a replicated factorial design to examine interactions between mycorrhizal fungi, ecotypes, tree species, spoil material, and replicates.
Keywords: mycorrhizas; pines; symbiosis; greenhouses; seedlings; plant growth; revegetation; land reclamation; coal mines.

17 Improving Estimates of Sodium Hazard of Coal Surface-Mined Overburden. Berg, W.A. (Colorado State Univ., Ft. Collins, CO, 80521). **Project number:** COL01469. **Contract:** COL01469. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$25,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to determine: (1) the change in sodium hazard of western surface-mined coal overburden upon exposure to the atmosphere and subsequent weathering; and (2) if the change is great enough to appreciably increase the water permeability of the overburden. Three samples of freshly exposed overburden from each of four surface coal mines in the western states will be exposed to five different laboratory and greenhouse weathering treatments and sampled periodically. Unweathered and weathered samples will be analyzed for the sodium hazard by determining the sodium adsorption ratio, the exchangeable sodium percentage, and permeability.
Keywords: overburden; coal mines; surface mining; sodium; hazards; weathering; adsorption; greenhouses; plants; permeability.

18 Role of Belowground Processes in Stabilization of Spent Oil Shale. Reid, C.P. (Colorado State Univ., Ft. Collins, CO, 80521). **Project number:** COL02011. **Contract:** COL02011. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) continue monitoring performance of existing selections of superior tree ecotype (Pinus ponderosa)-mycorrhizal fungi associations established in TOSCO oil shale microplots; (2) add rhizosphere bacteria and microbivorosus or phytophagous nematodes to these planted-mycorrhizal associations, and assess rates of remineralization of labile pools of N and P; (3) establish soil-plant-microbial associations in gnotobiotic soil microcosms using TOSCO shale, with and without topsoil; (4) grow mycorrhizal infected and uninfected pine seedlings with and without rhizosphere microflora and fauna, in greenhouse microplots; and (5) grow pine seedlings in gnotobiotic microcosms (flasks), same permutations as above, measure changes in soil N, P, and plant growth.
Keywords: spent shales; mycorrhizas; pines; symbiosis; nematodes; bacteria; soils; oil shales; greenhouses; plant growth; nitrogen; phosphorus; land reclamation; in-situ retorting; revegetation.

19 Regional Analysis of Vegetation: Environmental Systems on Surface-Mineable Lands. Bonham, C.D. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COL02023. **Contract:** COL02023. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will characterize specific biological systems overlying strippable energy sources in the Rocky Mountain Province; characterize specific environmental systems that are associated with those vegetation systems; and describe biotic and abiotic characteristics of the ecosystems which are most important for their reclamation. Soil and vegetation maps will be obtained from land management and state agencies. Literature and field data will be used to describe and model each vegetation-soil unit studied. Response unit maps for each vegetation type will be completed by the end of the second year. A vegetation and soil survey will be conducted in each of the selected study areas where major surface mining for fuels will occur in the West. After the survey has been made, overlay maps will be made and each study site will be sampled to obtain estimates of cover by species, season of maximum morphological development for the major species, and dominant species in each lifeform category.
Keywords: surface mining; baseline ecology; environment; regional analysis; land reclamation; environmental impacts.

20 Toxic Effects on the Aquatic Biota from Coal and Oil Shale Development. Skogerboe, R.K. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COLV01188. **Contract:** COLV01188. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Environmental effects assessment.

This study will assess effects of coal combustion on the aquatic biota; ammonia toxicity to fishes and aquatic macroinvertebrates; and effects of coal and oil shale mining on receiving streams in increased inloads of dissolved solids. Western Colorado is coming under heavy pressure for energy development, particularly coal and oil shale development. At the same time, Western Colorado is renowned for its wildlife including fishing. The relationship and impact of energy development on aquatic biota will be determined using ecosystem sampling techniques and quantifying ammonia concentrations by gas chromatography.
Keywords: toxicity; aquatic organisms; coal industry; oil shale industry; chemical effluents; combustion products; water pollution; energy source development; ammonia; environmental impacts.

21 Distribution and Concentration of Trace Elements in Wildlife Food Chains in the PICI. Nagey, J.P. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COLV01769. **Contract:** COLV01769. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil shale(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The presence, occurrence, and concentration of potentially hazardous elements from the development of oil shale extraction operations should be monitored in the Piceance Creek Basin before disturbances in the environment occur. Effect on animal health is to be measured. Research will concentrate on: distribution of trace organics and inorganics in soils and plants before disturbance; distribution of trace substances in raw oil shale and all end products of the retort process; fats and biological availability of trace substances in the spent shale oil and other products; sterilizers available for controlling release, removal, or amelioration of effects; and measurement of toxic effects on animal population.
Keywords: wild animals; oil shale industry; biological effects; environmental impacts; chemical effluents; toxicity; physiology; oil shales.

22 Analysis and Modeling Lake Michigan Fish Population. Vandyne, G. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COLV05500. **Contract:** COLV05500. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Assessment of power plant effects such as entrainment, impingement and relatively small thermal increments on Lake Michigan implies a need for a systems analysis approach. A modelling effort is proposed to examine and interrelate the data from the fishery and relate investigations in the vicinity of the Donald C. Cook Nuclear Power Plant to determine power plant effluent pollution effects on commercial and sports fish in Lake Michigan. The model will examine changes over time on a multispecies population sector. Climatic variables, plant operations and seasonal effects will be used as driving variables in the model to change the values of elements in the transition matrices. The model, after development and revisions, will be used to make predictions of impacts of alternative power plant operational stages on the population vector of the lake ecosystem.
Keywords: lake michigan; biological models; fishes; population dynamics; power plants; thermal effluents; biological stress; biological effects; aquatic ecosystems.

23 Air Pollution Emission Inventory of Fireplaces. Buchan, R. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COLV05514. **Contract:** COLV05514. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Studies will provide accurate information on the impact of fireplaces as an air pollution source in Vail, Colorado, so that sound decisions can be made with respect to emission control strategies. This initial phase of the project will be for the purpose of gaining background information, refining experimental design, and developing a data tabulation format and data analysis model. Second phase of the project will be devoted to data collection. The time period of this phase was selected as it is the peak ski season and fireplace usage should be at its highest. Final phase of the project will be for data analysis, evaluation, conclusions and preparation of a report with recommendations. Data collected will be analyzed in accordance with established statistical methods and evaluated accordingly.
Keywords: fireplaces; air pollution; colorado; wood; environmental impacts; air quality; coal; combustion products.

24 Grain Drying with Solar Energy in the Humid South. Bagnall, L.O.; Chaw, K.V. (Univ. of Florida, Gainesville, FL, 32601). **Project number:** FIA-AG01852. **Contract:** FIA-AG01852. **Supported by:** Florida Univ., Gainesville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$16,000.
Related energy source: solar(100) **R and D categories:** Environmental effects assessment.

The research objectives are to develop and evaluate solar drying systems. The approach is to construct plastic solar collectors and conduct corn and soybean drying tests using two 100-bushel metal bins. Various air flow rates will be used. The tests will include drying experiments during the daytime hours only, drying experiments with the blowers run all day and all night, and experiments with the blowers on a humidistat setting at night. Temperatures throughout the collector, temperature profiles in the grain bins as well as the relative humidity, ambient temperature, and insolation will be monitored and recorded by a data acquisition system.
Keywords: cereals; southeast region; solar drying; flow rate; solar collectors; maize; soybeans; blowers; temperature distribution; research programs; humidity.

25 Resource Recovery from Livestock Wastes. Newton, G.L. (Georgia Coastal Plain Expt. Station, Lifton, GA, 31794). **Project number:** GE000271. **Contract:** GE000271. **Supported by:** Georgia Univ., Tifton (USA). Georgia Coastal Plain Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objectives are to: (1) determine if deep-pit stored manure can be used for methane production and the feeding value of digester sludge; (2) develop means of reducing the nitrogen loss from oxidation ditches; (3) develop ways of utilizing fibrous materials removed from the stream of a flush waste removal system; (4) determine if certain algae can be used effectively to produce a usable product from waste waters; and (5) incorporate procedures for resource recoery into systems and evaluate the practicality. Waste from beef, dairy, and swine research units will be available for research on recovery of livestock waste material. Both laboratory and larger scale research studies will be initiated to evaluate the component parts of the waste material for feed, fertilizer, and gas production. At the same time, environmental pollution will be monitored.
Keywords: manures; methane; biosynthesis; sludges; waste product utilization; cattle; swine; animal feeds; fertilizers; air pollution; monitoring; anaerobic digestion.

26 Design Parameters and Equations for Anaerobic Bioconversion of Organic Wastes. Yang, P. (Univ. of Hawaii, Honolulu, HI, 96822). **Project number:** HAW00528-S. **Contract:** HAW00528-S. **Supported by:** Hawaii Univ., Honolulu (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$6,000.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The rate constants (based on biological concepts) and equations for the design and prediction of production of methane and degree of stabpilization of organic waste in the batch, semi-continuous flow with constant solid recycle systems are evaluated. The operational stability of constant sludge recycle system at normal and shock loading conditions is investigated. Laboratory and pilot scale operations will be used for the evaluation of design parameters for batch operations. These parameters will be applied as the design criteria for the development and operation of semi-continuous flow and constant sludge concentration recycled continuous flow systems. Animal wastes, crop residues, and sewage treatment sludge will be used for demonstrating the application of design parameters evaluated from laboratory and pilot scale studies.
Keywords: methane; batch culture; stability; design; anaerobic digestion; agricultural wastes; sewage sludge; biosynthesis; manures; mathematical models.

27 USDA: Fugitive Dust Emission. Belt, G.H. (Univ. of Idaho, Moscow, ID, 83843). **Project number:** IDA-ES-0126. **Contract:** IDA-ES-0126. **Supported by:** Idaho Univ., Moscow (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$33,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Emission of fugitive dust caused by heavy trucks operating on unpaved roads between mine pit and tipple will be measured; climatological, road surface, vehicle and traffic conditions which influence the emission factors will be monitored to develop a simple mathematical model useful in predicting emission rates on a daily or annual basis. Field measurements of dust emission will be made using an array of high volume samplers on a vehicle trailing the test vehicle under selected speeds and road surface conditions.
Keywords: dusts; mining; vehicles; environmental impacts; monitoring; mine haulage; air pollution; mathematical models.

28 Electrochemical Conversion of Biomass into Proteins and Hydrogen. Steinberg, M.P. (Univ. of Illinois, Urbana, IL, 61801). **Project number:** ILLU10-0376. **Contract:** ILLU10-0376. **Supported by:** Illinois Univ., Urbana (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$7,000.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objective is to investigate technical and economic feasibilities of electrochemical oxidation of biomass to produce feed protein and by-product hydrogen, safe handling and storage of hydrogen, and hydrogen-oxygen fuel cell production of dc electricity. Liquid swine manure will initially be the biomass to be converted in bench scale electrochemical cells. Aerobic bacteria will utilize oxygen as it is produced at the anodes and hydrogen, and energy source, will be produced and collected at the cathodes. The hydrogen will be utilized in a fuel cell to produce dc electricity to supplement operation of the electrochemical cell. Technical operational parameters will be studied to achieve optimum growth of single cell protein and production of hydrogen. Conditions promoting additional production of hydrogen from biomass by anaerobic bacteria will also be studied.
Keywords: feasibility studies; technology assessment; electrochemistry; oxidation; biomass; animal feeds; hydrogen production; manures; swine; electrochemical cells; single cell protein; anodes; cathodes; oxygen; direct current; bacteria; aerobic conditions; biosynthesis.

29 Reclamation of Surface Mined Lands. Boast, C.W. (Univ. of Illinois, Urbana, IL, 61801). **Project number:** ILLU15-0331. **Contract:** ILLU15-0331. **Supported by:** Illinois Univ., Urbana (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$30,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Strip mine spoils are characterized and their properties are related to geographic region, pre-mine landscape, overburden materials, coal strata mined, mining procedure, and age of spoils. Factors are identified that limit stand establishment, crop performance, and farming operations. Rate of organic matter accumulations, structure development, weathering down of compaction zones and shale fragments, and chemical changes in mine spoils are determined. Physical properties of reclaimed soils are related to soil moisture content at the time of mining and grading. The significance of reclamation practices and effect of soil development over time will be deter-

mined by observing near surface features of spoils that vary in age. Hydrology and soil moisture characteristics of disturbed lands will be determined. Procedures include root system development studies, field and laboratory soil analysis and use of remotely sensed imagery.
Keywords: surface mining; land reclamation; spoil banks; chemical composition; geographical variations; overburden; age dependence; soils; hydrology; moisture; revegetation; plants; roots; soil chemistry; remote sensing; coal mines.

30 **Characteristics of Mine Land Overburden Due to Short Term Weathering.** McFee, W.W. (Purdue Univ., Lafayette, IN, 47907). **Project number:** IND050057B. **Contract:** IND050057B. **Supported by:** Purdue Univ., Lafayette, IN (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$20,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to identify materials in mine overburdens likely to weather rapidly that influence management of reclaimed lands in western Indiana; (2) to characterize their weathering rates and trends; (3) to determine the changes that effect physical, chemical, and mineralogical properties important to plant growth, hydrologic characteristics or physical stability; and (4) to relate weathering to criteria used to evaluate materials for plant growth potential and to problems of stability and water movement. Samples will be selected from the more important strata in the eastern edge of the Illinois coal basin with emphasis on materials likely to be important in the root zone in future reclaimed lands. Some of the materials will be selected for intensive weathering studies along with the more representative materials already collected in an ongoing study. Triplicate samples in columns will be subjected to the equivalent of three years' precipitation each week (36 weeks). There will be concurrent trials with water and .01 N H2SO4. Physical phenomenon will be evaluated by submitting samples to freezing-thawing cycles and wetting-drying samples. Particle size distribution and wet aggregate stability both before and after treatment will be an indication of physical stability, tendency to crumble and seal, and the changes in water holding capacity.
Keywords: overburden; weathering; land reclamation; indiana; roots; plants; particle size; soil mechanics; moisture; revegetation.

31 **Physical and Chemical Criteria for Assessing Plant Growth Potential of Mine Land Overburden.** McFee, W.W. (Purdue Univ., Lafayette, IN, 47907). **Project number:** IND059027B. **Contract:** IND059027B. **Supported by:** Purdue Univ., Lafayette, IN (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$46,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) determine physical and chemical parameters that predict suitability of overburden material for plant growth; (2) evaluate by bioassay potential of overburden materials as plant growth media; (3) develop criteria for use prior to mining to determine materials most acceptable for surface placement; and (4) field test criteria on reclaimed lands. Overburden strata from selected surface coal mines in glaciated and unglaciated regions of Indiana will be identified, measured, and sampled. Material extracted from exposed highwalls or borings will be analyzed for physical and chemical properties and used in greenhouse pot tests and outdoor lysimeters to determine plant growth potential. Based on overburden properties and bioassay, criteria will be developed for overburden placement.
Keywords: plant growth; overburden; revegetation; surface mining; coal mines; indiana; physical properties; chemical properties; greenhouses; bioassay; land reclamation; testing.

32 **Mine Spoil Reclamation in the Intermountains and Northern Rocky Mountain Regions.** Packer, P. (Utah State Univ., Logan, UT, 84321). **Project number:** INT-1603. **Contract:** INT-1603. **Supported by:** Utah State Univ., Logan (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$576,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) devise technology to establish and maintain protective vegetative cover on mine spoils; and (2) determine criteria for modification of mine spoil environments to enhance revegetation success, improve soil stability, and limit surface runoff. The approach taken is to identify plant materials adaptaple to mine spoil environments. This needs to be done to the following kinds of mine spoils: coal, phosphate, oil shale, and heavy metals. Site preparation development includes, seeding and planting methods required for successful plant materials establishment on these kinds of mine spoils. The effects of alternative mine spoil configurations on success of plant materials establishment and resulting surface runoff and soil erosion are determined and evaluated.
Keywords: spoil banks; land reclamation; rocky mountain region; coal mines; revegetation; stability; soils; stability; runoff; plants; phosphates; oil shale mining; metals; mining; site preparation; cultivation techniques.

33 **Alleviation of Physical Hydrologic Impacts of Surface Mining Activities.** Burroughs, E.R. Jr. (Forest Service, Bozeman, MT, 59715). **Project number:** INT-1652. **Contract:** INT-1652. **Supported by:** Forest Service, Bozeman, MT (USA). Intermountain Forest and Range Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$540,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) assess effects of mining-related transportation systems on water resources and develop methods for minimizing impacts; (2) assess methods for depositing and stabilizing mine spoils to keep water quality within acceptable limits; (3) develop techniques for mineral exploration with minimal environmental impacts; and (4) develop techniques to repair and stabilize streams containing deposits of mine spoils or tailings. The approaches are, through in-house and extramural research: (1) develop equations to predict changes in spoil materials and environmental impacts of mining operations and associated road systems; (2) utilize available data to evaluate effects of spoils placement and land placement techniques; (3) develop exploration procedures to minimize environmental impacts; and (4) carry out studies to determine how channels containing deposits of spoils and tailings can be rehabilitated.
Keywords: surface mining; coal mines; transportation systems; spoil banks; environmental impacts; ground water; water quality; mathematical models; pollution control; waste management.

34 **Surface Environment and Mining in the West.** Davis, G. (Dept. of Agriculture, Billings, MT, 59101). **Project number:** Seam-West(TBD). **Contract:** Seam-West(TBD). **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$2,277,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to determine and evaluate the environmental impacts of mining and related activities both on site and surrounding areas. The adaptability and suitability of a large number of grass, forb, shrub, and tree species to surface-mined environments will be studied. Various spoil-bank treatments such as topsoiling, fertilizing, mulching, and watering are under study.
Keywords: surface mining; environmental impacts; coal mines; grass; trees; shrubs; revegetation; biological adaptation; spoil banks; fertilizers; humus; irrigation.

35 **Deep Tillage Studies on Reclaimed Loess and Glacial Till.** Anderson, C.E. (Iowa State Univ., Ames, IA, 50011). **Project number:** IOW02265. **Contract:** IOW02265. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$10,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

This study will: (1) evaluate the effectiveness of deep tillage in combating the problems of compaction on loess and glacial till found in overburden from surface coal mining in the Midwest; (2) compare water intake, erosion rates and crop yield response to normal chisel plowing and 3 different deep tillage practices applied during the first year after reclamation; (3) evaluate effect of time on response to deep tillage; (4) evaluate effect of field slope on the response to deep tillage; and (5) evaluate the effect of 2 different crops on response to deep tillage. Plots will be established on reclaimed spoil at the Iowa Coal Project Demonstration Mine. Tillage treatments will include conventional chisel plowing, subsoiling to 18" one-way, subsoiling to 80" in 2 perpendicular directions, and subsoiling to 30" one-way. Two crops, corn and grass-legume meadow, will be studied and plot slopes of 3 to 5% and 10%. Each treatment combination will be replicated twice. A rotating boom rainfall simulator will be used to apply controlled simulated storms on 3 different occasions each year. Measurements will be made on depth, intensity and duration of simulated rainfall and surface runoff, sediment discharge and changes in soil moisture. Soil physical properties and crop yields will be measured for each plot.
Keywords: cultivation techniques; land reclamation; overburden; spoil banks; surface mining; coal mining; demonstration programs; soil mechanics; crops; yields; maize; grass; pastures.

36 **Soil Profile Characteristics of Restored Soils at a Coal Surface Mine.** Miller, G.; Henning, S. (Iowa State Univ., Ames, IA, 50011). **Project number:** IOW02269. **Contract:** IOW02269. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$8,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Soil profile characteristics of soil restored at a coal surface mine are determined and changes in the soil profile resulting from initial post-restoration management practices are measured. Detailed descriptions of the restored soil will be made in the field of soil profiles taken on a sampling grid over a restored forty acre site. Samples will also be obtained for chemical and physical analysis. Soil profile density will be measured with a two probe gamma

density gauge. The degree of homogeneity in the restored soil across the site will be determined. Changes in the restored soil profile resulting from initial post-restoration management practices will also be measured.
Keywords: coal mines; surface mining; land reclamation; revegetation; sampling; soil chemistry; soils.

37 Establishment of Several Crop Rotations on Restored Soils at a Coal Surface Mine. Dumend, L.C. (Iowa State Univ., Ames, IA, 50011). **Project number:** IOW02270. **Contract:** IOW02270. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$15,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will: (1) initiate systems of crop rotations to determine their adaptation to restored soils at a coal surface mine; and (2) determine the yield and economic return from each crop and crop rotation system. Six crop rotations will be initiated: continuous corn, corn-soybean, corn-oats-meadow, permanent meadow (grass), permanent meadow (legume), and winter wheat-soybeans double crop. Each crop year of individual rotations will appear. A subsoil tillage treatment will be conducted on one-half of all plots. A split-plot design will be employed and all treatments will be replicated at least three times. Plant emergence, plant density and yields will be measured. Economic returns will be calculated by subtracting production costs from the market value of the crop. Plant samples and soil samples will be obtained yearly and fertilizer rates will be adjusted to obtain maximum or near-maximum yields.
Keywords: crops; land reclamation; demonstration programs; yields; coal mining; surface mining; maize; soybeans; oats; pastures; grass; wheat; cultivation techniques; soil mechanics; plants; soils.

38 Behavioral Effects of Coal Conversion Products. Buck, W.B. (Iowa State Univ., Ames, IA, 50011). **Project number:** IOWV42923-03. **Contract:** IOWV42923-03. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Increased emphasis on coal burning and energy generation implies a marked increase in coal stack emissions. These contain significant quantities of heavy metals. It is desired to determine effects of increased exposure of primates to coal conversion products. A computer-assisted transmittent TV monitoring system is being developed. It will be used to evaluate behavioral changes in monkeys exposed to varying concentrations of heavy metals such as mercury and lead contained in coal stack emissions.
Keywords: stacks; gaseous wastes; coal; combustion; metals; combustion products; monkeys; behavior; mercury; lead; biological effects.

39 Soil Amendments and Artificial Revegetation for Modification of Drastically Disturbed Land Areas. Graves, D.H.; Wittwer, R.F. (Univ. of Kentucky, Lexington, KY, 40506). **Project number:** KY00611. **Contract:** KY00611. **Supported by:** Kentucky Univ., Lexington (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$22,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) develop revegetation techniques for the stabilization and improvement of economic productivity of drastically disturbed land areas; (2) study moisture stress and its effect on the growth of trees and associated plants on drastically disturbed land areas; (3) determine the cost of the various combinations of revegetation and soil modification techniques; and (4) develop a computer simulation model to predict various levels of vegetative response at alternate cost levels. Initial major emphasis will be on the identification of atmospheric and soil environmental factors critical to the establishment of trees on surface mine spoil and the effectiveness of mulch as a means of modifying these conditions. A complete economic study relating to the availability and use of various mulching mediums is planned. After initial studies, various combinations of soil amendments and silvicultural techniques will be applied on a pilot-scale.
Keywords: soils; revegetation; moisture; cost; additives; computer codes; simulation; ecology; humus; cultivation techniques; pilot plants; surface mining; coal mines; land reclamation.

40 Reclamation of Surface Mined Coal Spoils. Barnhisel, R.I. (Univ. of Kentucky, Lexington, KY, 40506). **Project number:** KY01205. **Contract:** KY01205. **Supported by:** Kentucky Univ., Lexington (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$32,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine the chemical and physical properties of surface mined coal spoils and determine how these properties affect establishment and survival of vegetative cover; (2) evaluate, in field experiments, the lime rates predicted from both the standard buffer pH method and a new laboratory test for determining potential acidity (or sulfides); (3) develop methods of tillage to produce a stable microrelief which allows infiltration of water and subsequent utilization by vegetation; (4) evaluate the systems developed with respect to reduction of runoff and erosion; (5) develop forage management systems for reclaimed coal spoils; and (6) evaluate grain crop production on spoils to which adequate lime and fertilizers have been applied. Site preparation techniques will consist of readily available equipment and seeded to commercially available plant species. Fertilizers applied where needed. Spoil samples and plant forage and grain yields will be collected to evaluate experimental objectives. A portable rainfall similator will be used to evaluate methods developed.
Keywords: surface mining; coal mines; spoil banks; land reclamation; revegetation; chemical composition; calcium oxides; stabilization; runoff; erosion; fertilizers; crops; seeds; productivity; rain.

41 Essentiality of Adapted Mycorrhizal Fungi for Reforestation of Strip Mine Sites. Hendrix, J.W. (Univ. of Kentucky, Lexington, KY, 40506). **Project number:** KY01207. **Contract:** KY01207. **Supported by:** Kentucky Univ., Lexington (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$11,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study will: (1) evaluate the performance of the ectomycorrhizal fungus Pisolithus tinctorius on a wide range of timber and pulp species and over a wide range of strip mine conditions; and (2) isolate and evaluate other ectomycorrhizal fungi which may promote superior seedling performance or prove easier to utilize. Seedlings will be grown in sterilized seed beds, with and without P. tinctorius inoculum. Seedlings will be transplanted to strip mine sites, and their performance will be evaluated for several years. Mycorrhizal fungi will be isolated rom superior trees on orphan mine sites. Seedlings infected with these fungi will be grown, transplanted to mine sites, and evaluated as in above.
Keywords: fungi; surface mining; land reclamation; revegetation; forests; optimization; waste management; coal industry; coal.

42 Direct Seeding of Commercial Forest Trees on Surface Mine Spoil. Carpenter, S.B.; Wittwer, R.F. (Univ. of Kentucky, Lexington, KY, 40506). **Project number:** KY01208. **Contract:** KY01208. **Supported by:** Kentucky Univ., Lexington (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine the effects of site factors (aspects, slope, mine spoil moisture content, surface temperature) on the establishment of forest tree species (Alnus glutinosa, Paulownia tomentosa, others) by direct seeding; (2) determine effects of practices such as liming, fertilization, mulching, and mixed species seeding on the success of broadcast seeding; and (3) determine the effects of grass-legume seeding mixtures on the establishment of forest tree species by direct seeding. The approach is to: (1) establish a complete environmental station at study area to monitor precipitation, evaporation, solar radiation, wind direction and velocity, air temperature, relative humidity, spoil temperature and moisture content; (2) combine liming, mulching, fertilization on small and large plot tests; and (3) broadcast seed mixtures of grasses-herbaceous legumes-tree seedlings to evaluate effects on site stabilization, erosion control. Studies will be established on small plots and on one-quarter acre plots. Direct seeding results for all treatments will be evaluated at three stages of tree seedling development: emergence, survival, and early growth.
Keywords: forests; seeds; revegetation; land reclamation; surface mining; spoil banks; coal mines; monitoring; precipitation; evaporation; solar radiation; wind; ambient temperature; humidity; humus; calcium oxides; fertilizers; seedlings; growth; cultivation techniques.

43 Proposal to Conduct a Feasibility Study of the Conversion of Animal Feedlot Wastes to Useful Energy. Frye, J.B. Jr. (Louisiana State Univ., Baton Rouge, LA, 70803). **Project number:** LAB02022. **Contract:** LAB02022. **Supported by:** Louisiana State Univ., Baton Rouge (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine if a dairy farm operation can design its waste management to include a fermentation system for energy production and lagoon system for the production of edible, high protein aquatic plants and be economically feasible or competitive with current dairy farm waste management practices. Dairy manure will be fermented to generate methane for use as supplemental energy. Various sludge from the fermenter will be used as a nutrient source for aquatic plants. The plants will be cycled back into the animals feed as a protein supplement and the effluent from the lagoon will be used as washwater for the feedlot. Techniques of plant harvest, transportation, and processing will be developed. An economic analysis of the total system will be undertaken to deter-

mine capital requirements, return on investment analysis, and cost and energy comparison between current dairy farm practices and a system in which wastes are managed for energy and aquatic plant production.
Keywords: farms; dairy industry; waste management; methane; biosynthesis; manures; anaerobic digestion; sludges; nutrients; plants; aquatic ecosystems; ponds; animal feeds; economic analysis; growth; waste product utilization; harvesting.

44 Identifying and Preventing Sulfur Related Problems in Soils Created in Coal Mining Operations. Fanning, D.S. (Univ. of Maryland, College Park, MD, 20742). **Project number:** MD087. **Contract:** MD087. **Supported by:** Maryland Univ., College Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$18,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) perfect x-ray spectrography and other techniques for measuring amounts and forms of sulfur in coal related rocks and soils and employ these techniques to study the distribution and kinds of sulfur in geologic columns, spoils, and soils; and (2) determine necessary depths and kinds of burial of sulfidic materials to prevent elevated acidity problems to growing plants and in coal mining operations to include special classes for those soils with sulfuric horizons and/or sulfidic materials. X-ray spectrography techniques for S will be modified to overcome problems of different x-ray response from different forms of sulfur by fusing the samples in the presence of an oxidant to prevent S volatilization. Also attempts will be made to do sulfate sulfide S by x-ray. S distribution and weathering will be examined in rocks of geologic columns and in soils and spoils associated with coal deposits in the George's Creek, MD, area employing the x-ray techniques developed. Sulfidic materials will be buried to various depths in various kinds of soil, left for one year, then dug up and examined, to find the depth of cover of soil materials required to prevent significant S weathering to sulfuric acid. Classification of minesoils and other man-made soils will be developed including special classes for those soils with sulfidic materials and sulfuric horizons.
Keywords: sulfur; coal mines; soils; contamination; x-ray spectroscopy; spoil banks; sulfates; sulfides; sulfuric acid; quantitative chemical analysis.

45 Ecology of Fishes of Lake Michigan and Its Tributaries in Relation to Electric Power Plants. Liston, C.R. (Michigan State Univ., East Lansing, MI, 48823). **Project number:** MICL01312. **Contract:** MICL01312. **Supported by:** Michigan State Univ., East Lansing (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$5,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This study seeks to: (1) understand the biology and ecology of fishes in near-shore waters of Lake Michigan near Ludington, Michigan, and in selected tributaries of Lake Michigan; (2) examine limnological aspects in these waters including temperature, water transparency, turbidity, dissolved oxygen, and benthos; and (3) relate findings to impacts of resource utilization, and to agencies responsible for the management of important sport and commercial fish species. Samples will be taken of adult, juvenile, and larval fishes using standard gill nets, trawls, seives, and meter nets during ice-free periods to identify species and record total numbers and weights for each method. Length, weight, sex and age for individuals of all species will be determined as well as food habits and fecundity for selected species. Limnological parameters at location of fish sampling sites will be determined.
Keywords: lake michigan; thermal power plants; baseline ecology; fishes; turbidity; benthos; oxygen; recreational areas; environmental impacts; physiology.

46 Characterization of Properties of Strip Mine Spoils as Related to Remote Sensing Measurements. Blanchar, R.W.; Barr, D.J. (Univ. of Missouri, Columbia, MO, 65201). **Project number:** MO00354-1. **Contract:** MO00354-1. **Supported by:** Missouri Univ., Columbia (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$38,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) characterize the available plant nutrient status of pre-mined overburden layers and the resultant mined spoils determining their necessities for selected plant species; (2) determine rate and control of pyrite oxidation in overburden layers; and (3) characterize vegetative responses and hydrologic conditions by remote sensing techniques. Study sites will be selected from three active surface coal mines in Central Missouri. Soil samples will be obtained from the different geologic layers in the high wall cuts. The rate of pyrite oxidation to sulfuric acid at various pH, EL and O2, also nutrient levels, will be determined. The necessity for lime and plant nutrients in reclaiming mined spoil areas will be determined by soil tests and field plot techniques. Vegetative cover and densities will be determined for all plots and check areas. Correlations will be made of vegetative responses with responses measured on color infrared film. Hydrology aspects of vegetative and topographic patterns will be determined from aerial photography. Results will be provided to Extension Service personnel to be utilized in educational programs and to the Missouri Land Reclamation Commission for use in their programs.
Keywords: spoil banks; surface mining; coal mines; chemical composition; remote sensing; overburden; plants; nutrients; oxidation; pyrites; sulfuric acid; revegetation; land reclamation; fertilizers; calcium oxides; soils; topography; aerial monitoring.

47 Salt Translocation in Saline-Sodic Mine Spoils. Hodder, R.L.; Klages, M. (Montana State Univ., Bozeman, MT, 59715). **Project number:** MONB00196. **Contract:** MONB00196. **Supported by:** Montana State Univ., Bozeman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$66,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) map translocation extent and depth of saline and/or sodic conditions in both overburden and spoils; (2) chemically and physically characterize saline-sodic sites; (3) study in the field and under lab conditions the salinization process in spoils; and (4) formulate specific recommendations for optimization of saline and/or sodic spoil reclamation. The 4-probe electrical resistency technique will be used to map depth and extent of saline conditions. Samples will be taken for characterization of specific saline-sodic sites. Leaching with irrigation water in the field and laboratory percolation tests will be conducted to study the salinization process. Psychometer and neutron probe techniques will measure in-situ soil water flow.
Keywords: overburden; spoil banks; salinity; translocation; salts; depth; sampling; leaching; field tests; bench-scale experiments; irrigation; fluid flow; coal mines.

48 Plant Response and Livestock Performance on Coal Mine Spoil Pastures. Depuit, E.J.; Jensen, I.B. (Montana State Univ., Bozeman, MT, 59715). **Project number:** MONB00197. **Contract:** MONB00197. **Supported by:** Montana State Univ., Bozeman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) determine if spoil vegetation is as productive, stable and useful as that which existed prior to mining disturbance by means of grazing with livestock; (2) compare quality of spoils, vegetation and native range for age at various seasons of the year; and (3) determine the effects of grazing on successional response of vegetation, seed scatter, productivity, accumulation of OM, soil fertility and compaction. The approach taken to meet the above objectives will be through a complementary grazing system utilizing native range vegetation supplemented with spoils vegetation. This system will be compared with exclusive spoils vegetation grazing the entire season. Data on plant productivity, density, frequency, reproductive capacity and soil bulk density will be obtained.
Keywords: plants; domestic animals; spoil banks; pastures; surface mining; land reclamation; revegetation; optimization.

49 Minesoil Resources in the Powder River Basin: Characterization, Evaluation, and Potentials. Dollhopf, D.J. (Montana State Univ., Bozeman, MT, 59715). **Project number:** MONB00201. **Contract:** MONB00201. **Supported by:** Montana State Univ., Bozeman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$8,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to identify and characterize the spectrum of minesoils in the Powder River Basin. Unique properties of minesoils will be identified and studied. A framework of criteria will be developed to evaluate the potential of mined land for various land uses. Standard methods in soil research will be used to describe minesoils located on a diversity of materials in the region. Extensive literature review and discussion with other researchers will be employed to build a list of criteria for evaluating minesoil potential.
Keywords: soil chemistry; soil mechanics; coal mining; land reclamation; surface mining; optimization.

50 Establishment and Seed Development of Species Grown on Reclaimed Areas. Wiesner, L.E. (Montana State Univ., Bozeman, MT, 59715). **Project number:** MONB00365. **Contract:** MONB00365. **Supported by:** Montana State Univ., Bozeman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$25,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will: (1) evaluate seed of species which have promise for revegetation; (2) develop treatments for overcoming dormancy of seeds to improve establishment; (3) evaluate establishment of species in new plantings; and (3) evaluate the biological aspects (viability, dormancy, size, amount, etc.) of the seed produced by plants growing on reclaimed areas. Seed species considered for

use in reclaiming spoils will be evaluated for speed of germination and dormancy. Those species having dormant seed will be studied to determine the cause of dormancy. Dormancy breaking treatments to be studied in the laboratory and the field include scarification, presoaking, chilling, alternate wetting and drying, plant hormones and other chemicals. On-site seed collections will be made from species successfully established on spoils. These collections will be evaluated for amount of seed produced, viability, and dormancy. Seed from these collections will also be compared with seed collected from plants in adjacent undisturbed areas. Planting will be made under reclamation situations and establishment correlated with pure-live seed and other seed traits.
Keywords: land reclamation; seeds; preferred species; revegetation; spoil banks; surface mining; soil chemistry; plants; seeds; viability; cultivation techniques.

51 Establishment, Composition and Productivity of Species Adapted to Areas Disturbed by Strip Mining. Wiesner, L.E. (Montana State Univ., Bozeman, MT, 59715). **Project number:** MONB00375. **Contract:** MONB00375. **Supported by:** Montana State Univ., Bozeman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$825,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will; (1) evaluate the productivity and composition change of native species recently established on mine spoils; (2) evaluate naturalized species to determine their establishment and productivity characteristics; and (3) continue to develop methods for overcoming seed dormancy of species which show promise for use in reclaiming mine spoils. Dormant seed population on reclaimed areas will be compared to undisturbed areas. Research plots established in 1976 will be evaluated for change in species composition and forage production. These plots contain ten different native species. Field plantings will be made on strip-mined areas to determine the establishment, productivity and adaptivity of introduced species; dormant seeds will be subjected to treatments such as scarification, presoaking, prechilling, and various chemicals and plant hormones; soil cores will be taken from 5-year-old stands established on mine spoils and from undisturbed areas. Cores will be sectioned and the number of seeds in each section will be determined. If possible, seeds will be identified and their viability determined.
Keywords: surface mining; land reclamation; spoil banks; revegetation; preferred species; plants; seeds; soil chemistry; viability.

52 Flexible Cultural Practices for Establishment of Perennial and Annual Vegetation on Topsoiled Strip. Wiesner, L.E. (Montana State Univ., Bozeman, MT, 59715). **Project number:** MONB00376. **Contract:** MONB00376. **Supported by:** Montana State Univ., Bozeman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$13,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will: (1) assess the capabilities of several annual and perennial crop species to function as barriers for the trapping and retention of winter snowfall; (2) determine if snow retention increases seedling establishment and subsequent growth of a forage mixture, if increased snow retention on a site affects maturity of the seed crop and monitor species composition changes associated with increased snow cover, increased soil moisture and reduced winter exposure on barrier vs. nonbarrier sites; (3) utilize annual nurse crops, stubble seeding techniques and frost seeding techniques, determine their impact on the success of perennial forage seedings on spoils materials; and (4) grow a green manure crop on stockpiled topsoil to determine if a significant decrease in weed seed and increase in nitrogen content can be made over uncropped stockpiled topsoil. Several annual and perennial grasses and forbs including wheat, barley, oats, flax, sunflowers, tall wheatgrass, sudangrass, sorghum and others will be planted in strips and will be evaluated for their ability to trap snow. Various forage mixtures will be seeded between barriers to evaluate establishment as it relates to moisture levels. Several annual crops will be seeded to evaluate establishment of forage species using nurse crops,' stubble seeding techniques and frost seeding techniques. Portions of stockpiled topsoil will be seeded with several green manure crops.
Keywords: surface mining; cultivation techniques; land reclamation; revegetation; optimization; plants; snow; preferred species; grass; barley; oats; sunflowers; flax plants.

53 Effects of the Brunswick Nuclear Power Plant on the Productivity of Spartina alterniflora. Stroud, L.M. (North Carolina State Univ., Raleigh, NC, 27607). **Project number:** NC05276. **Contract:** NC05276. **Supported by:** North Carolina State Univ., Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the effect of the construction and operation of the Brunswick Nuclear Power Plant on the productivity of Spartina alterniflora (smooth cordgrass). In order to fulfill the objectives, environmental analysis of the Oak Island and Dutchman's Creek must be determined. Field studies monitoring environmental parameters and sampling of above and below groun vegetation to determine productivity will be conducted. After initi gathering of data and vegetation samples, analysis of data, by con. puter and laboratory tests, will be carried out and a model developed for the area.
Keywords: aquatic organisms; grass; productivity; nuclear power plants; construction; operation; environmental effects.

54 Impacts of the Construction and Operation of Coastal Nuclear Power Plants on Estuarine Ecology. Huish, M.T. (North Carolina State Univ., Raleigh, NC, 27607). **Project number:** NC05332. **Contract:** NC05332. **Supported by:** North Carolina State Univ., Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) develop information for evaluating the effects of power plant construction and operation on the ecology of North Carolina estuaries; (2) establish baseline populations, diversity and movements of organisms in the intake and outfall areas of the Cape Fear River Estuary and adjacent ocean; (3) determine the effects of construction and operation of the discharge canal on the nursery utilization and productivity of Dutchman Creek; (4) determine the impact of entrainment and impingement on larval fish and crustaceans; and (5) develop information on heat tolerances of organisms. Sampling stations are established on lower Cape Fear River, offshore and at site of power plant. Regular collections of samples will be examined for changes in phytoplankton, zooplankton, larval fish, and crustaceans. Certain physical measurements will be obtained.
Keywords: nuclear power plants; environmental impacts; aquatic ecosystems; construction; operation; coastal regions; biological models; north carolina; fishes; crustaceans; impingement; thermal pollution.

55 Environmental Effects on the Response of Plants to Selected Air Pollutants. Heck, W.W. (North Carolina State Univ., Raleigh, NC, 27607). **Project number:** NC05360. **Contract:** NC05360. **Supported by:** North Carolina State Univ., Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$65,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study will investigate: (1) the response of selected plants to 03, SO2, NO2, and NH3 under growth conditions; (2) the dose-response relations of these pollutants or their mixtures on plant response under varied environmental stresses (light, temperature, humidity, nutrition and soil moisture; and (3) the effects of these stressors on pollutant uptake and plant nutrition. Growth and exposure chambers with controlled temperature, humidity and light will be monitored for pollutant and CO2 concentration, transpiration and temperature. Plant responses measured will include: pollutant and CO2 uptake, water loss, stomatal response, selected growth parameters, nutrient ratios and injury. Exposure will be episodic at one to several times in the growth cycle. Response measures will be taken over time so that rate functions can be generated.
Keywords: plants; ozone; sulfur dioxide; nitrogen dioxide; ammonia; dose-response relationships; nutrition; air pollution; toxicity; carbon dioxide.

56 Non-Petroleum Fuels for Power Units Used by Agriculture. Kaufman, K.R. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** ND01437. **Contract:** ND01437. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to evaluate the use of non-petroleum fuels such as ethyl alcohol, methyl alcohol, and methane for internal combustion engines. Tractor engines will be tested in the laboratory to determine the effects of substituting alcohol-fuel mixtures for tractor fuel. Both gasoline and diesel engines will be studied. Road tests will be made with automobiles to determine the effects of substituting gasoline-alcohol blends for gasoline. In all tests, comparisons will be made between the energy content of the alcohol-fuel blend and the fuel consumption of the engine. Next, engines will be modified and evaluated for performance and emissions while using alcohol-fuel blends.
Keywords: alcohol fuels; methane; internal combustion engines; farm equipment; ethanol; methanol; automobiles; gasohol; fuel substitution; road tests; fuel consumption; retrofitting; exhaust gases; performance.

57 Implications of the Atmospheric Environment on Coal Development in Western North Dakota (SEAM: Phase I). Method, T.; Nantt, D. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** ND02535. **Contract:** ND02535. **Supported by:** North Dakota

State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$3,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to: (1) characterize the frequency, intensity, and duration of low level radiation inversions at the Staton-Beulah, North Dakota, area; and (2) simulate the probable dispersion of waste effluents from various operational levels, areal distribution, and techniques of coal development at the Staton-Beulah, North Dakota, area. Two towers at the study site will be equipped with meteorological instrumentation for continuous temperature and wind profile observations. Time-dependent occurrence of low level inversions will be analyzed and related to surface cover and weather conditions. Atmospheric diffusion models will be used to simulate the dispersion of probable air pollutants from a power plant in the study-area and from a simulated coal-gasification plant around the Beulah area.
Keywords: coal industry; energy source development; north dakota; environmental impacts; air pollution; earth atmosphere; monitoring; temperature measurement; wind; weather; diffusion; gaseous wastes; simulation; fossil-fuel power plants; coal gasification plants; mathematical models.

58 Chemical and Physical Characteristics of Shaped Mined Lands and Their Effect on Plants. Pole, M.; Smith, C.M. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** ND04523. **Contract:** ND04523. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) determine a method or methods to successfully return strip-mined lands to original or better productivity; and (2) identify chemical and physical properties of spoilbank that affect plant establishment and productivity. Samples from recently levelled spoilbanks were taken by foot increments to 9 feet to evaluate the chemical and physical characteristics of the medium. Above-ground tissue samples, one square yard, were taken from the area surrounding the hole. Access tubes were installed to monitor soil water. Chemical analyses will include SAR, pH, electrical conductivity, and CaCO3 equivalent. Physical analyses will include texture, bulk density, and 15 atmosphere percentage water.
Keywords: chemical analysis; physical properties; coal mines; land reclamation; surface mining; spoil banks; plants; productivity; sampling; water; monitoring; ph value; electric conductivity; calcium carbonates; density; texture.

59 Surface and Root Zone Hydrology of Shaped Surface-Mined Spoil Banks and Rehabilitated Land. Carvallo, H.O.; Pole, M. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** NDO4524. **Contract:** ND04524. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Objectives are to: (1) identify runoff and erosion losses from selected surface mined spoils of varying degree of slope and surface cover under natural and artificial water application; (2) measure the amount and type of water soluble constituents in natural and simulated precipitation runoff flows; and (3) test soil erodibility factor for use in the Universal Soil-Loss equation. Two replications of standard size runoff plots on 1, 5, 9, and 14% slopes will be established and instrumented to measure runoff, erosion and water soluble constituents from a bare surface occurring under natural precipitation over entire year. A similar series of plots will be established on standard sized plots of 9% slope to evaluate the effect of varying topsoil depths, chemical amendments, mulches and cultural practices on runoff, erosion and water soluble constituents from the application of water from Purdue rainulator.
Keywords: spoil banks; land reclamation; surface mining; optimization; hydrology; cultivation techniques; plants.

60 Plant Establishment and Culture on Surface-Mined Lands. Pole, M.; Carvallo, H.O. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** ND04525. **Contract:** ND04525. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate cultivation practices and plant species suitable to return strip-mined lands to original or better productivity. Phosphorus and nitrogen fertility variables will be established on a levelled spoilbank without topsoil added, with an established grass-legume mixture. Phosphorus will be broadcast at rates of 15, 45, and 135 pounds P per acre; further, the P will be applied so that the amounts indicated will all be broadcast the first year; one-third applied in each of two years, and one-third applied in each of three years. Nitrogen (N) will be broadcast at rates of 30, 60, and 90 pounds per acre per year; the same rate will be applied on the same plot each year. 32P and non-radioactive P will be applied at the topsoil-spoil interface at rates of 0 and 90 pounds P per acre, and by drill attachment at rates of 0, 10, and 30 pounds P per acre to evaluate the P uptake and rate of root extension of spring wheat through topsoil depths of 2, 8, 14, and 26 inches. Nitrogen (N) will be broadcast uniformly over all plots. Tissue samples will be harvested 4 to 6 times for 32P count.
Keywords: surface mining; revegetation; land reclamation; coal mines; plants; productivity; phosphorus; nitrogen; fertilizers; spoil banks; excavation; grass; leguminosae; phosphorus 32; tracer techniques; uptake; roots; radionuclide kinetics.

61 Reclamation of Surface-Mined Areas (Surface-Mined Area Rehabilitation). Curtis, W.R. (Berea College, Berea, KY, 40403). **Project number:** NE1605. **Contract:** NE1605. **Supported by:** Berea Coll., KY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$1,356,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to develop practical methods of reducing damage to the environment and forest resources during surface-mining operation and to rehabilitate mined areas for the production of quality water, timber, wildlife, recreation, range and aesthetics in the Appalachian coal fields. An interdisciplinary team approach will be used to attack the defined problems: (1) determine quantities and characterize sources of sediment and chemicals entering streams from surface-mined areas and determine effect on streamflow; (2) study techniques for controlling erosion, sedimentation, and runoff from these areas; (3) study ways of reducing spoil bank instability such as spoil movement and placement, improved drainage, and grading; (3) study physical and mechanical properties of spoils; (4) determine physical, chemical, and biological factors of spoils which affect plant establishment and growth; (5) test procedures such as liming, fertilization, mulching, and site preparation to overcome any adverse effects; (6) develop methods of establishing herbaceous cover and trees at the same time; and (7) study potential for wildlife habitat and improved aesthetics.
Keywords: coal mines; surface mining; land reclamation; water quality; revegetation; appalachia; erosion; runoff; chemical properties; spoil banks; excavation; soil mechanics; biological effects; calcium oxides; fertilizers; humus; site preparation; wild animals.

62 Soil and Vegetation Characteristics of the Leviathan Mine, California, in Relation to Requirements. Butterfield, R. (Univ. of Nevada, Reno, NV, 89507). **Project number:** NEV00652. **Contract:** NEV00652. **Supported by:** Nevada Univ., Reno (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) stratify pit and waste dumps with respect to soils, relief, and microclimate; (2) study plant succession as affected by edaphic, topographic, and microclimatic factors; and (3) determine the most successful plant species, including native conifer species, and planting technique for revegetation. The approach will be to: (1) make measurements of slope and aspect and collect soil samples to be analyzed for physical and chemical properties; (2) compile species lists of tree and ground cover plants invading the mine dumps, and growing in the surrounding area; (3) collect data on plant cover, frequency and density; and (4) conduct greenhouse and field planting trials with native and introduced species using a variety of planting techniques and treatments.
Keywords: soils; plants; california; revegetation; preferred species; cultivation techniques; land reclamation; optimization; trees; inventories; spoil banks; surface mining; waste management; land pollution control; coal mining.

63 Evaluation of Tree Species for Environmental Amelioration and Energy Production. McCormick, J. (Univ. of Nevada, Reno, NV, 89507). **Project number:** NEV00671. **Contract:** NEV00671. **Supported by:** Nevada Univ., Reno (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to develop recommendations for using tree species in the production of energy and to modify environmental conditions. Tree plantings with a reasonable known history will be evaluated as to performance and cultural requirements. Tree substations which represent distinctly different climatic conditions will be selected and a species testing program will be initiated. Replicated plots will be used at each location to determine tree performance in regard to survival, growth, cultural requirements, and pest resistance.
Keywords: trees; environmental effects; energy source development; resource potential; resource conservation; air pollution abatement; preferred species; production.

64 Interactions of Chemical Pollutants and Microorganisms in the New Jersey Coastal Environment. Antoine, A.D. (Rutgers--the State Univ., New Brunswick, NJ, 08903). **Project number:** NJ00507.

Contract: NJ00507. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$22,000.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Objectives are to identify and assess specific pollution hazards that will suggest remedies or cleanup procedure. The interaction of various chemical pollutants such as petroleum hydrocarbons, polychlorinated biphenyls, persistent pesticide residues, and heavy metals, especially mercury, and of pollutants that give rise to eutrophication with estuarine microorganisms will be investigated in both laboratory and field experiments. The action of the pollutants on essential microbial processes such as organic matter degradation, nitrification, nitrogen fixation, etc., will be investigated. The concentration of pollutants in microorganisms and, through them, in higher members in estuarine food chains will be measured by radiometric techniques. Gas chromatography, mass spectrometry and atomic absorption spectrometry will be used in analysis for pollutants.
Keywords: new jersey; petroleum; hydrocarbons; pesticides; metals; mercury; water pollution; biodegradation; cleaning; microorganisms; food chains.

65 Enzymatic Degradation of Polymers Produced by Plant and Fungal Cells. Eveleigh, D.E. (Rutgers--the State Univ., New Brunswick, NJ, 08903). **Project number:** NJ00515. **Contract:** NJ00515. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$92,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Objectives are to produce catabolite repression resistant hypercellulase mutants of T. viride and clarify the mechanisms controlling the synthesis of cellulase. This project is directed to the microbial conversion of waste agricultural matter into useful by-products. Waste cellulosics (corn stalks, etc.) can be degraded to glucose enzymatically using microbial enzymes, and this product fermented to ethanol - a useful energy sparing material. Analogously, the waste agricultural components can be up-graded to high quality single cell protein by successive action of microbial enzymes and growth of food yeasts.
Keywords: biodegradation; enzymes; agricultural wastes; anaerobic digestion; fermentation; ethanol; single cell protein; microorganisms; polymers.

66 Toxicological and Physiological Effects of Heavy Metals and Selected Air Pollutants on Animals. Verlangieri, A.J. (Rutgers--the State Univ., New Brunswick, NJ, 08903). **Project number:** NJ00620. **Contract:** NJ00620. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$14,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies will (1) determine physiological and biochemical effects of mercury and lead in animals (specifically, central nervous system effects (spike potentials), cardiovascular system (atherogenesis), and the endocrine system (adrenal steroidiogenesis)); (2) determine the acute (LD50) and chronic (MED50) parameters of sis) andO, SO2 and NOx; (3) determine these parameters in combination; (4) study the effects of these air pollutants on respiratory system (exchange), reticulo-endothelial system, central nervous system (spike potentials, synaptic activity, locomotion, taxia, and sensitivity), and cardiovascular system (atherogenesis); and (5) attempt to correlate any overt physiological response to a biochemical mechanism. Mercury and lead compounds will be administered to rats, rabbits and chicks by oral and parenteral routes. Standard sampling and biochemical techniques will be used in analysis. The study of the physiology and biochemistry of air pollutants will utilize cages housed in plastic envelopes; CO, SO2 or NOx will be pumped in under flow and pressure controls. Radioisotope tracer methodology will be utilized in mobilization and precursor studies. Quantitative statistical analyses will be run and extension to human levels made.
Keywords: toxicity; physiology; animals; metals; air pollution; mercury; lead; rats; rabbits; chickens.

67 Oil and the Oyster Industry in the Delaware Estuary. Haskin, H.H. (Rugers--the State Univ., New Brunswick, NJ, 08903). **Project number:** NJ00782. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies will assess present hazards in the Delaware Bay to oyster production; estimate potential additional hazards of expanded petroleum-related operations in the area; and identify substances that may be particularly hazardous to oysters and whose concentration in the estuary would then be of special concern. Adult oysters and larvae will be exposed to petroleum and its products absorbed on fine clay and effects determined at varying concentrations. Bioassays with oyster larvae, in terms of changes in swimming behavior as the basis for an index to toxicity, will be used as a method. Toxic materials will be prepared and their fractions characterized for use in bioassay. Toxicity of heavy metal to oysters will be studied as well as possible synergism between heavy metals and petroleum hydrocarbons.
Keywords: petroleum industry; oysters; delaware; production; environmental effects; petroleum; toxicity; bioassay; metals; hydrocarbons.

68 Photochemical and Atmospheric Reactions of Halocarbon and Oxide of Sulfur and Nitrogen. Appleby, A. (Rutgers Univ., New Brunswick, NJ, 08903). **Project number:** NJ00941. **Contract:** NJ00941. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) determine the probable fates and environmental effects of certain halocarbons and related compounds by studying their photochemistry in controlled laboratory environments chosen to simulate atmospheric conditions; and (2) assess the feasibility of using electron beam or similar high energy radiations to remove simultaneously SO(2) and nitrogen oxides from gas streams. Gas mixtures will be prepared and irradiated using techniques and equipment already developed and presently available at Rutgers. Analytical procedures for determination of CCl(4), CHCl(3)COCl(2) will be developed from methods used previously, making use of the increased sensitivity and specificity of GC/MS. Irradiation of SO2/NO(x) mixtures will be by electron linear accelerator. Such a machine is not available at Rutgers and would have to be obtained.
Keywords: photochemical reactions; nitrogen oxides; sulfur oxides; atmospheric chemistry; chlorinated aliphatic hydrocarbons; irradiation; removal; electron beams; desulfurization; denitration.

69 Socio-Economic Analysis of Economic Development and Environmental Degradation: Four Corners Area. Eastman, C.E. (New Mexico State Univ., Las Cruces, NM, 88003). **Project number:** NM00203. **Contract:** NM00203. **Supported by:** New Mexico State Univ., Las Cruces (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to calculate the social and economic benefits and costs of economic development. Methodology will be developed for measurement of social and economic costs of environmental degradation, demand curves will be fitted to the supply curve for abatement, and a regional input-output model will be developed to evaluate effects on employment and income.
Keywords: economic impact; social impact; environmental impacts; energy source development; environment; air pollution; water pollution; land pollution; input-output analysis; regional analysis; energy analysis; energy models; new mexico.

70 Assessment of Energy Policy and Development Alternatives for New Mexico. Ward, F.A. (New Mexico State Univ., Las Cruces, NM, 88003). **Project number:** NM00251. **Contract:** NM00251. **Supported by:** New Mexico State Univ., Las Cruces (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$10,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); conservation(25) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this project are to estimate demand and supply functions for energy resources of importance to New Mexico; estimate and evaluate the interdependencies and substitutability among alternative sources of energy; establish long-run projections of future energy and energy related resource use, environmental quality, overall economic activity and production alternatives in light of projections of population growth, development of new technologies and the exhaustion of fossil fuels; evaluate the impact of policy alternatives upon New Mexico energy use and production patterns; and estimate the economic and environmental impacts of changes in energy use, policy and production patterns. Econometric analysis, interfuel competition models and cybernetic/similation studies will be utilized in conjunction with benefit-cost, input-output and L.P. to evaluate the economic impact of energy policy and development alternatives for New Mexico.
Keywords: new mexico; energy source development; energy policy; input-output analysis; simulation; environmental effects; economic impact; energy consumption; technology assessment; energy sources; supply and demand.

71 Effects of Topsoil Depth Over Saline-Sodic Spoils on the Productivity of Native Range Species. Gould, W.L. (New Mexico State Univ., Las Cruces, NM, 88003). **Project number:** NM04104-016. **Contract:** NM04104-016. **Supported by:** New Mexico State Univ., Las Cruces (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$20,000.

Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) determine the optimum depth topdressing mine spoils for maximum production of native range plants under natural rainfall conditions in a semi-arid climate; (2) evaluate the effect of soil depth on upward migration of salts from the underlying spoil; and (3) evaluate the effect of soil depth on root growth of native plants. Gradually increasing depths of soil from 0 to 125 cm will be placed over saline-sodic spoils to form a wedge-shaped block with surface dimensions of about 15 x 30 meters. This area will be seeded in rows running in the direction of increasing soil depth to three species of native grasses and one species of shrub. Three rows of each grass species and a single row of shrubs will be seeded in each replication. Forage production will be determined from the center row of each grass species. The seeded area will be irrigated during one season to get good plant establishment. During the second season irrigation plus rainfall will equal the average monthly rainfall amounts. Grass yields will be determined at each 10-cm increment of soil depth. Shrub canopy volume will be determined. The chemical characteristics of the spoil material and soil will be determined before seeding, and at the end of the growing season each year for four or more years. Core samples will be obtained to determine the biomass and orientation of roots in the various depths of soil or spoil.

Keywords: spoil banks; land reclamation; humus; soil mechanics; soil chemistry; plants; nutrition; optimization; grass; shrubs.

72 Economics of Coal and Oil Shale Development Environmental Quality in Rural Areas. Whetzel, V. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** NRE-42-309-54-01. **Contract:** NRE-42-309-54-01. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. The approach taken is to develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities. An interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies are developed. Budgeting techniques and linear programming will be used to estimate water demand and to appraise the economic and environmental implications of alternative water supplies.

Keywords: environmental impacts; economic impact; coal deposits; oil shale deposits; energy source development; rural areas; regional analysis; water requirements; socio-economic factors.

73 Economics of Coal and Oil Shale Development on Environmental Quality in Rural Areas. Juero, L. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** NRE-42-309-08-01. **Contract:** NRE-42-309-08-01. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$40,000.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. The approach taken is to develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities. An interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies are developed. Budgeting techniques and linear programming will be used to estimate water demand and to appraise the economic and environmental implications of alternative water supplies.

Keywords: environmental impacts; economic impact; coal deposits; oil shale deposits; energy source development; rural areas; regional analysis; water requirements; socio-economic factors.

74 Economics of Coal and Oil Shale Development on Environmental Quality in Rural Areas. Barse, J. (Dept. of Agriculture, Washington, DC, 20250). **Project number:** NRE42-309-11-00. **Contract:** NRE42-309-11-00. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$95,000.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. The approach is to: (1) develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities; and (2) develop an interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies. Budgeting techniques and linear programming will be used to estimate water demand and to appraise the economic and environmental implications of alternative water supplies.

Keywords: coal industry; oil shale industry; rural areas; resource development; environmental impacts; land use; water requirements; economic impact.

75 Economics of Coal and Oil Shale Development on Environmental Quality in Rural Areas. McMarin, W. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** NRE42309-38-01. **Contract:** NRE42309-38-01. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$15,000.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas; (2) develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities; and (3) develop an interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies. Budgeting techniques and linear programming will be used to estimate water demand and to appraise the economic and environmental implications of alternative water supplies.

Keywords: coal industry; oil shale industry; energy source development; rural areas; environmental impacts; land use; resource assessment; water requirements; economics.

76 Economics of Coal and Shale Development on Environmental Quality in Rural Areas. Whetzel, V. (West Virginia Univ., Morgantown, WV, 26506). **Project number:** NRE-42-309-54-01. **Contract:** NRE-42-309-54-01. **Supported by:** West Virginia Univ., Morgantown (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$25,000.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. The approach taken is to develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities. An interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies are developed. Budgeting techniques and linear programming will be used to estimate water demand and to appraise the economic and environmental implications of alternative water supplies.

Keywords: coal deposits; oil shale deposits; environmental impacts; rural areas; economic impact; energy source development; regional analysis; socio-economic factors; water requirements.

77 Economic Impacts of Energy Development and Use on Agriculture and Natural Resources. Green, J. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** NRE43-309-08-01. **Contract:** NRE43-309-08-01. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: Coal(25); oil shale(25); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study will analyze supply and demand factors that will influence the potential for fuel wood and home heating; analyze the economic feasibility of energy (biomass) crops, including land and water requirements, impacts on traditional crop production and environmental implications; and assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. Research will assess the economic resource use and environmental implications of public programs to encourage energy farms; develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities; and develop an interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies. Budgeting techniques and linear programming will be used to estimate water demand for

energy development and to appraise the economic and environmental implications of alternative water supplies.
Keywords: economic impact; energy source development; resource conservation; agriculture; energy demand; biomass; wood; space heating; coal industry; oil shale industry; comparative evaluations; water requirements.

78 Economic Impacts of Energy Development and Use on Agriculture and Natural Resources. Barse, J. (Dept. of Agriculture, Washington, DC, 20250). **Project number:** NRE43-309-11-00. **Contract:** NRE43-309-11-00. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(25); oil shale(25); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Study will analyze supply and demand factors that will influence the potential for fuel wood and home heating; analyze the economic feasibility of energy (biomass) crops, including land and water requirements, impacts on traditional crop production and environmental implications; and assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. Approach will assess the economic resource use and environmental implications of public programs to encourage energy farms; develop regional reports on current land and water use, the economic implication for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities; develop an interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies; and budgeting techniques and linear programming will be used to estimate water demand for energy development and to appraise the economic and environmental implications of alternative water supplies.
Keywords: economic impact; energy source development; agriculture; resource conservation; feasibility studies; crops; coal industry; oil shale industry.

79 Economic Impacts of Energy Development and Use on Agricultural and Natural Resources. McMartin, W. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** NRE43-309-38-01. **Contract:** NRE43-309-38-01. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(25); oil shale(25); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study will analyze supply and demand factors that will influence the potential for fuel wood and home heating; analyze the economic feasibility of energy (biomass) crops, including land and water requirements, impacts on traditional crop production and environmental implications; and assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. Research will assess the economic resource use and environmental implications of public programs to encourage energy farms; develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities; and develop an interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies. Budgeting techniques and linear programming will be used to estimate water demand for energy development and to appraise the economic and environmental implications of alternative water supplies.
Keywords: economic impact; energy source development; resource conservation; water requirements; agriculture; energy demand; biomass; wood; space heating; coal industry; oil shale industry; comparative evaluations.

80 Economic Impacts of Energy Development and Use on Agriculture and Natural Resources. Wenderoth, J. (Univ. of Pennsylvania, Philadelphia, PA, 19104). **Project number:** NRE43-309-42-06. **Contract:** NRE43-309-42-06. **Supported by:** Pennsylvania Univ., Philadelphia (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(25); oil shale(25); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study will analyze supply and demand factors that will influence the potential for fuel wood and home heating; analyze the economic feasibility of energy (biomass) crops, including land and water requirements, impacts on traditional crop production and environmental implications; and assess the economic implications of alternative coal and oil shale development and associated activities on environmental quality and the competition for resources in rural areas. Research will assess the economic resource use and environmental implication of public programs to encourage energy farms; develop regional reports on current land and water use, the economic implications for future resource use, resource competition, and environmental quality resulting from alternative levels of coal and oil shale development, and related activities; and develop an interregional linear program to evaluate conflicting reclamation budgets from available literature, cooperation with other agencies within and without USDA, and limited empirical studies. Budgeting techniques and linear programming will be used to estimate water demand for energy development and to appraise the economic and environmental implications of alternative water supplies.
Keywords: economic impact; energy source development; agriculture; resource conservation; wood; biomass; space heating; coal industry; oil shale industry; comparative evaluations; water requirements.

81 Completion for Rural Resources. Nelson, A. (Arkansas Univ., Monticello, AR, 71655). **Project number:** NRE43-322-04-01. **Contract:** NRE43-322-04-01. **Supported by:** Arkansas Univ., Monticello (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$7,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) develop functional relationships for the supply of land to agriculture and among competing uses, relating land availability to commodity prices, commodity policies, resource policies, non-agricultural competing uses and other significant variables; (2) relate agricultural land availability to agricultural capacity and develop linkages between policy variables and the amount of land used and agricultural capacity; (3) develop a system to account for land use changes over time as between agricultural uses, abandonment, reclamation, by irrigation or drainage, recreation, forestry, urbanization and surface mining; (4) use economic theory, models and statistical techniques to estimate functions relating land use for various purposes to explanatory variables; and (5) using a regional definition system consistent with other projects and progress areas of the Division and of the Commodity Economic Division, integrate land supply estimates with estimates of input supplies, yield projections and other measures of productivity to the capacity of agriculture.
Keywords: rural areas; land use; planning; resource conservation.

82 Competition for Rural Resources. Toon, T. (Dept. of Agriculture, Little Rock, AR, 72201). **Project number:** NRE43-322-05-05. **Contract:** NRE43-322-05-05. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$40,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) develop functional relationships for the supply of land to agriculture and among competing uses, relating land availability to commodity prices, commodity policies, resource policies, non-agricultural competing uses and other significant variables; (2) relate agricultural land availability to agricultural capacity and develop linkages between policy variables and the amount of land used and agricultural capacity; (3) develop a system to account for land use changes over time as between agricultural uses, abandonment, reclamation, by irrigation or drainage, recreation, forestry, urbanization and surface mining; (4) use economic theory, models and statistical techniques to estimate functions relating land use for various purposes to explanatory variables; (5) using a regional definition system consistent with other projects and progress areas of the Division and of the Commodity Economic Division, estimate land supply among competing uses by region; and (6) in cooperation with other Divisions, integrate land supply estimates with estimates of input supplies, yield projections and other measures of productivity to the capacity of agriculture.
Keywords: rural areas; resource conservation; land use; planning; agriculture; land reclamation; recreational areas; forests; urban areas; surface mining; economic development.

83 Competition for Rural Resources. Skold, M. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** NRE43-322-08-01. **Contract:** NRE43-322-08-01. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$50,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) develop functional relationships for the supply of land to agriculture and among competing uses, relating land availability to commodity prices, commodity policies, resource policies, non-agricultural competing uses and other significant variables; (2) relate agricultural land availability to agricultural capacity and develop linkages between policy variables and the amount of land used and agricultural capacity; (3) develop a system to account for land use changes over time as between agricultural uses, abandonment, reclamation, by irrigation or drainage, recreation, forestry, urbanization and surface mining; (4) use economic theory, models and statistical techniques to estimate functions relating land use for various purposes to explanatory variables; (5) using a regional definition system consistent with other projects and progress areas of the

Division and of the Commodity Economic Division, integrate land supply among competing uses by region; and (6) in cooperation with other Divisions, integrate land supply estimates with estimates of input supplies, yield projections and other measures of productivity to capacity of agriculture.
Keywords: rural areas; land use; planning; resource conservation.

84 Competition for Rural Resources. Benesch, K. (Economic Research Service, Washington, DC, 20250). ***Project number:*** NRE-43-322-11-00. **Contract:** NRE-43-322-11-00. **Supported by:** Economic Research Service, Washington, DC (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$274,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) develop functional relationships for the supply of land to agriculture and among competing uses, relating land availability to commodity prices, commodity policies, resource policies, non-agricultural competing uses and other significant variables; (2) relate agricultural land availability to agricultural capacity and develop linkages between policy variables and the amount of land used and agricultural capacity; (3) develop a system to account for land use changes over time as between agricultural uses, abandonment, reclamation, by irrigation or drainage, recreation, forestry, urbanization and surface mining; (4) use economic theory, models, and statistical techniques to estimate functions relating land use for various purposes to explanatory variables; (5) using a regional definition system consistent with other projects and progress areas of the Division and of the Commodity Economic Division, estimate land supply among competing uses by region; and (6) in cooperation with other Divisions, integrate land supply estimates with estimates of input supplies, yield projections and other measures of productivity to the capacity of agriculture.
Keywords: rural areas; land use; resource conservation; agriculture; mining; industry.

85 Competition for Rural Resources. McMartin, W. (North Dakota State Univ., Fargo, ND, 58103). **Project number:** NRE43-322-38-01. **Contract:** NRE43-422-38-01. **Supported by:** North Dakota State Univ., Fargo (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) develop functional relationships for the supply of land to agriculture and among competing uses, relating land availability to commodity prices, commodity policies, resource policies, non-agricultural competing uses and other significant variables; (2) relate agricultural land availability to agricultural capacity and develop linkages between policy variables and the amount of land used and agricultural capacity; (3) develop a system to account for land use changes over time as between agricultural uses, abandonment, reclamation, by irrigation or drainage, recreation, forestry, urbanization and surface mining; (4) use economic theory, models and statistical techniques to estimate functions relating land use for various purposes to explanatory variables; (5) using a regional definition system consistent with other projects and progress areas of the Division and of the Commodity Economic Division, estimate land supply among competing uses by region; and (6) in cooperation with other Divisions, integrate land supply estimates with estimates of input supplies, yield projections and other measures of productivity to the capacity of agriculture.
Keywords: rural areas; land use; planning; resource conservation.

86 Competition for Rural Resources. Sloggett, G. (Oklahoma State Univ., Stillwater, OK, 74074). **Project number:** NRE43-322-40-01. **Contract:** NRE43-322-40-01. **Supported by:** Oklahoma State Univ., Stillwater (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$40,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) develop functional relationships for the supply of land to agriculture and among competing uses, relating land availability to commodity prices, commodity policies, resource policies, non-agricultural competing uses and other significant variables; (2) relate agricultural land availability to agricultural capacity and develop linkages between policy variables and the amount of land used and agricultural capacity; (3) develop a system to account for land use changes over time as between agricultural uses, abandonment, reclamation, by irrigation or drainage, recreation, forestry, urbanization and surface mining; (4) use economic theory, models and statistical techniques to estimate functions relating land use for various purposes to explanatory variables; (5) using a regional definition system consistent with other projects and progress areas of the Division and of the Commodity Economic Division, estimate land supply among competing uses by region; and (6) in cooperation with other Divisions, integrate land supply estimates with estimates of input supplies, yield projections and other measures of productivity to the capacity of agriculture.
Keywords: rural areas; land use; planning,. resource conservation.

87 Regional Problems in Evaluating Environmental Aspects of Electricity Generation. Mount, T.D. (Cornell Univ., Ithaca, NY, 14850). **Project number:** NYC121437. **Contract:** NYC121437. **Supported by:** Cornell Univ., Ithaca, NY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$3,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study will identify the nature and geographic location of the important environmental consequences of supplying electricity to individual regional service areas for present and potential processes, and determine the differential impact on rural-urban areas and on income groups; determine the basic financial parameters of capital and operating costs of potential plants for each process, as well as the costs of environmental protection and abatement costs associated with each process; and develop useful information for utilities and customers to make decisions about particular processes and particular sites. This will involve: utilization of engineering data to define the economic matrix of capital and annual costs for generation, abatement, and transmission for the potential generating process; extrapolating other findings on public health and ecology to the specific emission patterns of present and future plants; random and/or stratified sample interviews to determine public opinion related to monetary and environmental costs of new facilities; and case study comparison of specific regions and service areas to determine structural similarities relevant to national policies. Benefit-cost analysis of optimum levels of demand growth and generation by process will be made.
Keywords: electric power; environmental impacts; energy demand; socio-economic factors; pollution abatement; regional analysis.

88 Producer Gas as a Petroleum Substitute. Albright, L.D.; Reines, R. (Cornell Univ., Ithaca, NY, 14850). **Project number:** NYC123423. **Contract:** NYC123423. **Supported by:** Cornell Univ., Ithaca, NY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$292,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) critically examine the known technology of making producer gas; (2) determine the feasibility of using this technology to reduce the dependence of agriculture in the Northeast on conventional fuel source; (3) design, construct and test a producer gas system including: gas generator, filter,heat exchanger, fine filter and engine; and (4) prepare a summary report of the study including an economic analysis of producer gas substitution for conventional fossil fuels and electricity. The first phase of this study will be to determine an optimum size of the producer gas generator. Then a gas generator will be designed, constructed and tested. After completing the tests, the generator will be connected to a filtering and heat exchanger system and finally to internal combustion engine. Operational characteristics of the system will be measured and any particular problem identified and corrected.
Keywords: producer gas; fuel substitution; feasibility studies; gas generators; design; construction; heat exchangers; internal combustion engines; performance.

89 Anaerobic Fermentation of Agricultural Waste-Potential for Improvement and Implementation. Jewell, W.J. (Cornell Univ., Ithaca, NY, 14850). **Project number:** NYC123360. **Contract:** NYC123360. **Supported by:** Cornell Univ., Ithaca, NY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$234,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Studies will Jtermine the potential for optimizing technology related to anerobic fermentation of agricultural wastes; identify fermentor designs capable of more rapid or more efficient recovery of energy containing by-products of gas, nutrients and solid residues; and demonstrate the feasibility of improved fermentors using small laboratory models followed by large scale pilot plants. Studies will be conducted with dairy cow wastes. This study will be divided into 3 major efforts: identification of improved fermentor designs using small scale laboratory models, definition of optimized fermentor designs, and demonstration of new process feasibility in large scale pilot plants. Two general concepts will guide the development of future optimized anaerobic fermentation technology: simplistic operation involving minimal manpower and the elimination of the waste by production of useful energy-containing by-products. The focus will be on the transformation of a waste into usable but currently unrecovered energy-containing by-products. The Cornell study has identified two unique anaerobic fermentation system designs: one capable of operation with the simplest of demands on the farm, and a second complex unit which might accomplish stabilization, methane production, liquid-solids separation and pathogen destruction in one unit operation.
Keywords: anaerobic digestion; fermentation; agricultural wastes; optimization; waste product utilization; feasibility studies; technology assessment.

90 Energy in Animal Manures. Muck, R.E. (Cornell Univ., Ithaca, NY, 14850). **Project number:** NYC123422. **Contract:** NYC123422. **Supported by:** Cornell Univ., Ithaca, NY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA. **Related energy source:** conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The utilization of biologically released heat from animal manures for on-farm applications was investigated. Specifically, the effect of heat energy released from in-barn stored manure on the quality of the environment within the barn was studied. Agricultural by-products, animal manure being a specific example, represent a considerable quantity of energy. These by-products represent to the agricultural engineer a challenge to make use of this energy to supplement our dwindling and increasingly more costly energy sources. The purpose of this research project is to take an overall look at energy from animal manures with specific emphasis on utilizing biologically produced heat and to provide some basic concepts into the magnitude of heat energy available, the conditions favorable to its release, and potential means of utilizing this energy. A comparison of the various forms of energy will be made to determine the efficiencies of energy utilization systems.
Keywords: manures; waste product utilization; waste heat utilization; technology assessment; energy source development; farms.

91 High Temperature Stabilization and Moisture Removal from Animal Wastes for By-Product Recovery. Dondero, N.C.; Van Soest, P.J. (Cornell Univ., Ithaca, NY, 14850). **Project number:** NYC123584. **Contract:** NYC123584. **Supported by:** Cornell Univ., Ithaca, NY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$30,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

An ideal animal waste treatment and residue recovery system would convert obnoxious wet animal wastes to an odorless, stabilized, pathogen-free material with moisture content less than 40% in a simple process without addition of large amounts of energy. The goals of this study will be to determine the feasibility of developing such a process and to build a bench scale pilot unit process to demonstrate its potential. The basic steps that will be utilized to meet the project goals are: (1) determination of kinetics of organic carbon decomposition and oxygen transfer limitations in semi-solid animal wastes created by combining the treated and dried animal wastes with the wet raw wastes; (2) determination of the heat released during aerobic stabilization and identify means of conserving the energy to achieve autoheating of the organics; (3) measurement of the rate of moisture removal from autoheated animal wastes; (4) combination of the above into a simple single unit pilot plant that would achieve high rate organic stabilization and simultaneous moisture removal; and (5) determination, at temperatures of 60 to 70 degrees C, autoheating requirements to produce pathogen destruction and maximum microbial production of protein.
Keywords: manures; waste processing; water removal; waste product utilization; waste heat utilization; decomposition; chemical reaction kinetics; single cell protein; biosynthesis; materials recovery; energy source development.

92 Environmental Implications of Heterotrophic Microbial Methane Oxidation. Weaver, T.L. (Cornell Univ., Ithaca, NY, 14850). **Project number:** NYC144420. **Contract:** NYC144420. **Supported by:** Cornell Univ., Ithaca, NY (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$8,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) examine the effects of heterotrophic microbial methane oxidation in soil and water; (2) investigate the involvement of this biological process in denitrification and carbon cycling; (3) examine the microorganisms involved in this process and the interactions between these microorganisms and the soil and water environments; (4) evaluate quantitatively the relative importance of this process in soil and water quality; and (5) reveal ways to regulate this process for soil and water improvement. Heterotrophic microorganisms capable of methane oxidation will be isolated, quantitated, and characterized from soil and water. Rates and quantities of methane utilization, denitrification, nutrient uptake, and metabolic waste production will be determined. Effects of physical and chemical environmental factors on these processes will be evaluated. This information will be combined to evaluate the importance of this process in environmental quality.
Keywords: methane; oxidation; soils; water; denitrification; carbon cycle; microorganisms; metabolism; nutrients; uptake; environmental effects; growth.

93 Use of Sewage Sludge to Improve Growth on Acidic Ohio Strip-MIne Spoils: Boron Toxicity Problem. Vimmerstedt, J.P. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** OH000016-MS. **Contract:** OH000016-MS. **Supported by:** Ohio Agricultural Research and Development Center, Wooster (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$8,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) describe boron toxicity symptoms in American sycamore; (2) determine whether boron toxicity or potassium deficiency is responsible for lesions on American sycamore leaves grown in toxic coal spoil amended with sewage sludge; and (3) determine rate of lime or potassium fertilization needed to correct the problem under field conditions. Boron toxicity symptoms will be described. Sycamore seedlings will be grown in nutrient solutions containing varying rates of boron. American sycamore will be grown in acidic coal spoil amended with Newark sewage sludge. Three rates of liming and 3 rates of KCl fertilization will be tested for correction of distress symptoms in a greenhouse study. Treatments that correct the problem in the greenhouse will be field tested on toxic coal spoils.
Keywords: boron; toxicity; sycamores; potassium; nutritional deficiency; spoil banks; revegetation; plant diseases; symptoms; sewage sludge; fertilizers; calcium oxides; therapy; plant growth; ohio; surface mining; coal mines; land reclamation; waste product utilization.

94 Use of Sludges and Top Soil in Reclamation Coal Strip-Mine Spoils. Sutton, P. (Ohio Agricultural Research and Development Center, Columbus, OH, 43216). **Project number:** OH000247-SS. **Contract:** OH000247-SS. **Supported by:** Ohio Agricultural Research and Development Center, Columbus (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$15,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) determine optimum rates of sewage sludge to obtain cover on old acidic mine spoils in greenhouse, and under field conditions; (2) determine effect of sludge applied to old acidic mine spoils on heavy metal content of vegetation and leachate; and (3) determine optimum depth of top-soil replacement on new spoil. Tall fescue will be grown in pots of acidic mine spoil treated with 6 rates of 2 sludges (high and low in heavy metals). Yield, cover and concentration of heavy metals, Mn, N, Al, P and K in the plants will be determined. Leachate will be collected from spoil lysimeters treated with 3 rates of 2 sources of sludge. Tall fescue will be grown and evaluated as above. Leachate will be measured and NO3 -N, NH4 -N, soluble salts, acidity, SO4, pH, P and heavy metals determined. Field plots will be established on a limestone and sandstone or shale spoilbank site. Four depths of topsoil will be applied. A forage mixture will be seeded and plots evaluated for infiltration, bulk density, cover and yield.
Keywords: surface mining; coal mines; spoil banks; land reclamation; sewage sludge; soils; greenhouses; metals; plants; leachates; grass; uptake; manganese; nitrogen; aluminium; phosphorus; potassium; field tests; nitrates; ammonium compounds; sulfates; ph value; limestone; sandstones; shales; cultivation techniques; seeds; revegetation; waste product utilization; depth.

95 Hydrology and Water Quality of Watersheds Subjected to Surface Mining. Hall, G.F.; Sutton, P. (Ohio Agriculture Research and Development Center, Wooster, OH, 44691). **Project number:** OH000248-SS. **Contract:** OH000248-SS. **Supported by:** Ohio Agricultural Research and Development Center, Wooster (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$129,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to (1) obtain complete hydrology and water quality data from four watersheds prior to, during, and after surface mining; (2) characterize physically and chemically overburden materials, spoil, and replaced topsoil; (3) determine erosion and runoff characteristics of treated and untreated reclaimed spoil; and (4) determine cost and benefits of mining and reclamation practices. With the cooperation of mining companies, three watersheds will be studied before, during, and after mining of No. 6, No. 9, and No. 11 coal seams. In a cooperative effort with the Bureau of Mines, USDI, ARS, USDA, and USGS, runoff weirs, sampling devices and observation wells will be used along with standard hydrologic instruments and techniques to get a complete hydrologic inventory and water quality from the watersheds. A fourth watershed on No. 8 Coal at the North Appalachian Experimental Watershed Research Center will be sampled for water quantity and quality (0.41 parameters). Economic data for mining and reclamation will be obtained.
Keywords: hydrology; water quality; watersheds; surface mining; coal mines; overburden; spoil banks; soils; chemical composition; erosion; runoff; cost benefit analysis; sampling; appalachia; land reclamation; environmental impacts.

96 No-Tillage Grain Crop Production on Land Reclaimed Following Strip Mining. Sutton, P. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** OH000264-SS. **Contract:** OH000264-SS. **Supported by:** Ohio Agricultural Research and Development Center, Wooster (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA. **Related energy source:** Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to demonstrate the practicality of no-tillage corn production on spoil areas following stripmine production of coal and reclaimed under the new law, and to demonstrate practices to tour groups and others who may be interested. Corn will be planted using the no-tillage method both on a reclaimed site and an adjacent undisturbed site. Crop yields from the two areas will be compared and yield levels over a several year period used to assess the economic practicality of grain production on reclaimed sites. Management factors needed for satisfactory corn production with no-tillage on reclaimed spoil areas will also be assessed. Experiments incorporating these factors will be established in the planted area as the need arises. In 1977, nitrogen rates will be studied. An area large enough for a moderate amount of grain production will be planted using the best management practices known. The area will cover approximately 20 acres for the 1977 season.
Keywords: crops; land reclamation; surface mining; coal mines; maize; plant growth; spoil banks; productivity; revegetation; cultivation techniques.

97 Reclamation and Management of Strip-Mined Land in Ohio. Sutton, P. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** OH000634. **Contract:** OH000634. **Supported by:** Ohio Agricultural Research and Development Center, Wooster (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$5,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) characterize physical and chemical properties of mined lands and correlate these properties with crop yield; and (2) correlate soil test values of mined lands with crop yields and fertilizer responses. Field plots will be located on coal mine spoilbanks that have been reclaimed and have good forage stands. Soil samples will be taken from each site for soil test and analysis for selected chemical and physical properties. Three rates of N, P and K will be applied in two applications each year. The relationships between soil test values, fertilizer responses, chemical and physical properties and dry matter yields will be investigated. Two sites will be selected to determine if alfalfa can be successfully produced on the high pH spoils. Three rates of P and K will be applied annually.
Keywords: ohio; land reclamation; coal mines; crops; productivity; spoil banks; soil chemistry; sampling; chemical properties; physical properties; alfalfa; nitrogen; phosphorus; potassium; fertilizers; revegetation.

98 Energy Policy, Biomass, and Agriculture: an Economic Analysis. Ives, E.; Hitzhusen, F. (Ohio Agricultural R and D Center, Columbus, OH, 43216). **Project number:** OH000650. **Contract:** OH000650. **Supported by:** Ohio Agricultural Research and Development Center, Columbus (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

Studies will determine the impact of present and evolving energy policies on agriculture; analyze the economics of selected crop biomass options; and delineate the role of agriculture in future energy strategies. This will be accomplished by partial equilibrium market analysis of specific policy issues with identification of non-market effects; production and conversion cost analysis of selected biomass energy options, domestically in major agricultural exporting countries and in selected Fourth World countries; and market analysis of international agricultural trade and domestic agricultural resource allocation implications of energy production from biomass as world energy prices rise; identify (from original and/or existing research) mutually comparable measures of cost and important non-market implication (environment, public health and safety, national security) of energy sources, including biomass, which may play significant roles in alternative energy futures; and use this information to identify the cost and non-market trade-offs among selected broad energy strategies which have reasonable likelihoods of being followed.
Keywords: energy policy; biomass; agriculture; economic impact; crops.

99 Economic Impacts of Coal Mining in Eastern Oklahoma. Schriner, D.F.; Badger, D.D. (Oklahoma State Univ., Stillwater, OK, 74704). **Project number:** OKL01674. **Contract:** OKL01674. **Supported by:** Oklahoma State Univ., Stillwater (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$2,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) estimate the quantity and value of current, past, and future coal production in Oklahoma and evaluate production characteristics of Oklahoma coal mining; (2) estimate the demand for Oklahoma coal including an analysis of factors responsible for current demand and potential future uses; (3) estimate local, regional, and statewide social and economic impacts caused by mining; (4) estimate the agricultural uses of the land and resulting values before and after the land is mined and reclaimed; (5) determine the change in public services required as a result of mining and reclamation; and (6) determine the environmental quality and quality of life impacts due to mining of the land and the reclamation practices. Secondary data will be analyzed to inventory current coal resources and project future production. Input-output analysis will be used to measure the impacts on Oklahoma from increases in mining activity. A demand analysis will be performed using multivariate techniques. Projecting future land uses and comparing present values will be used to evaluate different reclamation plans. Primary data will be collected to determine personal and environmental impacts.
Keywords: economic impact; coal mining; oklahoma; coal industry; energy demand; social impact; land use; environmental impacts; inventories; coal deposits; forecasting.

100 Effects of Petroleum Hydrocarbons on Marine Organisms. Caldwell, R.S. (Oregon State Univ., Corvallis, OR, 97331). **Project number:** ORE00365. **Contract:** ORE00365. **Supported by:** Oregon State Univ., Corvallis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$126,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine the relative toxicity of the principal water extractable hydrocarbons of crude and refined oils and evaluate the contribution of each to the toxicity of water soluble fractions (WSFs) of oil; (2) examine the possibility that some of the hydrocarbon components may have more than additive toxicity when present together in WSFs; and (3) test the hypothesis that hydrocarbon compounds capable of inducing the mixed function oxidase enzymes of the endoplasmic reticulum interfere with the adaptive responses of poikilothermic marine organisms to temperature by the interference with the activity of the fatty acid desaturase enzyme system. Toxicities of actual oil WSFs will be compared with synthetic WSFs and with the sum of the toxicities of individual components. Standard toxicological procedures will be used to determine the toxicities of petroleum hydrocarbons representing various classes of compounds and homologous series. A suitable test organism will be exposed to inducing (mixed function oxidase enzymes) petroleum hydrocarbons to: (1) determine effect on physiological thermal adaptation (e.g., upper lethal thermal limit); (2) determine effect of fatty acid composition of biomembranes; and (3) determine effect on fatty acid desaturase activity in vitro.
Keywords: petroleum; hydrocarbons; metabolism; aquatic organisms; toxicity; synergism; biological effects; physiology.

101 Energy Conservation in Drying Lumber and Veneer. Corder, S.E. (Oregon State Univ., Corvallis, OR, 97331). **Project number:** ORE-F-00020. **Contract:** ORE-F-00020. **Supported by:** Oregon State Univ., Corvallis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to evaluate the technical and economic feasibility of drying lumber with forced air combined with supplemental heating, using a steam-jet heat recovery system with a high-temperature kiln, modifying veneer-drying systems for reduced energy consumption, and recovery of energy from the exhaust of a veneer dryer. Calculations and analysis will be performed to predict performance of the proposed systems. Tests will then be conducted to verify performance and to help define operational problems which might develop. Energy savings will be identified and results of the findings will be publicized.
Keywords: economics; feasibility studies; drying; energy conservation; wood products industry; performance; heat recovery; wood; dryers; kilns.

102 Identification and Amelioration of Adverse Conditions Limiting Reclamation of Coal-Mined Lands. McKee, G.W. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02089. **Contract:** PEN02089. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) identify the factors limiting the reclamational revegetation of strip-mine spoil and deep-mine refuse; (2) identify plant species and strains tolerant of the adverse conditions; and (3) develop a system of reclamation for adverse sites resulting from coal mining. Physical and chemical properties of successfully revegetated mined lands will be analyzed and compared to those from similar sites where revegetation has been unsuccessful. Various species and strains of herbaceous and woody plants will be screened in greenhouses. Promising species will be further screened through nutrient-culture studies and field plantings. Techniques presently used in reclaiming mined land will be evaluated and new techniques will be devised and tested. All data obtained will be combined to develop a practical system of reclaiming adverse sites.

Keywords: coal mines; land reclamation; revegetation; surface mining; spoil banks; plants; physical properties; chemical properties; technology assessment; growth.

103 Methane Gas Production from Farm Waste. Branding, A.E; Persson, S. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02132. **Contract:** PEN02132. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine the technical requirements and economic feasibility for methane production from farm waste. The approach taken is to: (1) compile basic information on methane production from organic material; and (2) design pilot plant for producing methane from farm waste and build and test the system.
Keywords: methane; biosynthesis; agricultural wastes; anaerobic digestion; data compilation; pilot plants; design.

104 Reclamation of Strip-Mined Spoils Using Containerized Seedlings. McKee, G.W. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02193. **Contract:** PEN02193. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$22,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) develop a system for raising superior coniferous seedlings in containers in the greenhouse; and (2) evaluate the use of such growing stock for revegetating both land currently being strip mined and toxic spoils from past operations. A number of species and genetic selections within a species will be grown in contrasting types of containers under near-optimum greenhouse conditions with an extended growing season. The seedlings will be planted on a recently strip-mined site reclaimed under Pennsylvania's current law, some of the species and containers will further be evaluated at 5 additional sites in Appalachia. Container-grown red pine seedlings will be planted on highly acid strip-mine spoils in conjunction with different amendments and different grass-legume seed mixtures.
Keywords: surface mining; coal mines; spoil banks; revegetation; greenhouses; conifers; seedlings; pennsylvania; appalachia; pines; land reclamation; containers.

105 Selection of Aluminum-Tolerant Trees for Revegetating Acid Mine Spoils. Steiner, K.C. (Pennsylvania State Univ. , University Park, PA, 16802). **Project number:** PEN02258. **Contract:** PEN02258. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$17,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) develop laboratory techniques for evaluating the aluminum tolerance of trees; (2) determine the relative aluminum tolerance between and within tree species; and (3) select superior genotypes for revegetating acid mine spoils. Experiments will be conducted in three phases. Seedlings to be used in the experiments will be grown from seeds collected from four female parents in 10 to 15 populations for each of six tree species. Three greenhouse techniques will be evaluated with regard to their utility in selecting aluminum-tolerant trees. Using the best technique developed in Phase I, the relative aluminum tolerance of the selected species will be evaluated. Similarly, the variation in aluminum tolerance among populations and families within species will be sequentially evaluated. The most and least aluminum-tolerant families and populations in each species will be identified.
Keywords: trees; biological adaptation; aluminium; tolerance; revegetation; spoil banks; land reclamation; coal mines; seedlings; greenhouses.

106 Zoogeography and Ecology of Fishes in Pennsylvania. Cooper, E.L. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02276. **Contract:** PEN02276. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$8,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Objectives are to: (1) measure the impact of environmental disturbance on patterns of distribution of fish species; and (2) investigate the phylogeny of selected fish groups in order to assess the validity of species nomenclature. The severity of environmental degradation due to acid mine drainage, soil erosion, industrial pollution or other disturbances to aquatic habits will be correlated with the presence or absence of species of fishes known to be sensitive to these forms of pollution. Predictions of the level of pollution permissible to maintain diverse fish pollutions are then possible. Studies will be continued to better understand the diversity of taxa and the geographic distribution of fishes in northeastern United States.
Keywords: pennsylvania; fishes; ecology; species diversity; acid mine drainage; erosion; sensitivity; toxicity; usa; baseline ecology.

107 Interaction of Hardwood Tree Seedlings and Herbaceous Cover on Surface-Mined Land. McKee, G.W. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02315. **Contract:** PEN02315. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) evaluate the compatibility of various hardwood tree species with a herbaceous cover; and (2) develop a system of revegetating surfaced-mined land which will furnish both immediate site protection and long-term protection plus a potentially valuable product through establishment of hardwood trees. Seedlings or rooted cuttings of five hardwood species will be planted on regraded surface - mined coal land at three locations, immediately following sowing of locally recommended mixtures of grass and legume seed. Survival will be determined one month after planting, at the end of the first growing season, and at the beginning and end of the second growing season. Comparisons will be made of survival in unseeded plots and in a number of cover crop treatments (varied species, seeding rate, time of seeding).
Keywords: seedlings; surface mining; coal mines; land reclamation; revegetation; trees; grass; leguminosae; survival time.

108 Energy Recovery from Dairy Systems. Branding, A.E.; Anderson, P.M. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02334. **Contract:** PEN02334. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$4,000.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to develop and evaluate systems for recovering heat from dairy barn ventilation and milking systems. A heat recovery system using heat pump principles will be developed for capturing surfaces employed to absorb heat from the ventilation by cooling the air and condensing moisture; captured heat will be transferred through water-cooled condensers to a hot water storage tank. Evaporator design will incorporate means to minimize dust fouling and/or to simplify procedures for removing dust accumulations. Following development of operational systems, heat transfer coefficients, net energy recovery and capital costs will be determined. In addition, heat recovery by the use of newly developed water-cooled condensers for milk cooling equipment will be evaluated in relation to energy saving.
Keywords: farms; farm equipment; waste heat; condensers; evaporators; energy conservation; milk; dairy industry; heat recovery equipment; capital cost; performance.

109 Biogas Production from Anaerobic Digestion of Animal Manure. Persson, S.P.; Branding, A.E. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02345. **Contract:** PEN02345. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$350,000.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine the effects of operational and environmental factors on methane production by anaerobic digestion of animal residue at raised temperatures. The 100-cubic-m anaerobic digester developed for studies on methane generation from dairy manure will be operated to: (1) determine the effects of the following on biogas production rate and quality; (2) recycle liquid separate from digester effluent as dilution water; (3) use of milking center wastewater for dilution water; (4) pretreat poultry manure to reduce ammonia concentration; (5) develop automatic controls for reduced labor; and (6) conduct tests of biogas.
Keywords: manures; anaerobic digestion; methane; biosynthesis; environment; cows; chickens; water; recycling; operation.

110 Mineral Stress Adaptation of Natural Regeneration on Acid Mine Spoils. Steiner, K.C. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN02365. **Contract:** PEN02365. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to (1) evaluate putative differences in adaptation between progenies of trees occurring on acid mine spoils and progenies of trees on adjacent non-spoil sites; (2) determine if differences in adaptation exists between populations of the same species growing on different spoils; and (3) determine importance of mycorrizal fungi in establishment and growth of tree seedlings on acid mine spoils and interactions between fungus and tree genotype. Spoil and seed from disturbed and non-disturbed areas will be transported to University Park where a factorial experiment will be

conducted to study growth medium, mycorrhizal treatment and source of seed and interactions on growth survival and mycorrhizal development of seedlings.
Keywords: minerals; revegetation; spoil banks; biological adaptation; progeny; comparative evaluations; mycorrhizas; symbiosis; coal mines; land reclamation.

111 Influence of Sulfur Dioxide on Forest Ecosystems of the Northeastern United States. Davis, D.D. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** PEN12210. **Contract:** PEN12210. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$20,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Objectives are to: (1) determine the relative SO2 susceptibility of woody plants in northeastern United States; (2) study the influence of environmental factors on response; and (3) develop a model for predicting SO2 injury to vegetation. Seedlings of forest tree species and associated understory vegetation will be exposed to acute and/or chronic levels of SO2 in specially constructed exposure chambers. The relative susceptibility of various species will be determined based on percentage of foliage injured. Temperature, humidity, and light will be varied and plant response to SO2 recorded under various regimes. A computer model will be developed to express findings.
Keywords: sulfur dioxide; toxicity; metabolism; north atlantic region; terrestrial ecosystems; forests; biological models; trees; sensitivity; genetic variability; species diversity.

112 Study of the Conversion of Agricultural Wastes to Liquid Fuels. Felbeck, G.T. Jr. (Univ. of Rhode Island, Kingston, RI, 02881). **Project number:** RI00019. **Contract:** RI00019. **Supported by:** Rhode Island Univ., Kingston (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$6,000.
Related energy source: conservation() **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine by means of simulation experiments the naturally occurring conditions under which various organic materials could be converted to hydrocarbons; (2) apply the results of these experiments to the problem of geochemical prospecting for oil with particular emphasis on increasing the efficiency of drilling productive wells; and (3) apply the processes developed to the conversion of agricultural waste materials to liquid fuels. A matrix of organic and inorganic materials, blended to simulate marine sediment mixtures, will be subjected to appropriate laboratory conditions to simulate reaction times of up to 10 to the 7th power years at 100 degrees C. Reaction products will be compared with crude oil hydrocarbons to test process validity. The catalytic action of various metal compounds will be evaluated.
Keywords: agricultural wastes; simulation; conversion; hydrocarbons; natural occurrence; biogeochemistry; sediments; metals; catalytic effects; petroleum.

113 Mine Spoil Reclamation in the Southwest. Aldon, E.F. (Rocky Mountain Forest and Range Experiment Station, Albuquerque, NM, 87101). **Project number:** RM-1651. **Contract:** RM-1651. **Supported by:** Forest Service, Albuquerque, NM (USA). Rocky Mountain Forest and Range Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$364,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop methods for rehabilitation and management of mine spoils in the Southwest. The approach is to: (1) devise ways to establish and maintain vegetal cover by identifying plant materials adaptable to spoil environment, developing seeding and planting techniques, and devising means to augment water for plant growth; and (2) design spoil slopes and shapes to maximize stability and reduce runoff. This is a multifunctional research work unit including watershed management and range management.
Keywords: spoil banks; coal mines; land reclamation; revegetation; plants; stability; runoff; watersheds.

114 Effects of Multiple Land Use Practices on Big Game Habitat and Behavior in the Central Rocky Mountains. Ward, A.L. (Univ. of Wyoming, Laramie, WY, 82070). **Project number:** RM1712. **Contract:** RM1712. **Supported by:** Wyoming Univ., Laramie (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$185,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Studies will determine the environmental impacts and the interrelationships of major land use practices on the spectrum of habitats essential for optimum big game populations, and develop means for evaluating the adequacy of restoration of mined area in the northern Great Plains region. This study will: (1) determine the movements, habits, and other behavioral characteristics of big game in the vicinity of road systems of various standards and develop methods to mitigate unfavorable effects of these developments; (2) determine patterns of big game behavior and movements following timber harvest and activities related to increased human ingress; and (3) develop baseline ecological guidelines for evaluating the adequacy of restoration measures on surface mined areas.
Keywords: wild animals; habitat; behavior; rocky mountain region; land use; environmental effects.

115 Environmental Improvement and Multiple Use Management in the Northern High Plains. Bjugstad, A.J. (South Dakota School of Mines and Technology, Rapid City, SD, 57701). **Project number:** RM1752. **Contract:** RM1752. **Supported by:** South Dakota School of Mines and Technology, Rapid City (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$647,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

This study will develop means to: (1) increase production of wood, water, and animal products in the Black Hills; (2) maintain and reestablish the prairie woodlands; and (3) promote the reestablishment of plants, animals, and hydrologic stability on surface mine spoils and water impoundments in the Northern Great Plains. Land managers lack refined techniques for revegetating mine spoils to enhance habitat for nongame birds, deer, small mammals, and waterfowl. Studies will: (1) determine the use of naturally wooded draws by livestock, deer, and wintering species of nongame birds and determine what type of management is needed for regeneration of woody species; and (2) determine the effects of more intensive timber management practices on understory and overstory vegetation and water yield and quality in the Black Hills.
Keywords: surface mining; land reclamation; revegetation; plants; animals; hydrology; spoil banks; rocky mountain region; land use.

116 Minisite Preparation for Reforestation of Strip-Mined Lands. Hay, R.L. (Univ. of Tennessee, Knoxville, TN, 37916). **Project number:** TEN6841524. **Contract:** TEN6841524. **Supported by:** Tennessee Univ., Knoxville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to: (1) determine whether pine tubelings planted on prepared minisites on legally restored strip mines will survive and grow better than trees planted using conventional methods; and (2) determine what microsite spoil characteristics are most limiting to tree growth, and whether such factors can more effectively be determined by analysis of a small, localized sample than by a large sample of the site. The procedures to be used in this study will reflect the two different phases of the research. Phase one, involved with site assessment and determination of limiting factors, will essentially be a study of microsites and those soil characteristics which may be either limited or excessive. Information obtained in this phase of the work will be used as guidelines for the Phase Two which will be the field testing of minisite preparation, incorporating the best technology known at this time.
Keywords: surface mining; coal mines; revegetation; land reclamation; pines; cultivation techniques; soil chemistry; spoil banks; site preparation.

117 Controlling Strip Mine Runoff. Woods, F.W. (Univ. of Tennessee, Knoxville, TN, 37916). **Project number:** TEN00026. **Contract:** TEN00026. **Supported by:** Tennessee Univ., Knoxville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$15,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to: (1) develop design criteria for constructing back-sloped terraces on strip mined land in eastern Tennessee; (2) determine whether all precipitation can become impounded on this land and infiltrate the spoil; (3) determine the effects of terracing on plant growth; and (4) determine the effects of terracing on soil nutrient status. Terraces to be tested will have a backslope to contain rather than detain all precipitation intercepted by their basins. Two forms of terraces will be tested, straight and crescent. Grass sod will be established immediately after terraces are shaped. Runoff will be sampled by catching surface flow in water traps 3 meters wide. Volume of water and amounts and kinds of sediment will be measured. Two species of trees will be planted on the terraces. They will be containerized and will be inoculated with specific mycorrhizal fungi prior to planting. Soil samples will be taken prior to vegetation establishment and thereafter at 3-month intervals. Elements to be measured will include Ca, N, Al, Zn, Mg, Mn, P, Fe, Cu, S, B, and Mo. Soil acidity will also be measured.
Keywords: runoff; surface mining; coal mines; tennessee; land reclamation; cultivation techniques; nutrients; soils; excavation; sampling; calcium; nitrogen; aluminium; zinc; magnesium; manganese; phosphorus; iron; copper; sulfur; boron; molybdenum; soil chemistry; revegetation; pollution control.

118 Strip Mine Revegetation. Woods, F.W. (Univ. of Tennessee, Knoxville, TN, 37916). **Project number:** TEN00083. **Contract:**

TEN00083. **Supported by:** Tennessee Univ., Knoxville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA. **Related energy source:** Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide guidelines for the revegation of strip-mined areas and to increase the productivity of investments for this purpose. The approach to be used in this study will reflect different phases of the research. One, involved with site assessment and determination of limiting factors, will essentially be a study of microsites and those site properties which may be restrictive to revegetation. Information obtained in this work will be used as guidelines for subsequent work which will be the field testing of site preparation, incorporating techniques developed during the course of the work.

Keywords: surface mining; coal mines; revegetation; land reclamation; productivity; site preparation.

119 Forest Tree Fertilization. Buckner, E.R. (Univ. of Tennessee, Knoxville, TN, 37916). **Project number:** TNE00207. **Contract:** TEN00207. **Supported by:** Tennessee Univ., Knoxville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$3,000.

Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Objectives are to: (1) determine the response (diameter, height, basal area and cubic volume) of loblolly pine and selected hardwoods to various fertilizer rates and schedules; and (2) evaluate the influence of fertilization on the growth rate, form and color of tree species planted on reclaimed strip mines for Christmas tree production. There will be further testing of nutrients that promise to increase the economic return from loblolly pine plantations. Stem-form measurements will be made to detect cubic volume changes not related to the standard dbh-height measurements. Nitrogen fertilization plus heavy thinning to maximize the cubic volume growth of individual yellow-poplar trees will be continued. Fertilizer, mulching and cover crop combinations will be tested with various Christmas tree species on strip mines.

Keywords: forests; fertilizers; pines; cultivation techniques; optimization; nutrients; land reclamation; soil chemistry; surface mining.

120 Acid Forming Minerals in Overburden and Lignite as They Relate to Successful Reclamation. Dixon, J.B. (Texas A and M Univ., College Station , TX, 77843). **Project number:** TEX06351. **Contract:** TEX06351. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$25,000.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives will be to: (1) identify the location of acid producing minerals in the overburden and in the lignite beds of the major geological formations of Texas having a potential for strip mining; (2) characterize the acid producing minerals in terms of species, external morphology, surface area and reactivity; (3) determine minerals present in representative mine spoil and lignite overburden materials and characterize their properties during acidification; (4) monitor active or pilot strip mining operations in the state to determine acid production of spoil and potential of leveled spoil for revegetation; and (5) make recommendations regarding proper management of strip mine spoil to maximize the opportunity for successful reclamation and the return of the disturbed land to production agriculture. The study will involve an integrated laboratory and field study. Identification and characterization of pyritic minerals will be made in the laboratory on samples taken from the field. Field samples will be from areas where field reclamation and revegetation studies are being conducted. Additional samples will be collected from corings of potential mining sites.

Keywords: minerals; overburden; lignite; land reclamation; geologic formations; texas; spoil banks; revegetation; chemical analysis; coal mines; surface mining.

121 Histopathology of Marine Fish, South Texas OCS Monitoring and Environmental Studies. Haensly, W.E. (Texas A and M Univ., College Station , TX, 77843). **Project number:** TEXV-0401. **Contract:** TEXV-0401. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will investigate and report the microscopic anatomy and histopathology of 2 species of marine fish in the Gulf of Mexico and determine the histopathologic effects of exposure of fish for the drum family (Sciaenidae) to water soluble fractions of Southern Louisiana crude oil. Organ samples were taken from fish collected by other trawl in the Gulf of Mexico and processing began immediately using routine histological procedures. Tissue samples were fixed in formaldehyde and Helly solution, imbedded in paraffin, sectioned and stained with hematoxilyn and eosin.

Keywords: fishes; texas; offshore operations; monitoring; pathological changes; petroleum; toxicity; gulf of mexico; formaldehyde.

122 Chemical and Mineralogical Characterization of Lignite Overburden. Dixon, J.B. (Texas A and M Univ., College Station, TX, 77843). **Project number:** TEX-807-15-15. **Contract:** TEX-807-15-15. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) describe the profile characteristics and chemical, physical, and mineralogical properties of representative soils and overburden strata overlying major lignite deposits; (2) identify overburden strata that possess those chemical, physical, and mineralogical properties that are conducive to revegetation and sustained productivity; (3) determine minerals present in representative soil and overburden materials on proposed lignite surface mine sites and characterize their properties as related to acidification and reclamation; and (4) develop and test a model designed to predict properties of mixed mine spoil using chemical, physical, and mineralogical properties of the major strata and their related depths.

Keywords: lignite; overburden; mineralogy; chemical properties; physical properties; soils; revegetation; coal mines; land reclamation; mathematical models; coal mines.

123 Effect of Mine Spoil Age on Growth and Chemical Properties of Loblolly Pine. Buckart, L.F. (Stephen F. Austin State Univ., Nacogdoches, TX, 75961). **Project number:** TEXY00019. **Contract:** TEXY00019. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$1,000.

Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to study the soil--plant nutrient and wood constituent relationships of forest trees growing on mine spoil derived from surface lignite mining and to determine the changes in these relationships as well as the mine spoil ages. Mine spoil of various ages will be analyzed to determine changes in plant nutrient concentrations related to weathering and leaching (aging) of the spoil. These data will be correlated with analysis of foliage and wood of naturally regenerated loblolly pine trees on these spoil banks to determine relationships among nutrient levels and lignin, cellulose, and hemicellulose, along with changes in these relationships with aging of the spoil banks.

Keywords: lignite; coal mines; land reclamation; revegetation; trees; spoil banks; growth; weathering.

124 Vegetation of Lignite Coal Mine Spoils with Forest and Agronomic Species. Lowry, G.L. (Stephen F. Austin State Univ., Nacogdoches, TX, 75961). **Project number:** TEXY07031. **Contract:** TEXY07031. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$7,000.

Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to; (1) characterize the physical and chemical properties of freshly mined and/or freshly graded spoils; (2) determine initial survival and height growth of several common native tree species planted on spoils characterized; and (3) determine the effects of fertilization on the survival and growth of species tested. Plots 50 by 160 feet will be established on lignite strip-mine spoils in East Texas. Each of the 25 plots will be planted with seedlings of the following species: sweetgum, European black alder, shortleaf pine, and loblolly pine. Half of each plot will be designated as a control area and will receive no treatment; the other seedlings will receive an appropriate fertilizer. The height of each surviving seedling will be measured at the time of planting; comparisons between control and fertilized plots will be made after one growing season.

Keywords: lignite; coal mines; revegetation; physical properties; chemical properties; spoil banks; pines; growth; fertilizers; trees; land reclamation.

125 Utilization of Legumes in Revegetation of Environmentally Stressed Arid Mine Spoils. Skujins, J.J. (Utah State Univ., Logan, UT, 84321). **Project number:** UTA00288. **Contract:** UTA00288. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$55,000.

Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) isolate, characterize and use as an inoculum rhizobia from native sources capable of efficiently fixing nitrogen in association with the selected legumes in environmentally stressed soils and arid climatic conditions; (2) identify, successfully cultivate and develop appropriate management procedures of useful native legumes in association with appropriate management rhizobia in the environmentally stressed strip-mining disturbed soils with or without the presence of forage grasses; and (3) determine whether non-native Medicago and Melilotus in association with appropriate rhizobia can be used in successful revegetation of disturbed, strip-mined lands.

Keywords: leguminosae; land reclamation; arid lands; coal mines; spoil banks; surface mining; nitrogen fixation; bacteria; cultivation; revegetation.

126 Reclamation of Strip-Mined Land by the Production of Certain Horticultural and Agronomic Crops. Morse, R.D.; Odell, C. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, 24061). **Project number:** VA0336915-1. **Contract:** VA0336915-1. **Supported by:** Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$21,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) determine the production and cultural techniques necessary for the economical production of certain agronomic and horticulture crops on reclaimed strip mine areas of the Appalachian mountain region; and (2) determine the degree of adaptation of certain species of ornamental plants to reclaimed strip mine spoil sites. Horticultural and forage crops which seem most feasible both economically and culturally will be grown on strip mine spoil sites using fertility treatments as indicated by soil tests and characteristics of the spoil. The use of straw mulch, sawdust and sewage sludge (readily available) will be used on horticulture crops. Quantitative data will include percentage survival, growth rates, and marketable yields. Qualitative evaluations will be made of color, taste, and other horticultural characteristics. Yields and nutritive values will be determined for the forage crops.
Keywords: land reclamation; revegetation; surface mining; coal mines; crops; agriculture; cultivation techniques; productivity; nutrients.

127 Soil Amendments and Tillage Regimes Influence on Productivity of Stripmine Spoils for Vegetables. Morse, R.D. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, 24061). **Project number:** VA0336923-1. **Contract:** VA0336923-1. **Supported by:** Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$14,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Objectives are to: (1) determine the value of organic amendments on soil condition and crop yield of stripmine spoils; (2) compare different tillage regimes as to their influence on soil condition and crop yield; and (3) ascertain the interactions between organic amendments and tillage regimes on soil condition and crop yield. Combinations of organic manures (cover crops and sawdust, or possibly straw) and tillage regimes will be established on two newly-deposited stripmine spoils. At regular intervals, certain chemical and physical properties of the mine spoils will be analyzed, and growth and yield of the cover crops will be measured to monitor improvements in soil condition. Finally, selected vegetable crops will be grown on all treatment plots during the concluding four months of the project to evaluate the influence of the management systems on vegetable yield and quality.
Keywords: surface mining; land reclamation; performance testing; plants; nutrients; soil chemistry; cultivation techniques; fertilizers; crops; productivity; vegetables; soil mechanics.

128 Air Pollution Interactions on Creep Plants. Tibbitts, T.W. (Univ. of Wisconsin, Madison, WI, 53706). **Project number:** WIS01947. **Contract:** WIS01947. **Supported by:** Wisconsin Univ., Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Studies will determine sensitivity of selected crop cultivars to ozone, sulfur dioxide and nitrogen dioxide alone and in combination, and evaluate extent of damage to these crops around a coal fired power plant in Central Wisconsin. Controlled fumigations will be undertaken in the Biotron under optimum growth conditions to determine minimum threshold dosages for fumigations of 1 to 8 hrs for carrots, mint, peas, turfgrass, and alfalfa. The threshhold levels for ozone, sulfur dioxide and nitrogen dioxide as separate pollutants and as mixed pollutants will be determined. Study of stomatal response of the separate cultivars during fumigations will be followed with porometer measurements and silicone rubber impressions. Crop injury around a new coal-fired power plant will be followed both through a series of 16 alfalfa plantings located in a uniform manner around the plant and through continuous monitoring of the atmospheric pollutants.
Keywords: air pollution; ozone; sulfur dioxide; nitrogen dioxide; fossil-fuel power plants; chemical effluents; environmental effects; crops; carrots; leguminosae; grass; alfalfa; synergism.

129 Coal-Fired Steam Plants: Human Environmental Exposure to Air and Water. Helmke, P.A. (Univ. of Wisconsin, Madison, WI, 53706). **Project number:** WIS02241. **Contract:** WIS02241. **Supported by:** Wisconsin Univ., Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will determine the effects and ecological implications of a coal-fired generating station on water quality through an assessment of the effects of alternative methods of flyash disposal and utilization on the contamination of ground and surface waters; and an investigation of the aquatic health and potential for accumulation of chemicals in the cooling lake and their implications to human health. Samples of flyash and flyash-soil mixtures will be leached in columns and the leachates analyzed. Ground water will be collected from monitoring wells around flyash disposal pit and analyzed. Soil water will be collected from fields receiving flyash and analyzed. Pozzolanic properties of flyash will be studied in laboratory tests. Emphasis is on the elements As, Se, P, S, B, Cr, Pb, Cd, Zn, Hg, and Be.
Keywords: fossil-fuel power plants; man; water quality; fly ash; air quality; arsenic; selenium; phosphorus; sulfur; boron; chromium; lead; cadmium; zinc; mercury; beryllium; health hazards; environmental impacts.

130 Revegetation of Coal Mine Areas. McNeal, B.L.; Halvoison, A,R. (Washington State Univ., Pullman, WA, 99163). **Project number:** WNP00244. **Contract:** WNP00244. **Supported by:** Washington State Univ., Pullman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) characterize chemical and physical properties of soils in the mining area; (2) determine levels of nitrogen, phosphorus, potassium, and the micronutrients necessary for adequate and sustained plant growth; (3) verify grass species and fertility levels with field plot studies; and (4) develop an ongoing soil fertility management program by correlating soil test results with greenhouse and field studies. The approach taken is to: (1) initiate soil sampling program; (2) conduct greenhouse studies involving major soil materials with several grass species; and (3) conduct field plot studies with several grass species and fertility levels following results of greenhouse studies.
Keywords: land reclamation; revegetation; coal mines; soils; soil chemistry; physical properties; nitrogen; phosphorus; potassium; nutrients; plant growth; grass; greenhouses; sampling; field tests.

131 Utilization of Solar Energy in Food Processing. Kranzler, G.A.; Henry, K.L. (Washington State Univ., Pullman, WA, 99163). **Project number:** WNP00403. **Contract:** WNP00403. **Supported by:** Washington State Univ., Pullman (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$13,000.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The research objectives are to: (1) characterize energy use of specific unit processes that are important to the food processing industry of Washington State; (2) characterize solar energy availability at representative locations that are important centers for food processing in the state; (3) determine the potential for solar energy use at specific processing sites and necessary energy storage capacities; (4) adapt existing processes or develop new processes that can efficiently utilize solar energy for food processing; (5) determine minimum thermal processing requirements of foods while providing reasonable safety margins; and (6) evaluate the safety, quality, and storage stability of food products processed with solar energy. Published literature, personal communication, and field data collection will be used to obtain data. Processing operations and solar radiation characteristics will be studied together to define appropriate solar collection and storage systems. Technical and economic factors will be evaluated for solar energy systems. Where process modification is needed to utilize solar energy efficiently, investigations into new or improved processes will be conducted. Equipment will be constructed and tested to evaluate these processes.
Keywords: food industry; food processing; washington; solar energy; technology assessment; solar process heat; feasibility studies; research programs.

132 Components of the Radiation Exchange over Natural and Disturbed Forest Lands in West Virginia. Tajchman, S.J. (West Virginia Univ., Morgantown, WV, 26506). **Project number:** WVA00014. **Contract:** WVA00014. **Supported by:** West Virginia Univ., Morgantown (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$43,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

This study will: (1) establish basic criteria for evaluating radiation climates of selected cover types in areas of complex terrain; (2) determine characteristic temporal variability of radiation components at a bench-mark climatological station under standard conditions; analyze terrain to establish elevation, slope-aspect, and view-factor criteria for predicting radiation fluxes for individual terrain elements; (4) analyze surface and cover-type properties that affect radiation fluxes; (5) measure radiation components on selected days over natural forest cover on north- and south-facing slopes and typical light- and dark-colored coal mine spoils; and (6) develop a computerized model for simulating radiation fluxes over natural and disturbed terrain segments based on site parameters and measurements at a bench-mark station. All weather instrumentation will be

installed at the University Forest Climate Station to record and totalize the components of radiation exchange. These data will be used to characterize diurnal, seasonal, and weather-related variation in the radiation climate, and for comparison and prediction of radiation fluxes for other terrain elements and cover conditions. Two areas will be selected for terrain analysis in the general vicinity of the University climate station, one in natural forest cover and one in which barren coal mine spoils exist. Ten sites will be selected in each area.
Keywords: west virginia; climates; solar flux; seasonal variations; surface mining; coal mining; land reclamation; environmental impacts.

133 Successional Development from Grasses to Forests on Revegetated Strip-Mined Land in West Virginia. Smith, R.L. (West Virginia Univ., Morgantown, WV, 26506). **Project number:** WVA00015. **Contract:** WVA00015. **Supported by:** West Virginia Univ., Morgantown (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$12,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to determine the successional development of vegetation on revegetated strip mined lands. More specifically, the study will seek to: (1) determine the actual longevity of grasses on these sites; (2) determine what woody species invade the site once the initial grass cover is established; (3) determine what competitive interaction exists between the grass and colonizing woody species; (4) determine the influence of pH and the concentration of toxic elements on succession; and (5) determine how fast these sites are colonized by woody species and nature of community development. Sites chosen will have been revegetated within the past 10 years, have had the bond lifted, have subsequently been abandoned, and are not now under management. There will be three subsets: strip mine sites abandoned 10 years ago; strip mine sites revegetated under the 1967 law; and those revegetated under the 1972 regulations.
Keywords: west virginia; surface mining; coal mines; land reclamation; revegetation; grass; forests; ph value; abandoned sites; ecology.

134 Reclaimed Surface Mines as Possible Broad Range of the Wild Turkey in Pennsylvania. Samuel, D.E. (West Virginia Univ., Morgantown, WV, 26506). **Project number:** WVA00169. **Contract:** WVA00169. **Supported by:** West Virginia Univ., Morgantown (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to: (1) evaluate the use of food and cover by imprinted turkey poults on different reclaimed surface mines in Pennsylvania; and (2) survey different reclaimed surface mines in Pennsylvania prime turkey range to evaluate their use by adult birds. Imprinted birds will be taken to two reclaimed mines and two control sites. Items eaten per minute will serve as an index for comparing study areas for feeding efficiency. Cover will be determined by recording how many poults can hide themselves within five seconds of a distress call. A vegetation analysis will be conducted for each area. Monthly field observations will be made to determine use of reclaimed mines by adult wild turkeys. This will be accomplished by actual observations, gobble counts, droppings, and other identifiable turkey signs in cooperation with Pennsylvania Game Commission.
Keywords: surface mining; coal mines; pennsylvania; fowl; food; ecology; revegetation; land reclamation.

135 Mine Spoil Potentials for Plant Growth and Water Quality. Smith, R.M.; Sencindiver, J.C. (West Virginia Univ., Morgantown, WV, 26506). **Project number:** WVA00217. **Contract:** WVA00217. **Supported by:** West Virginia Univ., Morgantown (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) determine certain physical and chemical properties of coal overburden strata that influence suitability of stripmine spoil for plant growth, soil formation, and unpolluted runoff or seepage water; (2) determine rates of change by natural or induced weathering; (3) determine interaction between plants and properties of spoil and water; (4) determine effectiveness of plant cover, microorganisms and related practices in prevention of erosion and water pollution; and (5) improve precision of spoil classification. Core samples will be taken and analyzed for sulphur, carbonates, neutralizing capacity, mineralogy and available plant nutrients. Attempts will be made and identify the position of material in geologic sections in relation to coal horizons. Properties such as color, motteling, thickness of bedding textures, mineralogy, etc. will be studied. Spot plantings for special purposes will be tested. Erosion, sedimentation and water acidity and mineral content will be observed.
Keywords: spoil banks; coal mines; revegetation; water quality; overburden; physical properties; chemical properties; surface mining; plant growth; soils; runoff; weathering; plants; microorganisms; erosion; ph value; land reclamation.

136 Role of Microorganisms in Waste Disposal. Bissonnette, G.K. (West Virginia Univ., Morgantown, WV, 26506). **Project number:** WVA00244. **Contract:** WVA00244. **Supported by:** West Virginia Univ., Morgantown (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$46,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This study will concentrate on (1) anaerobic digestion for disposal of wastes generated in a family dwelling unit; (2) disposal of effluent and sludge from community sewage disposal plants; (3) generation of methane gas through the anaerobic digestion of animal manures; (4) aerobic composting of manures; (5) soil applications as a waste disposal system for industrial waste materials; (6) disposal of acid mine drainage; and (7) disposal of industrial wastes in aquatic environments. Laboratory and field experiments will be conducted of waste applications in aquatic and edaphic ecosystems. Systems will be evaluated for their microbiological populations and biological activity. Environmental factors will be manipulated to estimate optimum conditions for biological activity. Effects of toxicity, synergism, and antagonism within the populations will be investigated.
Keywords: microorganisms; anaerobic digestion; waste disposal; methane; manures; agricultural wastes; industrial wastes; acid mine drainage; aquatic ecosystems; composting; technology assessment; toxicity; synergism; physiology.

137 Conversion of Feedlot Waste into Single Cell Protein Animal Feed. Tengerdy, R.D. (Colorado State Univ., Fort Collins, CO, 80521). **Project number:** COLV02879. **Contract:** COLV02879. **Supported by:** Colorado State Univ., Fort Collins (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

Studies will determine whether agricultural waste can be a resource for feed and fuel production instead of a pollution burden. Animal manure represents the most concentrated and most abundant form of this resource. The main ingredients in feedlot waste are undigested cellulose and nitrogenous compounds. These ingredients may be converted to a valuable feed called single cell protein, or to fuel by microbial fermentation.
Keywords: single cell protein; animal feeds; agricultural wastes; waste product utilization; fermentation; cellulose; organic nitrogen compounds; biosynthesis.

138 Arid Land Strip Mine Reclamation. Lang, R.L. (Univ. of Wyoming, Laramie, WY, 82070). **Project number:** WYO069072. **Contract:** WYO069072. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$17,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) determine surface treatments, slopes, topsoil types and depths, mechanical and chemical treatments, and ecologically adapted plant species and selections that would maximize the reclamation results for land uses of reclaimed lands; and (2) develop planning procedures and methods of establishing and improving native fauna habitat on disturbed mine lands. Plant species, topsoil depth, and treatments will be studied on various types of disturbed mine sites to test their effects on the reclamation potential. Combinations of native fauna habitat, its composition, establishment, and design will be tested under the different climatic and edaphic conditions existing in the mining areas of Wyoming.
Keywords: surface mining; coal mines; land reclamation; soils; plants; wyoming; terrestrial ecosystems.

139 Impacts of Coal Energy Development in N.E. Wyoming on Agricultural and Related Environment Aspects. Vanvig, A.; Bradley, E.B. (Univ. of Wyoming, Laramie, WY, 82070). **Project number:** WY000998-WS. **Contract:** WY000998-WS. **Supported by:** Wyoming Univ., Laramie (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$19,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) identify the nature and magnitude of land and water transfers associated with coal-energy development in northeastern Wyoming; (2) quantify the benefits and costs of coal mineland reclamation; (3) evaluate the potential impact of coal mines on the surrounding groundwater aquifer; and (4) estimate the impact on agriculture of alternative levels and types of coal-energy development. Data will be collected on land, water and mineral transfers and leases occurring between ranchers and coal development interests in northeastern Wyoming from public records, state agencies and personal interviews. Data on water demands, groundwater aquifers, and costs of mineland reclamation will be obtained from secondary sources. Productivity of reclaimed land will be determined from several reclaimed areas in the state. A linear program-

ming model will be used to estimate the impact of coal developments on agriculture.
Keywords: coal deposits; energy source development; wyoming; agriculture; environmental impacts; land use; cost benefit analysis; ground water; aquifers; leases; water requirements; land reclamation; coal mines; cost; productivity; mathematical models.

140 Revegetation of Surface Mined Areas. Hornick, S.B. (Dept. of Agriculture, Beltsville, MD, 20705). **Project number:** 1103-20770-001. **Contract:** 1103-20770-001. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$94,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop soil and crop management practices for establishing forage or other crops on land disturbed by surface mining to prevent soil erosion, or drainage water pollution, and produce useful ground cover. Field, laboratory, and greenhouse studies will be conducted to determine: the needs of the disturbed soil surface for lime, fertilizer, and organic amendments; management systems needed for regrading, soil preparation, and mulching for crop establishment; and adaptability of crop species and varieties to these disturbed sites. Site chemical and physical characteristics will be correlated with crop requirements for predictive purposes.
Keywords: revegetation; surface mining; coal mines; soils; crops; field tests; bench-scale experiments; calcium oxides; fertilizers; organic compounds; excavation; cultivation techniques; chemical properties; physical properties; spoil banks; land reclamation.

141 Impact of Strip-Mining and Reclamation on the Quality and Quantity of Water in Mined Areas. Pionke, H.B. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** 1302-20771-001. **Contract:** 1302-20771-001. **Supported by:** Pennsylvania State Univ., University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$52,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to identify key relationships that determine the quantity and quality of water in a mined area and then to generalize these relationships for application to other sites. The approach taken is to simulate mathematically the ongoing physical and chemical processes for a site, and then field test the simulations at the site. Specifically, the approach in sequence is: (1) simulate spoil bank hydrology using available data to predict the amount, travel times, and quality of water at the expermental site; (2) develop methods for determining field parameters needed to predict quantity and quality of subsurface flow and surface runoff; (3) field validate simulation models; and (4) generalize results to other sites and/or identify key areas where expanded research is needed.
Keywords: water quality; surface mining; land reclamation; environmental impacts; mathematical models; simulation; spoil banks; hydrology; runoff; coal mines; flow models.

142 Grain Drying with Solar Energy in the Humid South. Hartsock, J.G. (Univ. of Florida, Gainesville, FL, 32601). **Project number:** 3090-20594-025-A(1). **Contract:** 3090-20594-025-A(1). **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$69,000.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine technical and economic feasibility of using solar energy for grain drying in the warm, humid, southern part of the United States. The approach is to: conduct experimental solar grain drying tests to determine conditions necessary to prevent spoilage under adverse southeastern weather conditions; make an overall evaluation of the feasibility of solar grain drying in the Southeast and propose guidelines, especially in view of the high susceptibility of the grain to aflatoxin contamination, as well as other types of spoilage; and further improve the low-cost suspended plastic collector and develop extension-type construction plans for this revised design.
Keywords: solar drying; cereals; crops; southeast region; weather; feasibility studies; research programs.

143 Hydrology and Water Quality of Watersheds Subjected to Surface Mining. Hamon, W.R. (Dept. of Agriculture, Watershed Research, Coshocton, OH, 43812). **Project number:** 3305-20810-002. **Contract:** 3305-20810-002. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$270,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Hydrologic and water quality effects of surface mining for coal on watersheds in the North Appalachian area are assessed. Guideline data for assessing adequacy and costs of alternative methods of runoff, sediment, and water quality control, and permit costs are developed. Four watersheds on representative coal formations are fitted with requisite hydrologic instrumentation to obtain precipitation, runoff, spring flow, soil moisture, and water quality data for one year prior to and 3 years after commercial surface mining. Watershed soil, overburden material, and geology are characterized. Standard runoff and erosion plots will be located in the watersheds to obtain erosion and sedimentation information. Mathematical models are developed to predict the quantity and quality of runoff before, during, and after mining.
Keywords: surface mining; hydrology; water quality; watersheds; appalachia; runoff; sediments; moisture; soils; coal mines; mathematical models; cost; monitoring; overburden; environmental impacts.

144 Equipment and Structures for On-Farm Production and Utilization from Agricultural Wastes and Residue. Fischer, J.R. (Univ. of Missouri, Columbia, MO, 15201). **Project number:** 3402-20400-006. **Contract:** 3402-20400-006. **Supported by:** Missouri Univ., Columbia (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The obectives are to: (1) determine physical, biological, and chemical relationships that occur during anaerobic digestion of agricultural residues; (2) develop equipment, operating technology and management procedures for on-farm production of methane gas from agricultural residue; (3) develop a method whereby methane gas may be effectively utilized on the farm to replace the use of fossil fuel energy; and (4) evaluate the recycling of digester effluent as a source of fertilizer. Laboratory studies will be conducted using six, 20-liter model digester systems to evaluate agitation requirements, effects of antibiotics, and the effect of rations on anaerobic digestion of swine manure for biogas production. A 420-liter prototype digester will be used to study the effect of loading rate on biogas production. Also this unit will be used in a comparison study of mixed mesophillic digestion with plug flow digestion. The farm size digester will continue to be used for: defining management problems, verifying reliability of equipment and the automatic control system, maximizing gas production from recycled solids and conservation of energy, and evaluating energy and effluent utilization.
Keywords: agricultural wastes; anaerobic digestion; methane; biosynthesis; fertilizers; sludges; chemical reactors; antibiotics; swine; manures; loading rate; recycling; farms; waste management; waste product utilization.

145 Reclamation and Management of Strip-Mine Spoils in the Northern Plains. Power; Ries, R.E. (Dept. of Agriculture, Mandan, ND, 58554). **Project number:** 3605-20770-001. **Contract:** 3605-20770-001. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$476,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to evaluate the physical, chemical, and biological properties of strip-mine spoils, and develop methods of restoring productivity to such despoiled areas. Physical, chemical, biological, hydrological, and geological characteristics of spoil materials are determined in the field, laboratory, and growth chamber. Information obtained forms a basis for devising engineering, cultural, and agronomic practices to be investigated. Field plots are established to evaluate the effects of such factors as chemical amendments and fertilizers, organic and inorganic mulches, different geologic and soil materials, tillage and land forming, plant species and cropping sequence, and related factors on the restoration of productivity to despoiled areas. Results provide a basis for reclamation of despoiled areas in a semiarid climate.
Keywords: surface mining; coal mines; land reclamation; spoil banks; chemical properties; hydrology; geology; biological effects; fertilizers; humus; cultivation techniques; revegetation; arid lands; waste management.

146 Factors Affecting Productivity of Reclaimed Mined Land. Ries, R.E.; Hofman, L. (Dept. of Agriculture, Mandan, ND, 58554). **Project number:** 3605-207770-003. **Contract:** 3605-207770-003. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Objectives are to: (1) evaluate effects of thickness and quality of replaced soil material on production of several crops; and (2) determine effects of grazing on soil, plant and animal performance. Several crop species are being grown on reclamation spoils covered with variable depth and quality of soil material; and resulting plant growth, water and nitrogen balances, and salt movement are being monitored. Definition of water movement near and across soil-spoil interfaces is being attempted. Revegetated mined land is being grazed at several intensities with steers, and effects on soil physical properties, plant stability, and animal performance are being determined.
Keywords: crops; nutrients; land reclamation; optimization; soil mechanics; plants; preferred species; animals; spoil banks; hydrology; revegetation; performance testing.

147 Protection of Soil Water, and Air Resources on Mined Land: New Land Reclamation Technology. Ries, R.E.; Sanduval, F.M. (Dept. of Agriculture, Mandan, ND, 58554). **Project number:** 3605-

20770-004. **Contract:** 3605-20770-004. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to develop technology that will ensure the protection of soil, water, and air resources associated with land disturbed by strip-mining. The approach will be to supplement ongoing mined-land reclamation research. Experiments are being conducted to determine: (1) the effects of disturbance by strip-mining on soil properties (aggregation, hydraulic conductivity, strength, nutrient availability, microbial activity, salt content and movement, etc.); (2) water balances, quality, and movement; and (3) effects on protection of air quality. From the information derived, various reclamation techniques are being evaluated to determine their potential for protecting these natural resources.
Keywords: surface mining; land reclamation; optimization; resource conservation; soil mechanics; air quality; coal mining.

148 Management of the Quantity and Quality of Surface and Subsurface Runoff from Distrubed Lands. Smith, R.E.; Woohiser, D.A. (Dept. of Agriculture, Fort Collins, CO, 80521). **Project number:** 5602-20770-003. **Contract:** 5602-20770-003. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$147,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to develop information and technology that can be applied to prevent or reduce erosion and surface water and ground water degradation caused by surface mining or other disturbances. Field studies will be initiated on surface mined lands in Colorado and Wyoming. Stream discharge measurements will be made and water quality and sediment samples will be analyzed to determine the contribution of dissolved and solid materials. Field and laboratory tests will be conducted to determine the erodibility of spoil materials and topsoil and weathering effects such as wetting, drying, freezing and thawing on physical and chemical properties. Field plots will be established using several adapted plant species and land surface modifications designed to control runoff and erosion and to enhance surface modifications designed to control runoff and erosion and to enhance plant establishment. Procedures will be developed to evaluate hydrologic effects of surface mining and to prepare environmentally effective mining plans.
Keywords: runoff; surface mining; land reclamation; stabilization; erosion; spoil banks; humus; weathering; soil mechanics; preferred species; revegetation; optimization; environmental impacts.

149 Grazing Management of Reclaimed Mined Lands. Booth, D.T. (Dept. of Agriculture, Cheyenne, WY, 82001). **Project number:** 5609-20770-003. **Contract:** 5609-20770-003. **Supported by:** Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the effect of livestock grazing on the vegetation and soil of reclaimed mine lands. The approach will be to collect basic data on the effect of grazing on the soil compaction, water infiltration, forage production, species diversity, and erosion and the necessity for special management practices. Lands that have been revegetated with a mixture of forages will be grazed at various stocking rates. Forage quality, yield and groundcover will be monitored to determine the effect of grazing on regrowth and plant populations and animal gains will be determined. Exclosures will be established for baseline comparisons on forage production and soil factors. These studies would be cooperative with the University of Wyoming, Animal Science Department, and NRP 201109 at Cheyenne. Data obtained will be used in establishing a working model of grazing management of reclaimed lands. Species diversity information generated by associated projects could be used in this model to predict management requirements and alternatives for those species mixtures not being studied.
Keywords: land reclamation; surface mining; pastures; management; revegetation; soil mechanics; optimization; performance testing.

150 Heating and Cooling a Swine Farrowing House with Solar Energy. Winter, D.W. (Purdue Univ., LaFayette, IN, 47907). **Project number:** 7002-20400-014A(1). **Contract:** 7002-20400-014A(1). **Supported by:** Purdue Univ., Lafayette, IN (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: solar(100) **R and D categories:** Environmental effects assessment.

The research objectives are to determine the effectiveness of the Kansas State solar energy collector and storer in heating and cooling a swine farrowing shelter under Indiana conditions and observe effects of heating on control of infectious pathogens. The approach is to: (1) adapt the Spillman design and construction the collector-storage unit as attachment to existing Purdue farrowing shelter; (2) obtain data on temperature, energy, and air flow to determine system performance; (3) monitor swine health and determine rate of gain of litters; and (4) supply performance data to refine Spillman's model.
Keywords: animal shelters; solar space heating; swine; indiana; flow rate; monitoring.

151 Soil and Water Management Systems for Revegetation of Strip-Mine Soil. Bennett, O.L. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, 24061). **Project number:** 7811-20770-002. **Contract:** 7811-20770-002. **Supported by:** Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA-$28,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to develop agronomic systems for revegetation of spoil areas from strip mines with emphasis on economic suitability for massive use by mining companies. Field studies and limited laboratory and geeenhouse studies will be conducted on spoil materials. Variables will include those pertinent to seed bed establishment, seeding, fertilizer rates and timing, species selection, and potential value of forage for purposes in addition to land cover and reduced erosion.
Keywords: revegetation; surface mining; coal mines; spoil banks; field tests; land reclamation; bench-scale experiments; greenhouses; seeds; fertilizers; plants; erosion; agriculture; economics.

DEPARTMENT OF COMMERCE

11000 Bulk Measurements for Nuclear Safeguards. Jones, F.E. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 14501. **Contract:** EA-77-C-01-6010. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** NRC; DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to provide a common and accurate basis for bulk measurement of nuclear fuels and disseminate to industry, government, other countries and the International Atomic Energy Agency (IAEA). Qualities to be covered are mass, volume, flow, pressure, temperature and density of nuclear fuels and media containing special nuclear materials. The approach is: (1) to provide measurement standards and methodology for the bulk measurement of nuclear fuels and special nuclear materials; (2) to evaluate existing measurement systems to determine applicability to, and capability for, bulk measurement of nuclear materials; (3) to transfer state-of-the-art measurement systems and methodology to the field; (4) to provide on-site training and consultation on bulk measurements and conduct workshops and seminars; and (5) to conduct research and development in support of the objective. To date, tank volume calibration technology has a factor between 10 and 100; a tank volume workshop has been held in the field; the feasibility of making tank solution density measurements in the tank with an accuracy competitive with laboratory measurements has been demonstrated; a mobile flow calibrator has been built and demonstrated at a nuclear fuel cycle facility; an automated tank volume calibrator has been built; portable devices to enable inspectors to make on-site weighings of UF6 cylinders have been assembled; commercially available pressure transducers have been evaluated; and a Measurement Assurance Program for determination of mass of UF6 cylinders has been initiated which enables monitoring of the performance of nuclear fuel plant weighing systems.
Keywords: safeguards; nondestructive analysis; nuclear fuels; standards; calibration standards; volume; uranium hexafluoride; equipment; measuring methods.

11001 Venus Atmosphere Laboratory Studies of the Reactions of Sulfur. Herron, J.T. (National Bureau of Standards, Washington, DC, 20234). **Contract:** W13424. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). **Funding:** NASA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The chemical kinetics of the reactions of sulfur monoxide will be characterized. The SO will be generated by reacting atomic oxygen with COS or S2O. Mass spectromctry will be used to follow the reactions of SO. To date, the rate of recombination of SO to the dimer has been measured. The reaction is termolecular and complicated by the secondary reaction to form SO2 and S2O. The significance of the work with regard to energy is that it furnishes information in the possible reactions of the sulfur-oxygen system in the combustion of sulfur containing fuels.
Keywords: sulfur oxides; sulfur dioxide; mass spectroscopy; dimers; combustion; fuels; chemical reaction kinetics; dimerization.

11002 Quantification of Fossil Fuels by Mass Spectrometry. Sieck, L.W. (National Bureau of Standards, Bldg. 222, Washington, DC, 20234). **Project number:** 12204-5433408. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to develop a method for the screening and quantification of fossil fuels and petroleum products using mass spectrometry without resorting to time-consuming sample preseparation or fractionation; and (2) to explore the possible use of photoionization as an alternative to electron impact in measurements involving mass spectrometers directly interfaced with liquid chromatographs. This technique will be capable of fingerpainting and quantifying complex mixtures of hydrocarbons and as such could prove to be a valuable technique for environmental monitoring.

Keywords: fossil fuels; petroleum; mass spectroscopy; photoionization; coal; natural gas; screening; air pollution.

11003 Surface Analyses and Reactions of Particulate Pollutants. Powell, C.J. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 12202-5411456. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE.

Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to apply modern electron-spectroscopic methods of surface analysis; (2) to determine the surface composition of particular pollutants in the atmosphere; and (3) to determine the nature and rate of pollutant reactions and transformations that occur on particle surfaces. To date, XPS (X-ray Photoelectron Spectroscopy) has been used to characterize the surface of ensembles of particles collected from precipitate flyash from the Dickerson, Maryland, Power Plant, and urban dust collected from St. Louis, Missouri, and Anacostia, District of Columbia. Twenty-nine elements were identified in the samples. Analyses were compared with bulk analyses of the samples as well as with other surface techniques (SIMS and EDX). Elements present in concentrations of 100 to 1000 ppM were detected. Many of the elements were found to be localized on the surface and not distributed uniformly through the bulk of the material. Work has begun on attempting to use lineshapes in Auger Electron Spectroscopy to characterize the valence state of particulate elements.

Keywords: fly ash; particles; dusts; chemical composition; surfaces; chemical state; photoelectron spectroscopy; elements; adsorption; auger electron spectroscopy.

11004 Calorific Value of Refuse Derived Fuels by Bomb Calorimetry. Domalski, E. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 12204-5433405. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE.

Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop a constant pressure flow calorimeter capable of burning 25 kg of sample of refuse or RDF from which a calorific value could be derived. Project scientists consult and work with appropriate committees in ASME and ASTM. The thermal correspondence between calorimetric measurements carried out in the kilogram-size calorimeter and three gram-size calorimeters currently being used or under test will be established. The statistical problem related to sampling will also be examined so that test procedures developed for the kilogram-size calorimeter will rest on a sound statistical basis. Necessary equipment for the kilogram-size calorimeter has been purchased. A 30-ton hydraulic press has been used to prepare a 5-kg pellet suitable for testing. Design is complete of a medium sized, 25-g calorimeter and tests of a prototype instrument have been made.

Keywords: refuse derived fuels; calorific value; calorimeters; solid wastes; design.

11005 Standardization of Environmental Analysis Associated with Increased Energy Production. Hertz, H.S. (National Bureau of Standards, Chemistry A113, Washington, DC, 20234). **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant measurements technology.

The objective of this program is to provide standard materials for use in the quality assurance programs of the Office of Health and Environmental Research contractors (and others) in order to increase the reliability and accuracy of analyses of environmental samples associated with increased energy production. Furthermore, in carrying out this program, a group of experts is assembled which can advise DOE on analytical methodology for trace-level organic compounds. Analyses are performed using state-of-the-art chromatographic and mass spectrometric procedures. To date, interlaboratory intercomparison studies have been performed on the analysis of various pure organic compounds dissolved in water and organic solvents at the part-per-million level, and on the analysis of phenols, polynuclear aromatic hydrocarbons, and aza-arenes in shale oil. Current efforts are focused on coal liquids from the SRC II process and analyses of alternate fuel waste streams are planned.

Keywords: quality assurance; standards; organic compounds; trace amounts; chromatography; mass spectroscopy; polycyclic aromatic hydrocarbons; comparative evaluations; phenols; shale oil; coal liquids; environmental materials; solvent-refined coal; chemical analysis.

11006 Reference Data for Environment and Health. Gevantman, L.H. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 14430. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** DOC.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The purpose of this research is to provide the physical and chemical data bases required for the identification of environmental pollutants and hazardous materials and for the prediction of their transport, transformation, and ultimate fate in the environment. Through consultation and cooperation with relevant agencies (EPA, NIH, NIOSH, DOE, DOT, DOD, and others) categories of physical and chemical data important to the realization of national environmental and health goals are identified. Lists of chemical substances identified by EPA and other federal agencies are scrutinized for the adequacy of data needed as input to models describing their movement and fate in the environment. Data centers and individual experts are engaged by OSRD to compile and evaluate needed data when deficiencies are discovered. The data are published and otherwise disseminated in a way to reach the intended audience of users. This task currently emphasizes kinetic and thermodynamic data needed as input to models of the polluted atmosphere and of natural water systems, as well as spectroscopic data required for detection of such pollutants. Increasing attention is being given to physical and chemical properties of toxic chemicals.

Keywords: physical properties; chemical properties; data compilation; environmental transport; chemical reaction kinetics; thermodynamic properties; mathematical models; air pollution; water pollution; monitoring; spectroscopy; toxic materials; data acquisition; information systems.

11007 Trace Elements in Silicon. Garner, E.L. (National Bureau of Standards, A219/922, Washington, DC, 20234). **Project number:** 5518471. **Contract:** NASA JPL WO-8604. **Supported by:** Minnesota Mining and Mfg. Co., St. Paul (USA). Isotope Power Lab. **Funding:** NASA.

Related energy source: solar(100) **R and D categories:** Pollutant measurements technology.

An important determinant of the cost of solar cells is the quality of the silicon or other semiconductor used in their construction. The tolerable concentrations of impurities in silicon have been shown to be below one part per billion (10/sup -9/) in some cases. Measurements of concentration in this range are difficult to perform with accuracy. We have provided analytical quality control for JPL in these concentration measurements and have shown that in a large fraction of the samples examined, the values only agree with the manufacturers' to within a factor of two. Clearly there is a measurement problem to be resolved. Besides refining methods in both activation analysis and mass spectrometry, a proposal has been made to prepare and issue a silicon reference material of purity comparable to that required for large-scale photovoltaic applications. The availability of such a common material is an essential tool in the resolution of existing discrepancies in ultra trace-level analysis of silicon and in the development of new methods of analysis.

Keywords: silicon; activation analysis; mass spectroscopy; impurities; trace amounts; elements; silicon solar cells; quality control.

11008 NDE Applications. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 14180. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** DOD; DOT; EPRI/NASA/NRC.

Related energy source: Coal(40); oil and gas(30); nuclear fission(30) **R and D categories:** Pollutant measurements technology.

The objective of this task is to conduct research and development on nondestructive evaluation (NDE) measurement methods and techniques in response to specific application problems faced by other government agencies. Present work (FY 79-80) includes: (1) development of the theoretical basis, measurement techniques and calibration procedures which are needed in order to evaluate the technical feasibility of using acoustic emission signal analysis for characterizing active cracks and defects in power plant structures; (2) development and evaluation of improved NDE procedures for inspecting the girth welds in oil and gas pipelines; (3) evaluation of the procedures used and the data obtained in a round-robin ultrasonic testing program on reactor welds; (4) comparative evaluation of different types of neutron sources for neutron radiography; (5) evaluation of NDE methods for quality control of concrete and other building materials; (6) determination of relationships between metallurgical structure, mechanical properties and NDE measurements of aluminum alloy plate; and (7) consultation on realtime radiography for aerospace vehicle components. Some recently completed activities under this task include: (1) an appraisal of future standardization requirements for ultrasonic NDE (for DOD); (2)

development of ultrasonic instrumentation for medical diagnostics (for NIH); and (3) development of ultrasonic inspection techniques for nuclear reactor components (for NRC).
Keywords: nondestructive testing; research programs; evaluation; defects; power plants; neutron sources; quality control; concretes; mechanical properties; industrial radiography; ultrasonic testing; welded joints; building materials.

11009 Corrosion and Chemical Stability of Materials in Service Environs. Brinckman, F.E. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 12111. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** DOC; DOD.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

Coupled disciplines of microbiology and organometallic chemistry are directed to concurrently: (1) establish key biogenic metal-containing molecules involved in biotransformations or biodegradation of materials; (2) develop appropriate element-specific measurement methods allowing speciation of diagnostic trace metabolites in materials' service media; and (3) generate underlying data base of aquatic organometallic chemistry support both identification of toxic metal species and their rates of formation or transport. New trace speciation methods have been developed and applied for biocidal organotin molecules in laboratory and field saline media, and for host controlled release polymer (CRP) matrices of concern to marine antifouling technology. Routing, direct speciation, and quantitation for aquated organotins at ppB concentrations are achieved by combinations of high performance liquid chromatography (HPLC) automatically coupled with graphite furnace atomic absorption detectors (GFAA). Thereby, leaching rates of specific biocidal organotin molecules can be determined for CRP performance and environmental hazards. Further methods were developed extending HPLC-GFAA to tin-containing macromolecular characterization by size exclusion chromatography. The general capability of HPLC-GFAA to speciate other biogenic or man-made toxic organometal (loid)s at environmental concentrations in various technologies was shown in an interlaboratory study on fate of inorganic and methylarsenic herbicides in soil components employing NBS-developed HPLC-GFAA element-specific methods. Overall significance of the work lies in potential for reliable measurements quantifying extent and rates of formation of key (possibly toxic) element-containing species serving as diagnostics for environmental degradation or fate of technological materials of diverse compositions.
Keywords: corrosion; microorganisms; biochemistry; biodegradation; metals; organic compounds; toxicity; biological fouling.

11010 Energy Related Pollutant and Effects Monitoring and Associated Methods and Techniques Development. Gravatt, C.C. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 81.BCLa;BCLb;BCLc. **Contract:** EPA-IAG-D5-E684. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(70); oil and gas(15); oil shale(15) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop stationary source and ambient gas SRM's, particulate SRM's, and methods and instrumentation to improve analyses of particulates. In FY 1979, SRM's for NO2 in air, NO in N2, O2 in N2, sulfate/nitrate on glass fiber filters (GFF), and an urban air particulate were completed. SRM's for CO2 in air, SO2 in N2, x-ray fluorescence standards, Pb on GFF are under development. Sulfate particulate instrument, and particulate and anthropogenic carbon method development continues. The NBS program provides SRM's and methodology for data quality assurance in assessing environmental impacts of air pollutants from conventional coal combustion and advanced energy technology operations.
Keywords: air pollution; monitoring; pollution sources; nitrogen dioxide; air; nitric oxide; nitrogen; oxygen; sulfates; nitrates; filters; aerosols; aerosol monitoring; quality assurance; environmental impacts; coal; combustion; air pollution monitors.

11011 Energy Related Pollutant Measurement and Instrumentation Development. Gravatt, C.C. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 81BCKa;BCKb. **Contract:** EPA-IAG-D5-E684. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(65); oil and gas(25); oil shale(10) **R and D categories:** Pollutant measurements technology.

In order to evaluate the environmental impact of both expanded, conventional, and new energy technologies, measurement techniques and monitoring systems are required for the development of a compatible data base. The major objectives of these two program elements are to develop methods and instrumentation for measurement of energy related pollutants, and to provide data quality assurance on special field studies and analyses related to characterizing the levels of pollutants injected into the environment. Emphasis is on the development of advanced measurement methods for water pollutants associated with energy technologies.
Keywords: energy source development; environmental impacts; quality assurance; data acquisition; monitoring; air pollution; water pollution; land pollution.

11012 Energy Related Pollutant and Effects Monitoring and Associated Methods and Techniques Development. Gravatt, C.C. (National Bureau of Standards, Washington, DC, 20234). **Project number:** BCMa;BCMb. **Contract:** EPA-IAG-D5-E684. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(35); oil and gas(35); oil shale(10); geothermal(10); hydroelectric(10) **R and D categories:** Pollutant measurements technology.

The objective of the BCM element of this program is to develop energy related water pollutant Standard Reference Materials (SRM's) for the conventional fossil fuel mining and combustion (BCMa), and SRM's for advanced fossil fuel technologies (BCMb). The western areas of the U.S. are the primary focus of studies/activities in these elements, since the western states are already or will be seriously impacted by present or projected energy-related development activities. The Western Energy/Environment Monitoring Study (WEEMS) was initiated to provide an accurate multimedia data base keyed to air and water pollutants and surface effects associated with projected western energy resource developments. The SRM's developed in the BCM element will be provided to EMSL/Cincinnati in support of the WEEMS project as well as in support of EPA quality assurance programs.
Keywords: water pollution; standards; monitoring; fossil fuels; mining; combustion; energy source development; environmental impacts; quality assurance.

11013 Energy Related Pollutant and Effects Monitoring and Associated Methods and Technique Development. Gravatt, C.C. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 81-BCN. **Contract:** EPA-IAG-D5-E684. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The assessment of the effects of radionuclides on both a regional and national scale requires the comparability of empirical data generated by new energy industries as well as the existing nuclear power industry. The purpose of this program is to provide a scientifically valid reference point from which future radiological environmental degradation can be measured, and upon which rational policy decisions may be made. The overall objective of this program is to provide validated radiological environmental quality baseline data in those geographical areas where the impact of new energy development is or is projected to be of major importance to the environment. The specific objective of this element is to develop an optimum radiological monitoring program and to provide radiological pollutant quality assurance. Studies at NBS leading to the attainment of this objective include: (1) the improvement of radiological monitoring techniques; (2) the evaluation of presently used environmental radiological surveillance programs; and (3) the provision of standards for measurement of radionuclides. The end product of NBS efforts will lead to an environmental radiological surveillance program capable of meeting required analytical sensitivities and providing adequate assessment information in a cost-effective manner.
Keywords: radioisotopes; baseline ecology; data acquisition; nuclear industry; radiation monitoring; standards; environmental impacts.

11014 Building Infiltration Evaluation. Hunt, C.M. (National Bureau of Standards, National Engineering Lab., Washington, DC, 20234). **Project number:** 7426543. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The purpose of this project is to obtain weather-correlated air-exchange-rate data on large buildings which will permit development and validation of predictive calculations for the air-exchange component of building energy demand. A by-product of this study is to determine whether current or reduced ventilation levels provide sufficient outside air for human safety. A study of the National Bureau of Standards' Administration Building was completed and reported during the last year. It showed that inside-outside thermal differences had very little effect on air exchange rate, which is the opposite of what some might expect. It also showed that the forced ventilation system, even with outside dampers sealed, contributed more to air exchange rate than natural infiltration. Three new tasks are in progress. These are: (1) to provide an automated air exchange measurement system as part of a University of Glasglow study of a large building, under the International Energy Agency auspices; (2) to provide similar instrumentation for the Park Plaza Building, a 26-

story office building in Newark, NJ; and (3) to develop fan pressurization equipment to measure the tightness of large buildings.
Keywords: office buildings; energy demand; air infiltration; ventilation; blowers; measuring instruments.

11015 Reactor Control Room Infiltration. Hunt, C.M. (National Bureau of Standards, National Engineering lab., Washington, DC, 20234). **Project number:** 7424419. **Contract:** AR(49-24)-0105. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The control rooms of nuclear power plants are designed so that in case of emergency they can be shut off from their surroundings and operated with recirculated air or air which has been treated to remove contaminants. This project is set up to assess the applicability of SF6 methodology and to assess leak tightness of control rooms and their associated duct work.
Keywords: power reactors; control rooms; ventilation systems; leak testing.

11016 Nuclear Materials Safeguards Studies. Schleter, J.C. (National Bureau of Standards, B109/245, Washington, DC, 20234). **Project number:** 14510. **Contract:** EA-77-C-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective is to support DOE and IAEA safeguards programs with systems analysis studies aimed at most effective use of data and information from all sources for achieving safeguards goals. Results directed to theory of safeguards information use and to manuals and instruction for implementing R and D results when performing safeguards. Contributions made to firm technical basis for: (1) design and development of DOE plant programs for protecting special nuclear materials against diversion, and (2) development and evaluation of IAEA safeguards approaches for detecting nuclear material diversion at facilities under international safeguards. The effort has been directed to the conceptualization of an overall safeguards information system (CSIS). Some components of the CSIS have been developed sufficiently to permit field testing. Chief among these is the systematic procedure, termed Diversion Path Analysis (DPA), that serves to direct a detailed examination of all conceivable possibilities for diverting material from domestic nuclear processing plants. Potential weak points in the plant material control and material accounting systems are thus identified and suggestions for remedial actions given. The DPA methodology is being extended to address international safeguards and serve as the basis for evaluating safeguards approaches implemented by the IAEA at specific facilities.
Keywords: safeguards; systems analysis; nuclear materials diversion; nuclear materials management; evaluation; vulnerability.

11017 Applied Mathematics for Nuclear Safeguards. Liggett, W.S. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 14504. **Contract:** AT49-25-9009. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

This work applies mathematics and statistics to the nuclear safeguards mission of NRC. Mathematics and statistics are needed to: (1) formulate valid yet simple step-by-step procedures for meeting NRC material accounting regulations; (2) optimize the measurement protocols that are part of measurement assurance programs; and (3) design experiments and interpret data. This work involves two approaches: development of statistical methods and consultation with NBS scientists.
Keywords: safeguards; mathematics; statistics; errors; nuclear materials management; accounting; data analysis.

11018 NDA Measurements for Nuclear Safeguards. Schrack, R.A. (National Bureau of Standards, Radiation Physics B119, Washington, DC, 20234). **Project number:** 14503. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** NRC; DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide a common and accurate basis for the non-destructive assay of nuclear fuels and disseminate to industry, government, other countries and the IAEA. This will be done by providing reference methods, reference materials and by evaluation of data. To date programs have been initiated and significant progress made in providing calibration standards in calorimetry for plutonium measurements and in producing uranium enrichment standards for non-destructive analysis. Neutron radiography systems are being developed using both accelerator and reactor neutron sources that will provide information on both the distribution and amount of special nuclear materials. Measurements have been made to determine the half-life of isotopes of plutonium and liaison programs developed with the major national and international laboratories.
Keywords: safeguards; nondestructive analysis; calibration standards; calorimetry; plutonium; uranium; neutron radiography; standards.

11019 Chemical Measurements for Nuclear Safeguards. Carpenter, B.S. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 14502. **Contract:** EA-77-C-01-6010. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** DOE; NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide a common and accurate basis for the chemical and the isotopic analysis of nuclear fuels and disseminate to industry, government, other countries and the International Atomic Energy Agency (IAEA). Chemical and mass spectrometric methods to be covered include ion exchange chromatography, microchemistry, titrimetric assay, isotope dilution mass spectrometry and thermal ionization mass spectrometry and chemical ionization mass spectrometry. Materials to be covered include uranium, plutonium and thorium. Other objectives are to provide the research, development and dissemination of reference methods, reference materials and reference data for accurate chemical and/or isotopic analysis; analyze U.S. primary standards versus international or other for NDA; and support measurement assurance programs by providing characterization measurements, assistance, samples and data interpretation, e.g., suggested corrective action for SALE and IAEA.
Keywords: safeguards; nuclear fuels; chemical analysis; isotope ratio; mass spectroscopy; titration; isotope dilution; uranium; plutonium; thorium; nondestructive analysis.

11020 Radiological Pollutants Quality Assurance. Hutchinson, J.M.R. (National Bureau of Standards, Radioactivity Section, Building 245, Room C114, Washington, DC, 20234). **Project number:** 5325485. **Contract:** EPA-IAG-D5-E684. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$86,000.
Related energy source: Coal(25); oil and gas(25); nuclear fission(50) **R and D categories:** Pollutant measurements technology.

The aim of the project is to improve and assure the accuracy and reliability of measurements of environmental alpha-particle and gamma-ray emitting radioactivity generated by both fossil fuel power plants and new nuclear power and fuel-cycle plants. Traceability to the EPA Q.C. Laboratory Las Vegas for these materials will be established by making tests on their measurement capability. Standards and test samples will be produced for EPA distribution to their monitoring networks.
Keywords: quality assurance; accuracy; reliability; alpha particles; gamma radiation; nuclear power plants; fossil-fuel power plants; monitoring; standards; radioactivity; radiation monitoring; biological effects.

11021 State Radiation Measurement Standards. Eisenhower, E.H. (National Bureau of Standards, Building 245, Room C229, Washington, DC, 20234). **Project number:** 5300109. **Supported by:** National Bureau of Standards, Washington, DC (USA). **Funding:** DOC-$225,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objectives of this project are to monitor the needs of state radiation control programs with regard to achieving improved accuracy and uniformity in the measurement of ionizing radiation, and to develop an NBS program which will provide the standards and services required to satisfy the most urgent state needs. Information regarding needs in state programs will be obtained continuously through interaction with a special task force of state representatives. Considerable effort will be devoted to investigation of alternative mechanisms for dissemination of standards and for measurement assurance. Specific pilot programs will be conducted. Institutional arrangements will be studied, and the most promising methods will be selected and tried. Regional calibration laboratories will be investigated as a possible method for dissemination of national standards. Three pilot projects are underway, including a regional calibration laboratory in Illinois. Two reports were developed under contract.
Keywords: dosemeters; calibration; calibration standards; planning.

11022 Theoretical Dosimetry. Berger, M.J. (National Bureau of Standards, Radiation Physics Division; Center for Radiation Research, Washington, DC, 20234). **Project number:** 5331106. **Supported by:** National Bureau of Standards, Washington, DC (USA). Center for Radiation Research. **Funding:** DOC-$125,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to improve radiation meterology and to contribute to the safe and effective use of radiation in industry and medicine by: (1) developing a detailed theory and accurate calibration of the response of various radiation detectors (e.g., ionization chambers, thermoluminescent detectors, solid-state devices) to x-

and gamma-rays and to electrons; and (2) calculating absorbed-dose distributions in human beings (or representative phantoms) for the case of irradiation by x-ray and electron beams, radionuclide sources and environmental radiation. The research involves the following activities: (1) the evaluation, compilation and systematic preparation of scattering and absorption cross sections; (2) the development of mathematical transport theories, involving the numerical solution of the Boltzmann equation or the simulation of transport by random numbers (Monte Carlo); (3) the systematic large-scale calculation of transport problems with the use of computers; and (4) the organization and analysis of transport results, by scaling procedures and development of semi-empirical formulas.
Keywords: radiation detectors; nuclear medicine; industrial radiography; technology assessment; dosimetry; x radiation; gamma radiation; electron beams; man; phantoms; radioactivity.

11023 Traceability of NRC Reference Lab. Hutchinson, J.M.R. (National Bureau of Standards, Radioactivity Section, Building 245, Room C114, Washington, DC, 20234). **Project number:** 5325474. **Contract:** NRC-05-72-100 . **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$65,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

Under the terms of an agreement with the Nuclear Regulatory Commission, NBC conducts a measurements assurance program with the Health Services Laboratory to the National Radioactivity Measurements System. A formal agreement with the Nuclear Regulatory Commission titled Testing of NRC Reference Laboratory, specifies that 13 test samples will be provided annually to HSL and the values determined for these 13 samples must be within predetermined limits of the NBS values.
Keywords: radiation monitoring; nuclear power plants; personnel dosimetry; dosemeters; calibration standards; radiation protection.

11024 Provide NRC Support for Development of a Data Base for the Impending NRC Regulation Change in Connection with Testing of Neutron Personnel Dosimetry Performance. Schwartz, R.B. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 5323482. **Contract:** NRC-01-80-015. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$30,000.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

A data base was developed to assist the NRC in deciding whether to specify a moderated or an unmoderated 252Cf fission source for the irradiations to be employed in future tests of the performance of the suppliers of personnel-monitoring services. Calculations were performed of the neutron fields produced by various moderators, to arrive at moderator materials and thicknesses which will simulate the neutron fields encountered near reactors. An assembly incorporating the selected moderator will be constructed and the computed spectra checked by measurements. The radiation fields from this assembly will be used to study the response of current neutron personnel dosimeters, whose response as a function of neutron energy is known from measurements at NBS, and elsewhere. The results will lead to information on the extent of error in the dose-equivalent derived from the difference in the spectral distribution between the radiation field employed for the test irradiations and that likely to be encountered by personnel wearing the dosimeter in the vicinity of a nuclear reactor.
Keywords: nuclear power plants; radiation protection; personnel dosimetry; data; dosemeters; performance testing.

13000 OCSEAP (Outer Continental Shelf Environmental Assessment Program) Data Base Management Support. Audet, J.J. Jr. (NOAA, National Oceanographic Data Center, 2001 Wisconsin Avenue, Page Building 1, Washington, DC, 20235). **Project number:** Research Unit 362. **Supported by:** National Oceanic and Atmospheric Administration, Boulder, CO (USA). Environmental Research Labs. **Funding:** DOC-$450,000.
Related energy source: oil and gas(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives are to establish and service a marine environmental data base (accession of OCS (Outer Continental Shelf) data in computer-compatible forms); and to provide data products and summaries using computerized data application programs to NOAA, BLM, OCSEAP investigators and others involved in Alaskan OCS activities. All OCS data will be structured into a data base that can be effectively searched, manipulated, and retrieved. NODC (National Oceanographic Data Center) historical data and other non-OCS data pertinent to the project will be included. Investigators will be assisted in the development of computer-compatible data formats. Graphic and other data products will be provided upon request.
Keywords: seas; aquatic ecosystems; data acquisition; computers; alaska; continental shelf; computer graphics; data processing; baseline ecology.

13001 OCS Base Line Studies. Picciolo, A.R. (NOAA, Environmental Data and Information Service (EDIS), 2001 Wisconsin Avenue, NW, Washington, DC, 20235). **Project number:** 8E1639;8E1679;8E1643. **Supported by:** National Oceanographic Data Center, Washington, DC (USA). **Funding:** DOC-$30,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The Bureau of Land Management is sponsoring environmental baseline studies in U.S. continental shelf regions where lease areas will be offered to private corporations for oil/gas exploration. Each of these studies is being managed by different federal or non-federal agencies. Besides Alaska, which is reported separately, these studies are presently in the mid-Atlantic, Eastern Gulf of Mexico, off Southeast Texas, off Southern California and the Georges Banks area. The Bureau of Land Management desires that the data from all the OCS studies be centrally archived in a standard fashion to facilitate data retrieval common to the whole program and have specified in each of their contracts that data will be submitted to the NODC in NODC acceptable formats. NODC is maintaining close contact with the Project Managements in the several areas, distributing common formats to each Project Office, and negotiating new formats to each Project Office, and negotiating new formats where required. These data, when received by EDIS, are processed, inventoried and added to the appropriate data base.
Keywords: land use; alaska; gulf of mexico; atlantic ocean; data; information retrieval; aquatic ecosystems; fishes; continental shelf; aquatic organisms; hydrocarbons; water; baseline ecology; texas; california.

13002 Fate and Effects of Petroleum Hydrocarbons and Selected Toxic Metals in Marine Ecosystems and Organisms. Wolfe, D.A. (NOAA, Marine Pollution Office, RX4, Broadway Street, Boulder, CO, 80303). **Project number:** B7121406. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA..
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) synthesize existing information and identify research gaps on the fate and effects of toxic metals and petroleum hydrocarbons on subarctic marine ecosystems; (2) develop capability to standardize analytical techniques for hydrocarbons and toxic metals and to provide intercalibration and routine analytical services; and (3) study specific processes controlling the distribution transport and effects (both physiological and ecological) of petroleum hydrocarbons and selected toxic metals in the subarctic coastal marine ecosystems as an input to the assessment of the impacts of petroleum releases into this type of ecosystem and to development of water quality standards. In the context of the extensive environmental assessments of the OCS (particularly in Alaska) being conducted by NOAA for BLM, this effort is designed to study intensively those aspects of the marine ecosystem that are related to the responsibilities of EPA (regulation) and to NOAA (environmental monitoring and prediction). The existing capabilities within NOAA will be used primarily, but will be extended in the area of analytical techniques.
Keywords: environmental transport; environmental effects; petroleum; hydrocarbons; toxicity; metals; aquatic ecosystems; aquatic organisms; arctic regions; weathering; behavior; biological accumulation; biological models.

13003 Meteorological Interpretations and Prediction of Air Quality in the Western United States. Bass, A. (Environmental Research and Technology, Inc., 696 Virginia Road, Concord, MA, 01742). **Contract:** 03-6-02-35254. **Supported by:** National Oceanic and Atmospheric Administration, Research Triangle Park, NC (USA). **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of the project is the selection, evaluation, verification and application of a long-distance dispersion model to estimate the impact of energy development in the Four Corners area on the regional air quality. The new model system will be used to examine various meteorological, emission, plant siting, and plant characteristic scenarios in the area encompassed by the states of Colorado, Wyoming, Utah, New Mexico, and Arizona.
Keywords: meteorology; air quality; forecasting; western region; environmental effects.

13004 Air Pollution Studies. Niemeyer, L.E. (NOAA Meteorology Lab., Environmental Research Center, Research Triangle Park, NC, 27711). **Contract:** EPA-79-D-X0348. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Research and Development. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

NOAA personnel will conduct research in various aspects of air pollution meteorology and the application of meteorology and climatology to environmental problems. This will include continuing efforts to develop, evaluate, and validate air quality simulation models on all temporal and spatial scales; development and adaptation of new concepts and technologies for the inclusion in air quality models of the effects of topography, complex sources, and pollutant

removal and conversion processes; extensive use of the Fluid Modeling Facility for the physical modeling of atmospheric dispersion problems; development and evaluation of boundary layer models; development and improvement of air quality forecasting techniques; development and improvement of air pollution climatological techniques; determination of the relationships between air quality and the optical properties of the atmosphere; and description and examination of the relationships between pollutant emissions, air quality, and meteorology. Air quality model users will be provided access to the models through continued implementation of the EPA Users Network for the Applied Modeling of Air Pollution (UNAMAP).
Keywords: air pollution; air quality; meteorology; environmental effects; functional models; atmospheric chemistry; sulfur oxides; nitrogen oxides; hydrocarbons; photochemical oxidants; aerosols.

13005 Meteorological Research Development of Long-Range Atmospheric Transport Models. Randerson, D. (NOAA, Weather Service Nuclear Support Office, P.O. Box 14985, Las Vegas, NV, 89114). **Project number:** GK-01-02-03-01. **Contract:** EY-76-A-08-0351. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$45,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Atmospheric Science and Power Production is a book being prepared for DOE-OHER to update and replace the widely used Meteorology and Atomic Energy--1968. The book will contain 20 chapters authored by experts from government, universities, and the private sector. Consisting of four sections--Fundamentals, Atmospheric Physics, Atmospheric Chemistry, and Applications--the book will cover a variety of topics related to the fate of power plant effluents.
Keywords: mathematical models; air pollution; diffusion; data; meteorology; computer codes; earth atmosphere; chemical effluents; climates; weather; environmental transport.

13006 Atmospheric Transport and Dispersion of Pollutants and Related Meteorological Studies. Ferber, G.J. (NOAA, Air Resources Laboratories, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** RD840310. **Contract:** EX-76-AA-28-0004. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$500,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of the project are: to develop and verify models of regional and global atmospheric dispersion of pollutants and resulting population exposures; and to use these models to calculate pollutant concentration patterns resulting from existing or proposed power production facilities. The objectives will be accomplished by (a) developing trajectory models to calculate transport, diffusion, and deposition of pollutants using specially prepared meteorological data tapes; (b) using existing atmospheric tracers (e.g., Kr-85) to verify model calculations; (c) developing special tracers (e.g., perfluorocarbons) and release, sampling, and analysis procedures for use in model verification experiments; and (d) collecting world-wide atmospheric radioactivity data to study global scale dispersion-deposition processes.
Keywords: fossil-fuel power plants; chemical effluents; stack disposal; air pollution; earth atmosphere; environmental transport; mathematical models; diffusion; deposition; human populations; krypton 85; tracer techniques; organic fluorine compounds; nuclear power plants; radioactive effluents; data acquisition; meteorology; sampling; plumes.

13007 Marine Measurement Quality Assurance. Basileo, M.A. (NOAA, Test and Evaluation Laboratory, Code C652, Building 160, Room 300, WNYA, Rockville, MD, 20852). **Project number:** EPA-IAG-D5-E693-EA. **Contract:** B62315. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** EPA-$160,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to develop common techniques for the standardization and intercalibration of sampling and sample analysis in the marine environment and to permit intercomparison of marine environmental measurements and the pooling of data from several sources for more reliable predictions/assessments of energy production and its effects on the environment. In providing a national capability for marine monitoring responsive to national energy needs and to local environmental constraints, a Federal involvement to develop appropriate methodologies is necessary. High priority effort will be expended to establish adequate instrumental evaluation techniques, standards, calibration procedures and methodologies, and intercomparison of measurement capabilities for quality assurance of monitoring instrument systems. Results will include instrumental and procedural standards for laboratory and field use; assessment and presentation of quality status of methodologies used for characterizing the marine environment; and mechanisms for quantifying instrument and measurement performances such that field data acquired will have definable uncertainties.
Keywords: seas; sampling; monitoring; energy sources; environmental effects; standardization; calibration; measuring instruments; standards; pollution; aquatic ecosystems; water quality.

13008 Underway Water Sampling System. Polanin, B.P. (NOAA, National Ocean Survey, Engineering Development Laboratory, 6001 Executive Boulevard, Rockville, MD, 20852). **Project number:** EPA-IAG-D6-E693-DX. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** EPA-$300,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The purpose of the Underway Water Sampling System development project is to provide an effective shipborne system to measure those physical and chemical parameters which determine the identity, concentration, transport, and distribution of pollutants arising from energy activities in the marine environment. The system will be used to characterize background or ambient levels of pollutants from sources such as offshore oil rigs and thermal power plants, as well as dredging or mining activities on the continental shelf. The overall concept envisions a ship traveling at speeds up to 10 knots while continuously obtaining water samples and oceanographic measurements which are processed in real or quasi-real time. This four-year development effort includes: analysis, subsystem development, system integration, and at-sea testing. This includes the current/depth measurement subsystem. Basic products obtained consist of hardware and software for measuring the vertical current profile from an underway vessel. Before their measurement subsystem can be used operationally, additional work must be carried out to develop it for specific users. Funding will come from those users who plan to use the system. No work is planned for FY80.
Keywords: energy sources; pollution; ecological concentration; seawater; environmental effects; thermal power plants; continental shelf; mining; ships; monitoring; oceanography; measuring methods; sampling; hydrocarbons; oil spills; water pollution; environmental transport; measuring instruments.

13009 Outer Continental Shelf Bathymetric Mapping Program. Fefe, C.X.G. (NOAA, National Ocean Survey, 6001 Executive Blvd., WSC-Z, Rm 199, Rockville, MD, 20852). **Project number:** R32301. **Supported by:** Bureau of Land Management, Washington, DC (USA). Div. of Minerals Environmental Assessment. **Funding:** DOI-$99,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

The objective is to prepare 1 : 250,000 scale bathymetric maps for the Bureau of Land Management requested areas of interest. The objective is being accomplished through the detail contouring of NOS or other reliabile data available. The primary products are reproducible map positives as requested by the Bureau of Land Management, which include the BLM Lease Blocks. Maps are primarily used by BLM in developing environmental impact statements for the sale area.
Keywords: atlantic ocean; continental shelf; meteorology; oceanography; data compilation; usa; maps; oil spills; economics.

13010 Ocean Oil Spill Concentration and Trajectory Forecast. Barrientos, C.S. (NOAA, National Weather Service, W427, Silver Spring, MD, 20910). **Project number:** BC6902. **Contract:** BC6902. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$150,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The main objective of this project is to develop a numerical model to predict ocean oil spill trajectories and fate of oil spill in the marine environment. The model will be implemented and used routinely in the National Weather Service, NOAA. Forecast methods for variables not presently available will be developed. The variables include small scale surface wind field, water current, wind induced drifts, and wave transport. The project is divided into four major process classifications: (1) weathering, (2) spreading, (3) turbulent diffusion, and (4) transport or advection. All the contract works to six universities were completed and the final reports are being reviewed. A computer program for oil spill trajectory has been developed and implemented. The program is available for routine use in case of an oil spill. It uses the latest forecasts from NOAA's Limited Area Fine Mesh Model. An oil layer movement model was developed. A set of dynamic equations for the oil is solved with wind forcing on top and water current forcing in the bottom. This advanced oil spill model formulation will be included in the program. The nature of the final product will be a forecast of oil spill trajectories for different projection times. The product will be in printed format and video display.
Keywords: petroleum; seas; forecasting; mathematical models; oil spills; environmental effects; trajectories; water pollution; diffusion; planning; data; air pollution; meteorology; pollution; oceanography; control; monitoring.

13011 Shipboard Environmental Data Acquisition System (SEAS). Reynolds, R.R. (NOAA, National Weather Service, Room 215, Code W44, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** 8AA860300. **Supported by:** National Weather Service, Silver Spring, MD (USA). **Funding:** DOC.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to develop an automated meteorological/oceanographic observation system for use on board ships cooperating in the international marine environmental observation program. The approach includes (1) developing an engineering model (SEAS-1); (2) operationally testing and evaluating SEAS-1 on the NOAA Ship Researcher and a MARAD ship; (3) developing and integrating with SEAS-1 additional sensors, e.g., automated expendable bathythermographic system; (4) developing and fabricating prototype systems and testing aboard a variety of commercial vessels; and (5) preparing procurement specifications for operational SEAS systems. The result expected is a fully automated environmental data observing system for shipboard use.
Keywords: environment; monitoring; data compilation; weather; meteorology; oceanography; ships; data acquisition; sampling; oil spills; data acquisition systems; performance testing.

13012 Experiments to Measure the Effects of Biofouling and Corrosion on the Performance of Heat Transfer Surfaces. Spiehler, F.A. (NOAA, Data Buoy Office, NSTL Station, Bay St. Louis, MS, 39529). **Project number:** EG-77-A-1078 (2), (3), (4). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE-$1,348,000.
Related energy source: solar(100) **R and D categories:** Pollutant monitoring.

The primary objective of the project was to determine the rate of biofouling and corrosion buildup on OTEC (Ocean Thermal Energy Conversion) evaporator tube sections at a candidate OTEC site in the Gulf of Mexico and to assess the deterioration of heat transfer through the tube sections as a function of the biofouling and corrosion process. As a secondary objective, initial baseline environmental data was collected. A large deep ocean data buoy was outfitted with experimental OTEC heat exchanger sections for evaluation of the buildup of corrosion and biofouling files in the tubes under various flow conditions of warm oceanic surface water at a candidate OTEC site in the Gulf of Mexico. In addition, monitoring of surface atmospheric conditions and water chemistry was conducted through use of meteorological and water quality indicator instrument systems installed on the buoy. All data was collected automatically and relayed ashore for analysis of heat transfer co-efficients and assessments of fouling film developments. Macrofouling sample panels was installed at all levels in the water column and recovered for toxonomy analysis ashore. The buoy was deployed for 14 weeks of tests in FY 1979. Results of microbiological growth were obtained. The buoy was recovered. Tests were conducted to include copper, nickel, stainless steel, titanium, and aluminum internal corrosion and aluminum external corrosion. The final report of FY 1979 test phase will be provided to DOE by March 1980.
Keywords: ocean thermal power plants; biological fouling; corrosion; evaporators; gulf of mexico; heat exchangers; heat transfer; buoys; tubes; water chemistry; meteorology; films; test facilities; copper; nickel; stainless steels; titanium; aluminium; performance.

13013 Boundary Layer Wind and Turbulence Prediction. Gilhousen, D.B. (NOAA, National Weather Service, Room 806, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** RC2901. **Contract:** EY-77-A-09-1007. **Supported by:** Department of Energy, Aiken, SC (USA). Savannah River Operations Office. **Funding:** DOE-$40,000.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this program are to develop, implement, operate, and evaluate an automated system to predict boundary layer wind and turbulence parameters for an instrumented TV tower near the Savannah River Laboratory's nuclear reactor site; and to use the Model Output Statistics (MOS) technique to develop statistical regression equations to predict winds (u and v components and speed) and turbulence parameters for differing levels on the TV tower. These forecasts will be based on the output from a complicated numerical prediction model and surface weather reports. Objective wind and turbulence forecasts are produced twice each day for periods of 6, 9, 12, 15, 18, 21, and 24 hours. These are then used at the Savannah River Laboratory to predict the transport of radiation in case of an accident.
Keywords: meteorology; wind; turbulence; velocity; forecasting; boundary conditions; earth atmosphere; automation; weather; measuring methods; savannah river plant.

13014 Ocean Thermal Energy Conversion. Vadus, J.R. (NOAA, Office of Ocean Engineering, 6010 Executive Blvd., Rockville, MD, 20852). **Project number:** EG-77-A-29-1078(1). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE-$2,199,000.
Related energy source: solar(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the project is to develop ocean engineering systems to assure the economic viability of a commercial OTEC plant. The ocean engineering program concentrates on the platform, sea water and stationkeeping subsystems of the OTEC plant. The general approach to each subsystem is the same. First, systems analysis studies are conducted to analyze the relative importance of all parameters involved in the design and development of the subsystem. Then, more detailed design and/or development studies are conducted to solve the related engineering problems. Laboratory model and field model test programs are then conducted to supply empirical data to validate mathematical models related to each subsystem's design. Data are analyzed and correlated to supply information useful to the final design and construction of each subsystem. A candidate CWP design will be constructed and deployed to supply at-sea data on their behavior. In addition, a laboratory program will be conducted on the behavior of model scale OTEC platform/cold water pipe/stationkeeping systems.
Keywords: ocean thermal energy conversion; engineering; economics; offshore platforms; systems analysis; ocean thermal power plants; mathematical models; pipes; design.

13015 NOS Strategic Petroleum Reserve Support Project. Frey, H.R. (NOAA, National Ocean Survey, 6001 Executive Blvd., Rockville, MD, 20852). **Project number:** EL-78-I-01-7146. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). **Funding:** DOE-$630,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis

Baseline oceanographic and meteorological measurements were conducted for 1 year at two sites off Louisiana by the National Ocean Survey in support of the Department of Energy's Strategic Petroleum Reserve Program. The principal objective was to characterize the sites prior to brine disposal. Each site consisted of 5 stations; the stations were positioned along a 10 n.mi. alongshore section and a 4 n.mi. transhore section. Each station consisted of recording current meters (speed, direction, temperature, conductivity) at 1m and 3m above the bottom mounted on subsurface platforms. Wave and water level gages were affixed to the center station platform. Recording meteorological packages (wind speed, direction, air and sea surface temperature, barometric pressure) were positioned on proximate oil production platforms. In addition to the time series data obtained from the recording instrumentation, monthly CTD casts and water samples were obtained at 7 stations per site and at 2 stations which were intermediate between the sites. The water samples were analyzed for dissolved oxygen by the micro-Winkler system and for salinity. Data quality statistics derived from calibrations, field checks and operating verifications, and recalibrations were compiled.
Keywords: strategic petroleum reserve; brines; waste disposal; petroleum; underground storage; louisiana; meteorology; oceanography; environmental impacts; site selection.

13016 Oceanographic Data Base, for OTEC. Churgin, J. (NOAA, National Oceanographic Data Center, 2001 Wisconsin Avenue, NW, Washington, DC, 20235). **Project number:** EX-76-A-29-1041. **Contract:** EX-76-A-29-1041. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Technology. **Funding:** DOE-$91,000.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to develop as complete a statement as possible of the required oceanographic data for OTEC from existing and updated archives. The approach follows: (1) expand present OTEC data base to include instrument measured current data; (2) provide priority processing for all appropriate OTEC project generated and archival data; (3) work with DOE and OTEC contractors to define data collection activities to augment historical data now available for OTEC application; (4) work with DOE and OTEC contractors in further defining types, forms, and formats of data presentations and products likely required for OTEC; (5) provide data and data products to DOE and OTEC contractors; and (6) prepare proposal for further development of OTEC data products and support services including data requirements for the pilot OTEC plant.
Keywords: ocean thermal energy conversion; data; oceanography; information; data compilation.

13017 Climatology and Oceanographic Analysis of the Georges Bank and California Regions of the Outer Continental Shelf. Godshall, F.A.; Williams, R.G.; Bishop, J.M.; Everdale, F. (NOAA, Marine Environmental Assessment Division, 3300 Whitehaven Street, NW, Page Bldg. 2, Room 162, Washington, DC, 20235). **Project number:** RE1206. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Los Angeles Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to compile and analyze historical physical oceanographic and meteorological information necessary to describe the characteristics of oceanic and atmospheric air circulation, and the distribution of water masses in the Georges Bank and the California Outer Continental Shelf regions. This information will be used in a physical oceanographic field program to assess the dynamical properties of the region that could have an effect on ocean pollutants resulting from possible oil and gas extraction. The project involves the design and production of required physical oceanographic and meteorological analysis products obtained from available federal sources and from other selected institutional files; identification of water masses, geographical positions of ocean fronts, and ocean surface circulation; and evaluation of data quality and applicability to produce accurate and meaningful descriptions of the oceanographic characteristics of the study area. The project will generate statistics of water masses, ocean fronts, ocean currents, maps of sea surface temperature, salinity, graphs of anomalies of temperature, salinity, nutrients, and surface wave characteristics. Meteorological information including wind roses, distributions of offshore wind trajectories, wind persistence, air temperature, humidity, visibility statistics, and storm climatology will also be obtained.
Keywords: continental shelf; georges bank; oceanography; meteorology; data compilation; data analysis; offshore drilling; environmental impacts; petroleum; natural gas.

13018 Ocean Currents and Thermal Observations for OTEC. Molinari, R.L. (NOAA, Atlantic Oceanographic and Meteorological Labs., 15 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** B3333318. **Contract:** EX-76-A-29-1041. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE-$457,000; DOC.
Related energy source: solar(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project objectives are to obtain ocean current and thermal data in the Gulf of Mexico to evalute both the impact of the OTEC plant on the environment and the impact of the environment on the OTEC plant, and to obtain ocean thermal and velocity data necessary to design an OTEC grazing plant for operation in the South Atlantic. Fifteen months of data were collected in the Gulf at one potential site, which resulted in less emphasis placed on this area. Twelve months of data were collected at another site and these are being synthesized. Data from three cruises to the South Atlantic are being analyzed.
Keywords: water currents; seas; ocean thermal energy conversion; temperature gradients; gulf of mexico; environmental impacts; atlantic ocean; moorings; buoys; site selection; resource assessment; ocean thermal power plants.

13019 Outer Continental Shelf Environmental Assessment Program. Engelmann, R.J. (NOAA, Marine Pollution Office RX4, Broadway Street, Boulder, CO, 80303). **Project number:** R7120815. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI; DOC; EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide environmental information necessary to assess the potential impacts of petroleum exploration, development, and production on marine ecosystems of the Outer Continental Shelf of Alaska. This includes pre-developmental environmental characterization for comparison with post-developmental conditions and characterization of potential sources, trajectories, transformations, and effects of pollutants on organisms and ecosystems designed for prediction of impacts. In-house and contract research projects are conducted on various aspects of chemical and physical oceanography, geological and seismic profiling, reconnaissance of populations of marine mammals, birds, fish, invertebrates, and microorganisms, and laboratory studies on transformations and effects of contaminants.
Keywords: continental shelf; environmental impacts; baseline ecology; alaska; petroleum; exploration; ecosystems; aquatic ecosystems; thermal pollution; water pollution; air pollution; noise pollution.

13020 OTEC Satellite Surface Thermal Resource Study. Maul, G.A. (NOAA, 15 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** RH1000-B3333319. **Contract:** EX-76-A-29-1041. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Environmental effects assessment.

This research is for the purpose of providing an analytic tool for synoptic, long-term assessment of thermal resource variations at sites of probable OTEC locations via satellite imagery, assessing the potential application of this technology to baseline studies of the environment at probable OEC sites, and assessing the impact of the plant on the environment after operations begin. The approach is to (1) conduct simultaneous ship/satellite experiments in the Gulf of Mexico to provide data with which to interpret spacecraft imagery; (2) develop a technique for obtaining accurate, regional-scale, sea surface temperatures from satellite radiometer measurements; and (3) interact with other OTEC scientific investigators for synergism of remote sensing technology with more conventional technology.
Keywords: ocean thermal power plants; resource assessment; site selection; ocean thermal energy conversion; satellites; aerial surveying.

13021 Temperature Tolerances of Benthic Marine Invertebrates and Their Relationship to Regulatory Requirement for Thermal Effluent. Ford, R.F. (Univ. of California, Sea Grant College Program, A-032, La Jolla, CA, 92093). **Project number:** R/E-23. **Contract:** 04-8-M01-189. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; SDSU.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The work will involve (1) studies of lethal and sublethal temperature tolerances; (2) studies of temperature selection by motile invertebrates; (3) long-term laboratory experiments duplicating effluent conditions; and (4) related field studies. These data, in combination with information from other studies, will be used in the evaluations. The regulation limiting thermal discharges to delta-T's of less than 4 degrees F at points where they touch the shoreline will be evaluated. Another major application of the data will be to evaluate use of across-the-beach discharge systems for thermal effluent. Lack of adequate information about temperature tolerances has, in some cases, led to the establishment of arbitrary and questionable regulatory requirements by the agencies concerned. Our evaluations will provide information directly applicable to this problem. The information obtained by also be valuable to these users as a basis for reconsidering existing requirements and the associated design of generating stations. We have developed experimental systems for studies of temperature selection by motile invertebrates and those for simulation experiments to determine effects of long-term exposure to fluctuating temperature conditions of thermal effluent. Several test species have been selected and experiments are underway.
Keywords: tolerance; biological stress; temperature effects; benthos; physiology; thermal effluents; water pollution; thermal pollution; pollution regulations; invertebrates.

13022 Effects of Oil on the Growth and Energy Utilization of Juvenile Pink Salmon. Shaw, D.G. (Univ. of Alaska, Chapman Building, Fairbanks, AK, 99701). **Project number:** R/02-07. **Contract:** 04-8-M01-189. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; UAK.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine the effect of ingestion of oil contaminated food on the ability of pink salmon to utilize the food toward growth and its influence on the growth efficiency of young pink salmon. In this study, exogenous factors will be held constant. The only difference will be the presence of oil in the food of the test fish. Growth will be determined as a change in weight and length with times, and as weight and length correlated to each other. The project will develop the information necessary to predict the viability of pink salmon should they be exposed to an area which has been contaminated by oil.
Keywords: animal growth; fishes; salmon; petroleum; hydrocarbons; metabolism; biological effects; food; contamination; oil spills.

13023 Evaluation of the Possible Detrimental Effects of Coal Storage Areas on Commercial and Sport Fishing in Lake Superior. Carlson, R.M. (Univ. of Minnesota, 1980 Folwell Avenue, St. Paul, MN, 55108). **Project number:** R/F-2. **Contract:** NA79AA-D-00025. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; UMN.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Laboratory studies on the adsorption characteristics of coal particles determination will be undertaken in the first-year. This portion of the program will involve a determination of the efficiency of sized coal to absorb PAHs, chlorophenols, and other organic compounds known to be present in water from the Duluth--Superior Harbor. In a two-year effort, bioaccumulation of organic compounds adsorbed onto coal particulates will be studied. Fish will be exposed to organic compounds adsorbed onto suspended particles of coal in a flow-through chamber to determine if particulates can act as a source of organic contaminant. The proposed research program is intended to utilize recent advances in the methodology for the analysis of trace organics in water and in fish tissue as an aid in helping to provide the basis for site selection criteria and design parameters to minimize adverse effects upon local fisheries by the present and future coal storage facilities in the Duluth--Superior harbor. The initial exploratory investigations conducted in these laboratories have focused on the leaching of PAHs from western coal destined for storage in the Duluth--Superior Harbor. The results from this study have clearly demonstrated that PAH intrusion from leaching is negligible.
Keywords: environmental impacts; coal industry; acid mine drainage; fishing industry; lake superior; water pollution; polycyclic aromatic

hydrocarbons; biological accumulation; fishes; contamination; leaching; storage; coal.

13024 Petroleum Hydrocarbons in the Sediments and Benthos of Lakes Michigan (Indiana Harbor) and Superior (Duluth Harbor). Andren, A.W. (Univ. of Wisconsin, 103 Hydraulic Lab., Madison, WI, 53706). **Project number:** R/MW-13. **Contract:** NA79AA-D-00125. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; UWI.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to measure the levels of selected aliphatic and aromatic hydrocarbons in extracts from sediments and organisms collected from the near shore area of Lake Michigan adjacent to the Indiana Harbor and from Duluth Harbor in Lake Superior; and to evaluate the levels of petroleum derived versus indigenous aliphatic and aromatic hydrocarbons in sediments and organisms at these locations. This investigation will provide information on the depth-distribution of petroleum hydrocarbons in sediment cores from Lakes Michigan and Superior and the concentrations of petroleum compounds in important benthic organisms. This information will be useful to regulatory agencies in assessing the extent of petroleum pollution in the Great Lakes and formulating procedures for controlling it. The analytical methodology for separating, identifying and detecting 16 polyaromatic hydrocarbons by a combination of solvent extraction and gas chromatography has been developed.
Keywords: lake michigan; lake superior; harbors; coastal waters; sediments; water pollution; oil spills; monitoring; benthos; ecological concentration; hydrocarbons; gas chromatography; solvent extraction.

13025 Social Impact of Offshore Oil and Gas Developments in Two Southeastern New England Communities. Hurwitz, J. (Woods Hole Oceanographic Inst., Woods Hole, MA, 02543). **Project number:** R/B-30. **Contract:** 79AA-D-00102. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; WHOI.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this project are: (1) to investigate, monitor, and analyze the developing impact of offshore oil and gas exploitation on the social, economic, and political fabrics of two coastal New England communities (North Kingstown, Rhode Island, and New Bedford, Massachusetts); (2) to identify local enterpreneurs and workers in onshore support services; and (3) to pinpoint both overt and latent sources of conflict over oil-related developments within the local communities. In this context of rapid socio-economic change, old and new marine interests may clash and interested parties may compete for opportunities. This data, derived from studies of the impact of North Sea oil exploitation upon a number of Scottish communities, will be compared. These comparisons will generate predictive hypotheses concerning types of community response to offshore developments and thus provide otherwise unavailable information about current socio-economic and political changes resulting from onshore participation in the offshore support and supply industries. Such information will be useful to planners, government agencies, oil industry members, and community members.
Keywords: offshore operations; offshore drilling; offshore sites; oil wells; natural gas wells; natural gas fields; oil fields; socio-economic factors; social impact; political aspects; communities; north atlantic region; comparative evaluations.

13026 Co-Oxidation of Petroleum Hydrocarbons by Estuarine Microorganisms. Cooney, J.J. (Univ. of Maryland, H.J. Patterson Hall, Room 1222, College Park, MD, 20742). **Project number:** R/P-2. **Contract:** NA79AA-D-00058. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; UMD.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The long-term goal is to understand mechanisms of microbiological transformations of materials in aquatic ecosystems. The specific objectives of this three-year proposal are: (1) to determine if the ability to co-oxidize hydrocarbons is prevalent among estuarine microorganisms; (2) to examine as co-substrates a number of model compounds representative of refractory components of petroleum; (3) to examine as potential substrates a number of compounds which might promote co-oxidation; (4) to study the physiological processes involved in co-oxidation; and (5) to establish the effect(s) of seasonal and environmental variation of co-metabolism. Established and emerging industries should benefit from the potential for improved treatment of waste-water effluents containing oils and other compounds which are degraded slowly in aquatic systems. All users of the bay, commercial and recreational, may benefit from improved methods for removing recalcitrant components of oil. Resource managers may be aided in decisions regarding permissible levels of pollutants and in future decisions about design of waste disposal systems.
Keywords: microorganisms; hydrocarbons; estuaries; aquatic ecosystems; physiology; metabolism; environmental impacts; water treatment; waste water; oxidation; petroleum; biodegradation.

13027 Oil Spill Clean-Up and Liability Models. Nyhart, J.D. (Massachusetts Inst. of Technology, Building E38, Room 329, Cambridge, MA, 02139). **Project number:** R/T-20. **Contract:** NA79AA-D-00101. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; MIT.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this study are to create a deterministic model of the existing and alternative systems for oil spill clean-up in the United States and a parallel optimization model to study the locating of emergency clean-up capability for small to moderate sized spills. The purpose of both is to provide a tool for analysis of options before policy makers. The study should be useful to several federal agencies (including Coast Guard, USGS, NOAA, EPA, and the Treasury), to state agencies and to private industry in ameliorating the problems of oil spill clean-up. An awareness is needed of the full costs to society entailed in present and future oil pollution. This model would provide necessary scope to identify those costs. Given use by federal and state agencies and the private sector, end benefits could include: (1) a better structured clean-up effort; (2) a data base for use by drafters of oil spill legislation; and (3) a more effective research effort in clean-up capability.
Keywords: oil spills; social impact; government policies; environmental policy; cleaning; optimization; decision making; national government; civil liability; water pollution.

13028 Role of Marine Bacteria in Dissolved Petroleum Persistence in Northern Ports. Button, D.K. (Univ. of Alaska, Chapman Building, Fairbanks, AK, 99701). **Project number:** R/41-01. **Contract:** 04-8-M01-187. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** DOC; UAK.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to monitor the rise in bacterial population and rates of oxidation attributable to hydrocarbon input in Port Valdez; to describe the metabolism kinetics for dissolved hydrocarbon concentrations and bacterial populations from hydrocarbon input rates; and to better understand the fate of hydrocarbons in the marine environment, which will lead to better management of the discharge of petroleum in marine environments.
Keywords: bacteria; metabolism; petroleum; biodegradation; biochemical reaction kinetics; environmental transport; oil spills; water pollution.

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20000 Industrial, Chemical, and Domestic Wastewater Processing. Lard, E.W. (Naval Ship R and D Center, Annapolis, MD, 21402). **Project number:** DN-310180. **Supported by:** Naval Sea Systems Command, Washington, DC (USA). **Funding:** DOD.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to develop and evaluate systems to abate water pollution from Navy ships and reduce the generation of wastewater by the fleet. Treatment/management systems for black-and-white photographic film processing fluids, i.e., removal of silver, recuperation and reuse of fixer and wash water, and reduced-flow shower system were evaluated and production design by service evaluation was verified. A system to recycle photographic wastewater has been developed and constructed. Laboratory evaluation of the system is in progress. Water savings of 1.1 liters/sq-ft of film developed are expected. The development of a reduced flow shower has resulted in an 80% reduction in shower fresh water usage.
Keywords: waste water; water pollution control; photography; ships; military facilities.

20001 Department of the Navy Solid Waste Management. Brunner, D. (Civil Engineering Lab., Port Hueneme, CA, 93043). **Project number:** 63721-Y0817. **Supported by:** Naval Facilities Engineering Command, Alexandria, VA (USA). **Funding:** DOD.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.
Keywords: solid wastes; waste management; military facilities; materials recovery; energy conservation.

20002 Direct Exposure of Monolayers of Mammalian Cells to Airborne Pollutants in a Unique Culture System. Rasmussen, R.E. (Univ. of California, Dept. of Community and Environmental Medicine, Irvine, CA, 92717). **Contract:** F49620-79-C-0083. **Supported by:** Air Force Office of Scientific Research, Washington, DC (USA). **Funding:** DOD.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This research will measure the toxic effects of nitrogen oxides, sulfur dioxide, and ozone on cultured mammalian cells. Cells will be exposed to atmospheres containing low concentrations of pollutant gases, organic vapors, and particulates. Exposures will be done in a novel cell culture system that permits exposure of cells to air pollutants in a manner almost identical to what occurs in the respiratory tract.

Keywords: animal cells; air pollution; toxicity; nitrogen oxides; sulfur dioxide; ozone; cell cultures; organic compounds; gaseous wastes; aerosols; bioassay.

20003 Environmental Fate of Hydrazine Fuels. Zirroll, J.A. (Air Force Engineering and Services Center, Tyndall AFB, FL, 32423). **Project number:** 19002013. **Contract:** 19002013. **Supported by:** Air Force Engineering and Services Center, Tyndall AFB, FL (USA). **Funding:** DOD.

Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Because of the increased use of hydrazine type compounds in rocket fuels and in monopropellant generators, it is necessary to understand the chemistry of these compounds in the environment subsequent to their release by spills, venting, or incomplete combustion. This data is necessary because of the toxic nature of these fuels and the requirement to assess the environmental effect of their use. The time dependent fate of these fuels will be determined in atmospheric, aquatic and terrestrial phases. The level of minor components which may be significant will also be determined. Infrared and mass spectral analysis are used to determine reaction rates and decomposition products.

Keywords: hydrazine; rockets; propellants; environmental impacts; atmospheric chemistry; ecosystems; combustion products; air pollution.

20004 Fuel Jettisoning by USAF Aircraft. Clewell, H.J. (Air Force Engineering and Services Center, Tyndall AFB, FL, 32403). **Project number:** 19004C02. **Supported by:** Air Force Engineering and Services Center, Tyndall AFB, FL (USA). **Funding:** DOD.

Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective of this study is to determine the nature and extent of fuel jettisoning by Air Force aircraft and to provide the basis for an accurate assessment of the environmental effects associated with this procedure. An Air Force-wide reporting system was established, and data on fuel jettisoning practices was collected for a three and one-half year period. To determine the physical fate of the jettisoned fuel, a computer model of fuel droplet free-fall and evaporation was developed, incorporating experimental results from a study of fuel jettisoning by a KC-135 tanker carried out at Edwards Air Force Base together with the Air Force Geophysical Laboratory. Two reports are in preparation. The first documents the droplet modelling and indicates that for jettisoning at altitudes above 1500 meters when surface temperatures exceed 10 degrees C, more than 98% of the fuel will evaporate before reaching the surface. The second report summarizes Air Force fuel jettisoning practices and analyzes their environmental consequences. The analysis indicates that current Air Force policies concerning fuel jettisoning are adequate to minimize any negative environmental consequences, and that Air Force operational practices are in keeping with these policies.

Keywords: aircraft; fuel management; droplets; mathematical models; air pollution; evaporation; environmental impacts; government policies.

20005 Environmental Implications of Alternate Fuels. Gleason, C.C. (GE); Troth, D.L. (DDA). (General Electric Co., Aircraft Engine Group/Detroit Diesel Allison, Cincinnati/Indianapolis, OH/IN, 45433/46206). **Project number:** 19002A49. **Contract:** F33615-78-C-2006. **Supported by:** Air Force Engineering and Services Center, Tyndall AFB, FL (USA). **Funding:** DD-$00,000.

Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.

The impact of broadened specification aviation fuels on gas turbine engine combustor performance, pollutant emissions, and combustor life will be determined. In FY 77 the AFAPL and AFESC began contractural fuel character effects studies. In these parametric studies up to 13 fuel blends with varying hydrogen content, aromatic structure, volatility, and distillation end point are burned in a variety of aircraft engine combustor types. Studies on the J79, F101, and TF41 combustion systems are complete. Tests on the lowsmoke J79 combustor will be completed in FY 80. Data analysis shows that fuel hydrogen content is a key fuel property, particularly with respect to high power emissions (oxides of nitrogen and smoke), and that low power emissions are more dependent on fuel atomization and evaporation characteristics.

Keywords: fuel substitution; synthetic fuels; environmental impacts; aviation fuels; chemical properties; combustion products; gas turbine engines; performance; exhaust gases.

20006 Toxic Hazards Research in Environmental Toxicology. Crocker, T. (USAF Aerospace Medical Research Lab., Wright-Patterson AFB, OH, 45433). **Project number:** 6302-01-15. **Contract:** F33615-76-C-5005. **Supported by:** Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). **Funding:** DOD.

Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Environmental effects assessment.

The objective of this program is to provide specific data and knowledge on the toxic properties of new materials, propellants, and other atmospheric contaminants used or encountered by Air Force personnel in the development, testing, and operational phases of new aeronautical, aerospace, missile, and orbital systems. The results will provide tolerance criteria, toxicological information, and design criteria for pollution abatement procedures and equipment. Emphasis is upon the applied inhalation research areas. Occupational inhalation exposures will be investigated. In addition, the effort shall provide definitive data concerning the environmental impact of selected Air Force materials through the use of representative aquatic and plant species. Chronic inhalation toxicity and oncogenic studies were carried out with fuel components methylcyclomesane and tricyclodecane (JP-10), and with purified (sans N-dimethylnitrosamine) 1,1,dimethylhydrazine in mice. A subchronic inhalation study was completed on Decalin. Eye and skin irritation potential was established for U.S. Navy antifouling agents DMP-1 and DMP-2, JP-5 jet fuel from both petroleum and shale sources, and the ramjet fuel JP-10. Emergency exposure limit experiments were completed on JP-10 and methylcyclohexane. Details are found in AMIL-TR-79-56.

Keywords: toxic materials; health hazards; inhalation; air pollution abatement; aquatic organisms; plants; petroleum; oil shales; jet engine fuels; organic nitrogen compounds; hydrocarbons; toxicity; eyes; skin; biological fouling.

20007 Pathological Mechanisms. Hall, A. (U.S. Air Force, Aerospace Medical Research Lab., Wright-Patterson AFB, OH, 45433). **Project number:** 6302-06-20. **Supported by:** Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). **Funding:** DOD.

Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The approach will be to: (1) describe by light and electron microscopy and to document the pathologic change seen following toxic injury in experimental animals; (2) integrate these changes with clinical chemistry and hematological changes, and then ultimately, to correlate these changes with cellular biochemistry; (3) perform morphometry on tissues and cells at the microscopic level; and (4) determine the efficacy of drugs used for treatment of intoxication by evaluation of change in animal tissues and blood. Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) studies on animals exposed to Decalin have been completed. SEM studies of animals exposed to UDMH have been completed. There were no lesions. Studies on rats infected with Mycoplasma Pulmonis have been completed. These resulted in an improved culture technique for quality assurance which will improve the quality of rodents used on studies. A study of the acure oral toxicity of nonadecafluorodecandic acid was completed. Significant lesions were produced in the thymus, bone marrow, liver, and testicles. A technique for the perfusion of rodent kidneys has been developed. This will provide better specimens for TEM examination. A thiocarbohydrazide technique for preparing SEM specimens without the use of sputter coating is also being developed. This should result in less charging of lung specimens. Electron microscopy support was provided to the IN studies of tomato plants exposed to HCl.

Keywords: pathological changes; biochemical reaction kinetics; toxicity; animal cells; blood; tissues; drugs; efficiency; rats; perfused tissues; hydrocarbons; optimization.

20008 No Pathology Threshold. Hall, A. (U.S. Air Force, Aerospace Medical Research Lab., Wright-Patterson AFB, OH, 45433). **Project number:** 6302-06-25. **Supported by:** Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). **Funding:** DOD.

Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to develop nationally recognized data on chronic inhalation exposure effects of volatile Air Force chemicals and to provide safe occupational exposure limits (threshold limit values) which constitute concurrence with the Occupational Safety and Health Act as directed by Executive Order. The approach will be to establish an acceptable, noninjury concentration of Air Force chemicals under subacute and chronic exposures for the primary target organs. The methods used will be gross, light microscopy, and electron microscopy of animal tissues exposed to the test chemicals. Hematological, clinical chemistry, microbiological, and immunological findings will be evaluated. Stringent quality control on animals used in subacute and chronic toxicology studies will be maintained. Histopathological examinations and final pathology reports have been completed for all animals exposed to Navy shale-derived JP-5.

Histopathologic studies have been completed on all animals exposed to decalin and emergency exposure levels of JP-10. One year exposures to methylcyclohexane and JP-10, and ninety-day exposures to shale-derived DFM (Navy) and JP-5 have been completed for a variety of laboratory animals. Tissues are currently being processed for histopathological study. Exposure of rats, mice, and dogs to JP-4 vapors is in progress, and exposure of similar species to RJ-5 began during October 1979 and will terminate in October 1980.
Keywords: pathological changes; inhalation; toxic materials; health hazards; animals; sensitivity; hydrocarbons; occupational safety and health act; implementation; rats; mice; dogs; threshold dose.

20009 Environmental Toxicology. Crocker, T. (USAF Aerospace Medical Research Lab., Wright-Patterson AFB, OH, 45433). **Project number:** 6302-04-17. **Contract:** F33615-76-C-5005. **Supported by:** Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). **Funding:** DOD.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The results of this program will serve as a data base for: (1) assessing the environmental effects of Air Force operations; (2) providing information essential in preparing environmental impact statements and assessments; (3) setting threshold limits under which the Air Force can operate within the spirit and intent of the National Environmental Policy Act; (4) defending the Air Force against unfounded claims of ecological damage; and (5) providing information necessary for development of decontamination and disposal methods. The approach will be to provide definitive data concerning the environmental impact of selected Air Force chemicals through the use of representative aquatic and plant species. Laboratory studies will simulate conditions in ecosystems that may exist during an inadvertent spill or in the presence of waste disposal chemicals. Studies using plants and aquatic animals will be acute or chronic toxicity studies or both types if the chemical and its use may result in such exposures in a real ecosystem. Terrestrial plants, algal systems, and aquatic animals have been studied. With respect to plants, the phytotoxicity of hydrogen chloride (HCl) gas and aluminum oxide (Al2O3) particulates was studied. With respect to the algal studies, both freshwater and marine algae have been used to investigate the toxic effects of hydrazine fuels. Batch bioassays have been completed for hydrazine, unsymmetrical dimethylhydrazine, and monomethylhydrazine.
Keywords: chemical effluents; toxic materials; accidents; waste disposal; plants; animals; aquatic ecosystems; missiles; terrestrial ecosystems; hydrochloric acid; aluminium oxides; aerosols; hydrazine; toxicity; air pollution; water pollution.

20010 Acute Fish Bioassay. Fisher, J.W. (USAF Aerospace Medical Research Lab., Wright-Patterson AFB, OH, 45433). **Project number:** 6302-04-18. **Supported by:** Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). **Funding:** DOD.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine the water pollution potential of aircraft fuels and lubricants, missile propellants and their exhaust products, and other Air Force materials that if in sufficient quantity could result in significant detrimental effects on the environment. Transient physiological changes in organisms and toxic effects up to fish kills can serve as indices of potential pollution of the aquatic environment. The results of these studies will serve as a data base upon which environmental impact statements and assessments can be made as they apply to weapon systems using these chemicals especially where they may possibly enter an aquatic environment. The approach utilizes experimental concepts developed in water pollution technology and fisheries biology. The applied conditions of these operational AF compounds and the types of test organisms to be utilized determine the methodology for experimentation. Propellant bioassays accomplished with guppies will be repeated using the fathead minnow currently and other fish species subsequently. The acute toxicity of hydrazine, UDMH, aerozine-50 and MMH, respectively, will be determined. Following the determination of acute toxic levels of these important compounds, the efficacy of various chemicals will be evaluated relative to reversing or reducing the toxicity to fish life.
Keywords: fishes; bioassay; aviation fuels; lubricants; water pollution; missiles; exhaust gases; hydrazine; toxicity; hydrocarbons.

20011 Bioassay in Soil Microorganisms. London, S.A. (USAF Aerospace Medical Research Lab., Wright-Patterson AFB, OH, 45433). **Project number:** 6302-04-19. **Supported by:** Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). **Funding:** DOD.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to utilize microbial systems for evaluating the potential environmental impact of various materials used in Air Force operations, such as missile propellants, aircraft fuels and lubricants, and other substances used in consequential amounts that could have acute and/or chronic environmental effects. Microbial cultures isolated from soil samples will be investigated concerning their responses to both acute and chronic exposure to potential environmental pollutants. Responses to be evaluated will include growth kinetics, bacteriocidal/bacteriostatic effect, physiological changes, genetic (mutation) effects, pollutant degradation or accumulation. This effort will establish no-effect levels for single and multiple cultures and will serve as both a laboratory test system and a means of predicting potential environmental consequences of inadvertant intrusion in soil and water of Air Force materials.
Keywords: bioassay; soils; microorganisms; propellants; environmental impacts; biological indicators; sensitivity; water pollution; land pollution.

20012 Evaluation of Efficiency of Juvenile Bypass Systems. Mains, E.M. (Corps of Engineers, Portland, OR, 97209). **Supported by:** Corps of Engineers, Washington, DC (USA). Office, Chief of Engineers. **Funding:** DOD.
Related energy source: hydroelectric(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purposes of this program are to determine effectiveness of turbine-gatewell juvenile bypass systems completed and operating at existing hydro projects, and to develop criteria for new slots and ice-trash sluiceways to permit trapped juvenile salmonids to escape. At other locations, special conduit systems have been installed to accomplish the same purpose. An evaluation of these systems to determine super saturated gases and to determine the relative safety of each system to fish passing through them is in progress. A report will be prepared in FY 1980.
Keywords: hydroelectric power plants; fish passage facilities; operation; salmon; safety; entrainment; hydraulic turbines; efficiency.

20013 Air Pollution Control Guidance for Army Boilers and Incinerators. Mikucki, W. (U.S. Army, Construction Engineering Research Lab., P.O. Box 4005, Champaign, IL, 61820). **Project number:** 4A762720A896-026. **Supported by:** Corps of Engineers, Washington, DC (USA). Office, Chief of Engineers. **Funding:** DOD.
Related energy source: Coal(75); oil and gas(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the work is to provide technical and economic guidance for planning, design, construction, operation, and maintenance of air pollution control systems at Army installations. Investigations are conducted to provide information on Army emittes and compliance status, and develop rational fuel strategies, boiler modifications and abatement technology to provide an integrated air pollution control capability. Draft interim guidelines for technical and economic selection of air pollution control devices has been prepared.
Keywords: air pollution control; incinerators; furnaces; sulfur dioxide; maintenance; design; construction; operation; planning.

20014 Oil Pollution Control at Military Installations. Fileccia, R.I. (Army Construction Engineering Research Lab., P.O. Box 4005, Champaign, IL, 61820). **Project number:** 4A762720A896-009. **Supported by:** Corps of Engineers, Washington, DC (USA). Office, Chief of Engineers. **Funding:** DOD.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to assess the source, magnitude and nature of POL contaminants discharged at military installations and to evaluate processes and methods for control of this contamination. Sources and magnitudes of discharges are identified, methods for control are evaluated, and guidelines will be published for use by facility engineers. Preliminary design and guidelines for POL control from tactical/combat vehicle maintenance facilities have been published and field tests have been initiated.
Keywords: petroleum; pollution control; military facilities; environmental impacts; vehicles; exhaust gases.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

33000 Evaluate Fibrous Aerosol Monitor and Personal Fiber Counter. Baron, P.A. (National Inst. for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** 484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$75,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of this project is to evaluate instruments for determining compliance with OSHA asbestos standard. Three instruments will be evaluated. The Fibrous Aerosol Monitor (GCA Corp) will be field tested at locations where OSHA personnel are making inspections. The Magiscan image analysis system (Vickers Instruments) will be purchased and evaluated as a reference instrument for the NIOSH asbestos counting method. The Rapid Fiber Evaluation

System (Vickers Instruments) will be evaluated as a rapid screening instrument for analysis of filter samples.
Keywords: asbestos; monitoring; fibers; filters; measuring instruments; us osha.

33001 Mortality, Morbidity and IH Study of Oil Shale Workers. Costello, J. (National Inst. for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** 189. **Contract:** Z10-77-0027. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). **Funding:** EPA-$93,000.
Related energy source: oil shale(100) **R and D categories:** Epidemiological studies.

The purpose of this project is to determine the health effects, if any, of occupational exposure to shale oil. The study cohort is made up of 713 men who worked at the Anvil Points Oil Shale Retort from 1948 to 1977. The study is divided into a mortality study, a morbidity study, and an industrial hygiene component. The mortality study will compare mortality patterns among the shale oil workers with an appropriate control group from the states of Colorado and Utah. The morbidity study will compare the morbidity patterns of 326 oil shale workers with a control group of 326 coal miners from the Colorado Plateau. A job history, respiratory questionnaire, and dermatological examination will be given to each of the people in the two groups. Special attention will be given to age, race, smoking, skin complexion, years on the Colorado Plateau, and time spent in outdoor activities. The industrial hygiene portion of this study involves workshops, health hazard evaluations of oil shale facilities and cooperative work with people in the Estonian Republic of the USSR who are engaged in oil shale health research.
Keywords: oil shale industry; personnel; mortality; health hazards; oil shales; colorado; utah; medical surveillance.

33002 Mortality and Industrial Hygiene Study of Workers Exposed to Sulfuric Acid. (Enviro Control, Inc., One Central Plaza, 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VMH-E21-579. **Contract:** CDC-210-78-0102. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$172,000.
Related energy source: Coal(100) **R and D categories:** Epidemiological studies.

The purpose of this project is to conduct a historical prospective mortality study of workers exposed to sulfuric acid mist. Although the acute dangers of sulfuric acid, e.g., corneal injuries and mucous membrane irritation, are well recognized, the only chronic effect documented to date is corrosion of tooth enamel. There have been very few epidemiologic studies of sulfuric acid exposed workers, and none that have examined their mortality, despite the fact that about 30 million tons are produced annually in the US and that about 200,000 workers have potential exposure. The public is also exposed because sulfur dioxide, a common air pollutant, partially oxidizes in the atmosphere and on respiratory tissue to sulfuric acid. The historical prospective method of examining mortality will be utilized to follow workers who were exposed at least 6 months to sulfuric acid and who worked between 1940 and 1960. Cause-specific comparisons will be made to US death rates adjusted for age, calendar time, sex, and race.
Keywords: sulfuric acid; health hazards; mortality; personnel; occupational safety; chronic exposure; human populations; epidemiology.

33003 Industrial Hygiene Study of Insulation Material Workers. (Enviro Control, Inc., One Central Plaza, 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VMH-E21-582. **Contract:** 210-78-0081. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$149,000.
Related energy source: conservation(100) **R and D categories:** Epidemiological studies.

Members of the insulation trade have long been noted to experience excess mortality due to malignant and non-malignant respiratory diseases. Much of this observed disease has been attributed to asbestos fiber exposures; however, the hazards associated with many of the other insulation materials used are unknown. The purpose of the proposed research is to determine quantities of the various insulation materials used in the U.S., end use categories for these materials, number of workers potentially exposed to each material, and probably exposure levels. Exposure levels to the most commonly used materials will be determined through industrial hygiene surveys. As of this date, a literature review has been performed, and a tripartite review meeting of representatives from industry, labor, and government was held. Polyurethane and urea formaldehyde foams have been selected as the materials for study.
Keywords: thermal insulation; fibers; inhalation; personnel; health hazards; occupational diseases; risk assessment; respiratory system diseases; epidemiology.

33004 Industrial Hygiene Study of Solar Energy Component Manufacture. (PEDCO-Environmental, Inc., 11499 Chester Road, Cincinnati, OH, 45246). **Project number:** VMH-E22-583. **Contract:** CDC-210-78-0059. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$148,000.
Related energy source: solar(100) **R and D categories:** Epidemiological studies.

A new technology which will be playing an increasing role in meeting this country's needed energy demands will be in the utilization of solar energy photovoltaic cells for direct conversion of sunlight to electricity. This project is designed to characterize those processes, and industrial hygiene concerns related to the manufacture of photovoltaic devices. The essentials of this study are detailed in the contract with PedCo Environmental as performing three tasks: (1) literature search, review, and recommendations for facilities to study; (2) industrial hygiene walk-through surveys of manufacturing facilities making photovoltaic arrays and of base materials unique to photovoltaic manufacture; and (3) in-depth industrial hygiene surveys in selected facilities. An in-depth literature review of the process materials and toxicology of the process materials has been performed. Existing standards of exposure limits are provided when available.
Keywords: photovoltaic cells; manufacturing; toxic materials; toxicity; occupational safety; health hazards; safety; manufacturers.

33005 Industrial Hygiene Study of Petroleum Refineries. (Enviro Control, Inc., One Central Plaza, 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VMH-E22-584. **Contract:** CDC-210-78-0082. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$272,000.
Related energy source: oil and gas(100) **R and D categories:** Epidemiological studies.

Petroleum refineries in the U.S. process crude oil into approximately 3 x 10/sup 6/ m/sup 3//day of refined products. By definition refinery activities start with crude oil storage and terminate with storage of the refined products. There are approximately 250 refineries in the U.S. employing about 100,000 production workers. Refineries range in size from 500 to over 64,000 m/sup 3//day with the average refinery processing 6900 m/sup 3//day. Over 3000 different chemical compounds may be present in crude petroleum with additional compounds being formed during the refinery process. Since the health effect to refinery workers from these chemical compounds has not been well defined, toxic and carcinogenic chemicals may be present in the working environment during the refinery of crude petroleum. A program is being conducted to identify and quantify worker exposure to potentially hazardous agents in refineries and to provide baseline data which may be used to assure safe and healthful working conditions in the petroleum refineries. Project objectives will be achieved by conducting an in-depth industrial hygiene characterization of worker environments in selected refineries, at selected unit operations, and/or within selected job classifications with information obtained in comprehensive industrial hygiene surveys. As of this date, laboratory analysis of samples collected during the industrial hygiene surveys is in progress.
Keywords: petroleum refineries; working conditions; toxic materials; safety; monitoring; health hazards; personnel; pollution control.

33006 Mortality Study of Workers Exposed to Small Fibrous Glass. Bayliss, D.L. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VMH-E22-585. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$22,000.
Related energy source: general science(100) **R and D categories:** Epidemiological studies.

In order to evaluate if there is excess mortality of malignant respiratory disease in workers exposed to fibrous glass ranging in size 1 to 3 mu in diameter, NIOSH has initiated a retrospective cohort mortality study of workers exposed to such fibers in a flame attenuation process that existed in the 1940s. This study supplements an earlier retrospective cohort mortality study on the same plant that showed increased mortality of non-malignant respiratory disease. The population of the previous study was generally exposed to fibers greater in diameter (e.g., > 3 mu) than have been shown to be carcinogenic in man or animals and therefore the present study was deemed warranted to evalute the small fiber diameter exposures. To date, records of 2,000 employees have been obtained and vital status ascertainment completed. In order to determine whether the worker group exposed to the small diameter fibrous glass particles suffer from unusual cancer mortality, a matched control group has been selected from the non-exposed segment of the worker population at the above plant. A final report is being completed.
Keywords: personnel; mortality; fiberglass; inhalation; occupational diseases; epidemiology; respiratory system diseases; carcinomas; health hazards; glass industry.

33007 Criteria for Occupational Safety and Health Standards: RF/Microwave. Cleveland, R.F. Jr. (Equitable Environmental Health, Inc., 6000 Executive Blvd., Rockville, MD, 20852). **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$261,000.
Related energy source: nuclear fusion(100) **R and D categories:** Epidemiological studies.

Criteria for recommended occupational safety and health standards are being developed for RF/microwave radiation, including the energy application of the transmission to earth of solar energy collected in space. Criteria are based on available world-wide literature, and data that have been generated and collected by Federal agencies (EPA, DOE, DOD, DHEW, FAA, VA, NASA). Draft documents have received extensive external and internal review and update and most of the comments have been incorporated into the document where appropriate. The document is presently being finalized.
Keywords: microwave radiation; occupations; standards; health hazards; safety standards; biological effects; electromagnetic fields; electromagnetic radiation.

33008 Criteria for Occupational Safety and Health Standards: Coal Liquefaction. Woods, G.R. (JRB Associates, 8400 Westpark Drive, McLean, VA, 22101). **Contract:** 210-78-0017. **Supported by:** National Inst. for Occupational Safety and Health, Rockville, MD (USA). **Funding:** EPA-$332,000.
Related energy source: Coal(100) **R and D categories:** Epidemiological studies.

The Criteria for a Recommended Standard...Occupational Exposures in Coal Liquefaction Plants has been revised as an Occupational Hazard Assessment for Coal Liquefaction Plants. The new report contains a critical review of available health literature and information. It also identifies and recommends work practices, engineering controls, medical surveillance, and exposure monitoring for reducing the risks of adverse health effects to workers. The assessment does not have any recommendation for promulgation of standards for occupational exposures in coal liquefaction plants.
Keywords: occupational safety; health hazards; coal liquefaction plants; standards; risk assessment; medical surveillance; monitoring; personnel.

33009 Morbidity and IH Study of Workers Exposed to Sulfur Oxides and Nitrogen Oxides. Gamble, J.F. (National Inst. for Occupational Safety and Health, Morgantown, WV, 26505). **Project number:** VKL E21—170. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). **Funding:** EPA-$221,000.
Related energy source: general science(100) **R and D categories:** Epidemiological studies.

The purpose of this study is to develop dose-response relations of both an acute and chronic nature for the various species of sulfur and nitrogen compounds in support of health standards development. The two essential interdependent parts of this study are the measurement of dose and of response. A measure of environmental dose will be obtained by personnel sampling for the compounds under investigation. Measurement of worker response include a questionnaire on demographic variables and respiratory symptoms, chest x-rays, and pulmonary function. A sample of the workers will be tested before and after work for changes in pulmonary function. Environmental measures will be taken concurrently. Levels of exposure that produce chronic effects will be estimated from total work history and environmental sampling at the time of the medical survey. Data collected from 5 salt mines showed a slight association of changes in pulmonary function over the shift with NO2 concentrations. Data from over 200 workers exposed to H2SO4 mist and controls is now being analyzed. Data on over 300 workers exposed to diesel exhaust has been collected.
Keywords: sulfur oxides; nitrogen oxides; health hazards; standards; occupational safety; working conditions; chronic exposure; nitrogen dioxide; diesel engines; exhaust gases; personnel; medical surveillance.

33010 IH Study of Coal Gasification Plants. Telesca, D. (Enviro Control Inc., 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VKPE22215. **Contract:** 210-78-0090. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). Appalachian Lab. for Occupational Safety and Health. **Funding:** HEW-$330,000.
Related energy source: Coal(90); oil and gas(10) **R and D categories:** Health protection, safety, and industrial hygiene.

This contract includes an in-depth industrial hygiene characterization of worker environments in two types of coal gasification facilities, one hi-Btu and one lo-Btu. Each plant project will be divided into three tasks. Task I includes a literature search, pilot plant walk-through, grab sampling, laboratory analysis, documentation and description of work places and a report of study proposal to the project officer. Task II includes qualitative area, personnel, and bulk sampling, laboratory analysis, documentation of results, and preparation of a sampling protocol for Task III. Task III includes quantitative detailed industrial hygiene monitoring, sample analysis, and determination of eight-hour daily time-weighted average and peak concentrations of potentially hazardous substances.
Keywords: coal gasification plants; industrial medicine; working conditions; fuel gas; by-products; gaseous wastes; liquid wastes; chemical effluents; emission; chemical composition; carcinogens; health hazards; hydrocarbons; inhalation; sampling; pollution control.

33011 Study of Coal Liquefaction Processes. Telesca, D. (Enviro Control Inc., 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VKP E22-225. **Contract:** 210-78-0101. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). Appalachian Lab. for Occupational Safety and Health. **Funding:** EPA-$369,000.
Related energy source: Coal(90); oil and gas(10) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective is to perform an in-depth industrial hygiene characterization of worker environments in four coal liquefaction plant facilities. The study will address coal liquefaction products, processes, and material containment methods, worker exposures and locations for industrial hygiene surveillance during commercial plant operations. The approach involves performing the following four tasks. Task I includes a detailed literature search, analytical methods development and verification, walk-through surveys and development of a study protocol. Task II includes the survey of the first plant as a test of the protocol. Task III is the detailed study of three liquefaction plants and Task IV is the preparation of a final report. Identification of liquefaction process health hazards in the developmental phase of the technology will provide information to assess current and future health hazards and to provide information for health protection design considerations.
Keywords: coal liquefaction plants; working conditions; health hazards; industrial medicine; hydrocarbons; carcinogens; mutagens; emission; particles; inhalation; safety; personnel.

33012 Evaluate Passive Organic Vapor Monitors. Perkins, J.A. (Univ. of Utah Research Inst., 520 Wakara Way, Salt Lake City, UT, 84108). **Project number:** 484. **Contract:** 210-78-0115. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$70,000.
Related energy source: general science(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives of this program are to discover performance capabilities and limitations of commercially available passive organic vapor monitors and to make recommendations based on the findings of this study for the use of passive organic vapor monitors in sampling and analysis. The approach involves a series of experiments comprising a statistically designed testing protocol to experimentally determine the effects, on monitor performance, of the following: contaminant, concentration of contaminant, length of sampling, ambient temperature and humidity, face velocity, sample storage, and mixtures of contaminant. The testing is still on-going.
Keywords: vapors; organic compounds; monitoring; sampling; gas analysis; testing; measuring instruments; testing; performance; hydrocarbons; personnel dosimetry; comparative evaluations.

33013 uv-VIS Dosimeter. Breuer, G.M. (National Institute of Occupational Safety and Health, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** 484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$10,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This project was designed to begin development and evaluation of prototype personal monitors for exposure to ultraviolet light. Currently available chemical actinometers and solid-state electronic transducers would be used to give an integrated measure of incident ultraviolet intensity. Five prototype monitors were built, including two direct-reading electronic monitors using solid-state photodiodes. One chemical system shows good sensitivity and selectivity for the 300 to 400 nm region and is being further developed. The direct-reading monitors show good sensitivity for the 200 to 315 region and human skin response, but additional work, now in progress, is required to eliminate response to unwanted radiation.
Keywords: ultraviolet radiation; monitoring; measuring instruments; design; transducers; sensitivity; design; readout systems; display devices.

33014 Automated Personal Sample Fiber Counter. Baron, P.A. (National Inst. for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** 484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$134,000.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

An instrument is being developed and tested to provide rapid screening of filter samples for asbestos fibers. The principle of detection involves evaluating the light scattering pattern from individual particles on a filter to determine whether they are fibrous.
Keywords: fibers; asbestos; filters; monitoring; visible radiation; light scattering; pattern recognition.

33015 Test and Evaluate Portable Microwave Spectrometric Analyzer. Baron, P.A. (National Inst. for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** 484. **Contract:** IA77-17. **Supported by:** National Inst. for

Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$208,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The portable microwave gas analyzer developed by LLL was evaluated for use in industrial hygiene field work. Performance parameters and factors governing reliable field use were considered. The device represents a step forward in the use of the sensitive and extremely selective microwave absorption technique for these applications, but several differences and recommendations for second generation improvements on them were noted. The weight (37 kg plus vacuum pump) is greater than desirable. An improvement in temperature stabilization of the Gunn diodes was suggested and carried out by LLL. A much improved sampling pump (34 times greater flow with 30 times less power drain) was installed. A second-generation instrument is now being built by Martin-Marietta Corporation with US Army funding.
Keywords: gas analysis; microwave equipment; absorption; weight; pumps; sampling; transport; nitrogen compounds; hydrocarbons; modifications; reliability; measuring instruments; vapors; gases.

33016 Mortality and IH Study of Workers in Coal-Fired Power Plants (TVA). Waters, T.D. (TVA, Division of Medical Services, Room 139, Patten Towers, Chattanooga, TN, 37401). **Project number:** 238. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). **Funding:** EPA-$634,000; TVA-$58,000.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The primary purpose of this study is to measure the mortality of specified study groups of employees of the Tennessee Valley Authority (TVA) in potentially hazardous occupations (determined by industrial hygiene survey) relative to control groups of TVA employees in other lines of work. The effects of age, sex, race, income level, and cigarette smoking would be minimized on these comparisons. A second purpose is to determine the mortality experience of a large heterogeneous work force in an established energy producing industry in order to use the findings for comparisons with other ways of producing electric energy. A third purpose is to measure the prevalence of early retirement due to disability among employees in potentially hazardous occupations compared to employees not exposed to these hazards. A pilot study to determine the proper way to abstract data for the mortality study has been completed. Industrial hygiene measurements of oxides of sulfur and nitrogen have been done. A tape containing data on workers on whom NIOSH is to determine vital status has been received. Ordering of death certificates of known deceased persons has begun.
Keywords: fossil-fuel power plants; tennessee valley authority; personnel; mortality; occupational safety; experiment planning; coal; petroleum; chemical effluents.

33017 Develop Performance Specifications for Personal Aerosol Monitors. Rajendran, N.; Tillery, M.I. (IIT Research Inst., Chicago, IL, 60616). **Project number:** 484. **Contract:** 210-78-0092. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA; NIOSH-$318,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of the project is to evaluate the aerosol collection characteristics of personal aerosol samplers; the project is divided into two parts. The first part which is being done under contract is developing a computer model that can be used to estimate the inlet efficiency of a wide variety of inlets under a number of different conditions. The computer model has been developed and the final report is being revised for final submission. The second part of the project is an experimental determination of the sampling efficiency of two commonly used personal aerosol sampling devices. The sampling efficiency is being determined as a function of inlet geometry, air flow rate, and sampling angle relative to the air flow. The experimental work is completed and the final report is being written. The experimental data will be compared to the results obtained from the model when the data are available. A set of sampling recommendations for the use of personal samplers will be developed from the results of the model and the experimental data.
Keywords: personnel; aerosol monitoring; measuring instruments; samplers; aerosols; efficiency; sampling; design; performance.

33018 Diesel Exhaust/Coal Dust Animal Exposure Studies. Hinners, R.G. (EPA, Health Effects Research Lab., 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** EPA-79-R-X0330-1. **Contract:** IA-79-3. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The potential health hazards of the introduction of diesel-powered vehicles into coal mines are unknown. Accordingly, NIOSH needs to conduct toxicological studies on animals incorporating combined exposure to diesel exhaust and coal dust. Pathologic changes from such combined exposures may differ from those resulting from exposure to either agent alone. This project has four specific objectives. The first is to determine if combined exposure to diesel exhaust and coal dust changes the incidence of neoplastic disease as compared with controls and to exposure to each alone. The other three objectives are investigation of pulmonary damge, immune potential, and mutagenic potential of combined exposure to coal dust and diesel exhaust and each agent alone in comparison to control populations. An estimated 26,700 workers in 385 underground metallic and nonmetallic mines are potentially exposed to diesel emissions. Results to date include completion of the inhalation exposure facilities. Atmospheric characterization will be performed during first quarter of FY 80; animals will be introduced into the experimental atmospheres in second quarter of FY 80.
Keywords: diesel engines; exhaust gases; coal mines; dusts; carcinogenesis; health hazards; miners; exposure chambers; inhalation; laboratory animals; lungs; pathological changes; immune reactions; mutagenesis; synergism.

33019 Insulating Materials: Long-Term Inhalation Effects. Mitchell, R.I. (Battelle Columbus Labs., 505 King Street, Columbus, OH, 43201). **Project number:** BCL 525-J-4726x. **Contract:** 210-78-0037. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

With the increased emphasis on energy conservation, there has been an increase in the usage of fibrous glass products for thermal insulation. This has led to an increase in the exposure both environmentally as well as occupationally. Animal tests in which glass fibers have been introduced into the pleura of rats have shown that, depending upon the size of the glass fibers, a moderately high incidence of mesotheliomas can be produced. Similar tests with asbestos have produced a higher percentage of mesotheliomas. The objective of the program is to conduct a long-term, low-level inhalation study of glass fibers of known size in order to determine the adequacy of current OSHA standards.
Keywords: thermal insulation; fiberglass; inhalation; monkeys; rats; exposure chambers; chronic exposure; lungs; neoplasms; carcinogenesis; safety standards; size.

33020 Evaluation of Respiratory Protection in Coal Preparation Plants. Evans, J. (EnviroControl, Inc., 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VQC R31-432. **Contract:** 210-78-0085. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The contract is a three-phase project to measure workers' respirable hazards and protection in coal preparation plants and surface mines. The first phase is the selection of 10 facilities and obtaining written permission from each facility's management to perform the study. The second phase is the development of the study protocol to be employed in 10 field trips. The protocol includes characterization of dust and chemical vapors by unit process (size, concentration, and analysis); observations of workers near the unit process (number, time, and use of respirator); evaluation of respirator program; and quantitative measuring of respirator fit. The third phase is the field work at the sites selected in Phase I using the protocol developed in Phase II. Phase I and II have been completed; Phase III has resulted in 8 field trips as of February 11, 1980.
Keywords: coal mines; surface mining; coal preparation plants; occupational safety; working conditions; health hazards; dusts; vapors; chemical composition; respirators; evaluation.

33021 Control Technology for Coal Gasification and Liquefaction. Telesca, D.R. (Enviro Control, Inc., One Central Plaza, 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** 210-78-0084. **Contract:** 210-78-0084. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives of this project are to: (1) document and evaluate effective engineering control technology used by the coal conversion industry to minimize worker exposure to harmful chemical and physical agents; (2) assess monitoring devices and work practices used to reduce worker exposures; (3) document personal protective equipment used by workers; and (4) determine research needs for new control technology. About 20 to 30 plant surveys will be made of engineering control systems at coal conversion plants, analogous industries, and architectural/engineering firms. To date about 12 surveys have been completed.
Keywords: coal gasification plants; coal liquefaction plants; personnel; monitoring; safety engineering; occupational safety.

33022 Portable XRF Analyzer. Rhodes, J.R. (Columbia Scientific Industries, 11950 Jollyville Road, P.O. Box 9908, Austin, TX, 78766). **Project number:** 484. **Contract:** AC05-77EV05464. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

A contract was awarded to Columbia Scientific Industries in September 1977 to develop and construct two prototype x-ray fluorescence analyzers. NIOSH provided DOE funds under interagency funds to obtain two additional prototypes. The instrument is intended to be a self-contained, portable field instrument capable of analyzing filter samples for 25 elements of concern to industrial hygienists. The prototypes are currently being assembled and laboratory and field testing will commence when they are delivered. This type of analyzer will greatly improve information feedback of pollutant levels to the industrial hygienist and reduce the need for analytical support facilities.

Keywords: x-ray fluorescence analyzers; design; field tests; dusts; air pollution; elements.

33023 Battery Evaluation of Personal Sampling Pump. Bicking, C.A. (Tracor, Inc., 1776 E. Jefferson Street, Rockville, MD, 20852). **Project number:** 484. **Contract:** 210-78-0090. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of this work are to experimentally determine the effect of various environmental and use conditions on the mean cycle-life of rechargeable batteries; to determine, by survey, user experience with rechargeable batteries with emphasis on typical cycling of battery charge and on useful life; and to develop a set of recommendations relative to the use of rechargeable batteries in portable monitoring equipment. The laboratory approach is based on a full factorial experimental design including three levels of the following four variables: depth of discharge, rate of discharge, ambient temperature, and recharge rate. The pre-test and user survey have been completed while the main test is on-going. Any conclusions drawn at this time would be preliminary. The products of this contract will be a family of graphs which can be used to predict the behavior and life of batteries used in monitoring equipment, and a set of recommendations for the use of rechargeable batteries in portable monitoring equipment.

Keywords: electric batteries; service life; research programs.

33024 Assessment of Engineering Control Monitoring Devices. Bochinski, J.H. (Enviro Control, Inc., One Central Plaza, 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** 407. **Contract:** 210-79-0011. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The purpose of this project is to assess the availability and state-of-the-art of monitoring devices which have potential use in engineering control and exhaust recirculation systems. The first phase of the project will classify the monitors according to their operational characteristics and determine their suitability for use as control monitors. A guide for the selection of control monitoring equipment for a given application will be developed. Some in-plant evaluation of existing control monitoring systems will be made to assess their reliability and prompt the use of control monitoring equipment. The contract was awarded in October 1979. The first task of the contract has been completed and work is continuing.

Keywords: reliability; availability; reviews; control systems; monitoring; air pollution monitors; exhaust recirculation systems; vehicles; design.

33025 Development of a Prototype Gas Chromatograph. Angell, J. (Leland Stanford Jr. University, Stanford, CA, 94305). **Project number:** 484. **Contract:** 210-77-059. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The goals are to develop a highly specific, real time exposure monitor utilizing silicon etching techniques to make a microprocessor controlled gas chromatograph which will be able to: (1) automatically sample the atmosphere around the person every minute for eight hours; (2) measure the concentrations of up to ten different vapors simultaneously to within 10% accuracy; (3) calculate and store the time-weighted-average and peak concentrations for each of the gases; (4) measure concentrations down to 10 ppM now and eventually maybe down to 1 ppM; (5) display stored concentrations upon demand; and (6) sound an alarm when any concentration exceeds a predetermined value. Initial prototypes of the instrument will be delivered to NIOSH for testing in the spring of 1980.

Keywords: air pollution monitors; design; gas chromatography; alarm systems; air pollution; aerosol monitoring.

33026 Evaluate Control Technology for Diesel Powered Equipment in Underground Mines. Freedman, R. (Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, PA, 15213). **Project number:** 0-9277407-VOC-E31. **Contract:** IAA 79-17. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

A survey of several coal and noncoal mines will be made to obtain data on typical duty cycles for vehicles powered by diesel engines. The objective is to provide baseline numbers for calculation of integrated levels of significant contaminants at various mine locations. In addition, the data will be useful for assessing fuel and manpower requirements for productivity studies. The mining vehicles will include LHD's, locomotives, personnel transports, supply tractors, and shuttle cars. Representative mining operations will include room and pillar, bench, and blast and cave mining. A survey of about 25 mines will be conducted in which time studies of the operating equipment will be made. The horsepower output of each vehicle will be estimated and, if possible, measured during each cycle. The calculated average power use will be correlated with emission levels for several contaminants.

Keywords: diesel engines; mining equipment; energy consumption; exhaust gases; underground mining.

33027 Industrial Hygiene Characterization of Resource Recovery Industry. Mansdort, Z. (Midwest Research Inst., Kansas City, KS, 64110). **Project number:** 4856-L(9). **Contract:** 210-79-0013. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). **Funding:** EPA.

Related energy source: conservation(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The resource recovery facilities operational or under construction in the U.S. are projected to replace in excess of 7% of the fossil fuels used for electric power generation. Previous assessment studies conducted in DRDS indicate the need for an in-depth occupational environment characterization of these facilities. Emphasis will be on airborne pathogens, toxic chemicals, physical agents (noise and heat primarily), and the nature and significance of particulates and gaseous emissions. The purpose of this contract is to more fully define occupational health problems in the resource recovery industry. Detailed occupational health assessments will be made to: quantify health problems through an industrial hygiene survey; define necessary programs including the feasibility of a retrospective cohort mortality study, medical surveillance, including a cross-sectional morbidity study, pre-employment physical and periodic medical examinations; evaluate the feasibility and desirability of development of a criteria document; and recommend control procedures and areas for control technology development.

Keywords: resource recovery facilities; environmental effects; health hazards; noise pollution; pathogens; toxic materials; power generation; feasibility studies; municipal wastes.

33028 Energy Industrial Medical Protocol. Partridge, L.I. Jr. (Arthur D. Little, Inc., Acorn Park, Cambridge, MA, 02140). **Project number:** 239. **Contract:** 210-78-0100. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Health effects assessments.

The following subprojects are included in the project: (1) summary of potential hazards associated with coal liquefaction and gasification as determined from literature review, extrapolation from analogous industries, and engineering theory; (2) summary of current medical programs at synthane, hygas, bigas, steam-iron gasification facilities and SRC, H-coal, clean coke, and synthoil liquefaction facilities; (3) recommendations for on-site acute care facilities; (4) development of standard occupational/medical history forms suitable for medical and epidemiological uses; (5) development of standard forms for recording worker exposure to hazards which are suitable for medical and epidemiological uses; (6) evaluation of aryl hydrocarbon hydroxylase activity as a useful screening tool to determine employees at high risk of developing lung cancer following polynuclear aromatic hydrocarbon exposure; (7) development of a medical monitoring program tailored to unit operation specific hazards; (8) recommendations for a screening program to detect teratogenic effects of occupational exposures; and (9) recommendations for follow-up of terminated, disabled, and retired workers.

Keywords: coal gasification plants; coal liquefaction plants; coal preparation plants; health hazards; personnel; medical surveillance; industrial medicine; occupational diseases.

33029 Recirculation of Exhaust Air Pilot Study. Holcomb, M. (Rexnord, Inc., 5103 W. Beloit Rd., Milwaukee, WI, 53201). **Project number:** 0-9277417 VQA E31. **Contract:** 210-78-0011. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA.

Related energy source: conservation() **R and D categories:** Health effects assessments.

A pilot study is being conducted by contract to evaluate several air cleaners and return air contaminant monitoring devices in a welding exhaust system. The welding exhaust is being characterized according to its particulate concentration, particulate chemical

composition, particulate size distribution, gaseous constituents and gaseous concentrations. The air cleaners will be evaluated by their ability to produce reliable low level outlet concentrations. The air monitors will be evaluated for accuracy of measurement and sensitivity for the range of concentrations and for the particular particle size in the air cleaner exhaust. Finally, the capital and operating cost on a volume flow basis will be determined for each air cleaner/monitor combination tested. A two-stage, low voltage electrostatic precipitator has been tested and evaluated and an electronically augmented baghouse and aspirated cartridge filter are being tested in parallel. These air cleaners will be compared on the basis of cleaning efficiency, reliability and cost (capital and operating) upon completion of testing. Air monitors being tested for use with particles are of the nephelometer type, beta attenuation type, piezoelectric type and optical tape sampling type. Gaseous monitors for carbon monoxide, ozone and oxides of nitrogen are also being evaluated.
Keywords: air cleaning systems; air pollution control; particles; gaseous wastes; welding; baghouses; carbon monoxide; ozone; nitrogen oxides; aerosol monitoring; exhaust gases.

34000 Testing Compounds for Mutagenic Activity in a Meiotic Non-Disjunction Test in Neurospora crassa. Griffiths, A.J.F. (University of British Columbia, Botany Department, CA, V6T 1W5). **Project number:** 263-77C-0604CC. **Contract:** 263-77C-0604CC. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$17,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to assay environmental chemicals for mutagenic activity in a meiotic non-disjunction test in Neurospora crassa. Two strains of Neurospora crassa have been developed with a series of genetics markers in each on Linkage Group I (LGI). When these two strains are crossed to each other and ascospores are plated (about 10/sup 6/ ascospores per cross) on minimal medium, the only ones that can grow are disomic for LGI. The aneuploid condition is unstable and breaks down to form a heterokaryon composed of two (haploid) nuclear types representing the original disomic pair of chromosomes. This heterokaryon is called a pseudowild-type and segregates vegetatively into the two components; thus, pseudowild-type frequency is an index of the frequency of meiotic non-disjunction involving LGI in this organism. Control platings (untreated crosses) have shown that spontaneous non-disjunction frequencies are quite constant with an average value of 4.9 x 10/sup -5/. A total of 10 chemicals have been found which give significantly higher frequencies of non-disjunction than found in control crosses. In order to develop a truly comprehensive battery of tests for mass screening programs, we must be able to detect all classes of genetic alterations. No such assay exists for non-disjunction. Because of this we only have scanty evidence of chemicals which will cause non-disjunction. This is an important class of genetic alteration with regard to genetic disease in man.
Keywords: mutagenesis; biological indicators; neurospora; meiosis; mutagens; mutations.

34001 Chemical and Environmental Mutagen Studies Utilizing the Tradescantia Test System. Van't Hof, J. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** ERP 1.3 ADG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$175,000; EPA-$175,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary objective of this program is to determine the feasibility of using the Tradescantia stamen hair system to detect the mutagenicity of gaseous and particulate air pollutants. Tradescantia was chosen because of the breadth of radiobiological data on the somatic mutation syste, the versatility and relative ease of handling experimental material, high sensitivity to both chemical and physical mutagens and its small number (12) of large chromosomes suitable for cytological analysis. Moreover it can be exposed directly to ambient air pollutants. The Tradescantia system is being utilized in applied studies (testing of new compounds) in both laboratory and field exposures although recent major efforts have been in field studies. New chemicals are being screened individually for mutagenicity under laboratory conditions and facilities are being prepared to explore the possibility of synergistic reactions between mutagens. Applied studies have been extended into the field through the use of a Mobile Monitoring Vehicle (MMV) which has been fabricated and is undergoing field testing in high pollution areas throughout the country. Pollution site selection and field exposures are being carried out in collaboration with EPA.
Keywords: tradescantia; mutagenesis; feasibility studies; biological indicators; mutagens; synergism; monitoring; mobility; mutations; gases; aerosols; particles; bioassay; mutagen screening.

34050 Statistical Development of Multistage Carcinogenesis Models. Prentice, R.L.; Crump, K.S. (Fred Hutchinson Cancer Research Center/Louisiana Tech Univ., Seattle/Ruston, WA/LA, 98104). **Project number:** RFP NIH-ES-77-22. **Contract:** NIH-ES-77-22. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$150,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The objective is to develop and evaluate statistical procedures for utilizing data from animal tests conducted at high, often maximum tolerated dose rates to estimate carcinogenic risks at very low dose rates, such as might be encountered by humans in their daily environment. Under the Fred Hutchinson Cancer Research Center contract a variety of studies based on proportional hazards and accelerated failure time models will be initiated, including (1) the investigation of various multistage and multipath assumptions leading to tumor incidence rates, (2) the adaptation of the use of cause specific hazard functions and cause specific regression coefficients to the estimation and extrapolation of dose effects in the presence of competing causes of death, and (3) the investigation of the use of censored data generalizations of Wilcoxin and log-rank test statistics in the derivation of estimators of dose effect coefficients. Under the Louisiana Tech University contract an application of Cox's life table method to the multistage model (for carcinogensis) will form the basis for extending an existing procedure for analyzing dichotomous data so that time-to-tumor information can be utilized. With this approach hypothesis tests about the shape of the dose response curve at low doses will be developed as well as procedures for obtaining point estimates and confidence intervals for the age-dependent risk of cancer at low dose rates. In the absence of relevant human data cancer risk estimates extrapolated from laboratory animal experiments will continue to have a major impact on regulatory decision-making policies.
Keywords: carcinogenesis; statistical models; biological models; animals; human populations; health hazards.

34051 Statistical Analysis of Mutagencsis Testing Data. Margolin, B.H. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 40005-02BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The long-term objective of this project is to develop appropriate statistical techniques for the analysis of data arising from the Mutagenesis Testing Program. Focus has been on data from microbial test systems. Statistical procedures currently employed by other researchers in mutagenesis for the design and analysis of microbial experiments have been studied, and new and improved procedures have been devised.
Keywords: statistical models; mutagenesis; biological models; mutagen screening; data analysis.

34052 Risk Assessment for Environmental Carcinogens. Hoel, D.G. (National Institute of Environmental Health Services, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-41001-05 BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The overall purpose of this project is to develop improved statistical techniques for using data from animal carcinogenicity tests conducted at high dose levels to estimate long-term human risk from chemical carcinogens at very low dose levels. Current research efforts have focused on such topics as the evaluation of competing risks and pharmacokinetics in the framework of multistage models for carcinogenesis as well as the question of species-to-species extrapolation. Also the question of model convergence at low doses and the incorporation of background is studied.
Keywords: carcinogens; risk assessment; carcinogenesis; biological models; animals; human populations; comparative evaluations.

34053 Environmental Contaminants of Infant Foodstuffs: the Breast Milk and Formula Project. Rogan, W.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-43002-03 BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Epidemiological studies.

The objectives are to: (1) establish a cohort of breast and formula fed infants; (2) develop methodology to obtain reliable and reproducible samples of human body fluids and tissue from mother and child; (3) develop reliable methods for analysis of PCB's and other related parameters; (4) develop and apply statistical procedures for the analysis of data generated from the study; and (5) evaluate the children for specific outcomes thought to be related to organochlorine exposure due to PCB's.
Keywords: human populations; milk; children; infants; diet; contamination; organic chlorine compounds; metabolism; food chains; cattle.

34054 Pharmacokinetic Modeling and Methodology Development. Tuey, D.B. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z 01 ES 42002-07 BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$28,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this project is to develop pharmacokinetic models and methods for quantitating the mechanisms of the uptake, distribution, metabolism, and excretion kinetics of environmental xenobiotics in various animal species. Mathematical models of the in vivo pharmacokinetics of several halogenated biphenyls in the rat have been developed and have been scaled to the mouse. Other models have been constructed to describe the disposition of these environmental contaminants in animals following chronic exposure. The pharmacokinetics of xenobiotics in marine animals that serve as human food sources is also being modeled. These mathematical models are intended to provide functional strategies for helping to extrapolate the disposition of chemical contaminants in the environment from one compound to another, and from one animal species to another, ultimately to include man. The evaluation and implementation of existing techniques and the development of new methodologies needed to accomplish these objectives are an integral part of this project.
Keywords: biological models; mathematical models; aromatics; biphenyl; food chains; contamination; biochemical reaction kinetics; biological accumulation; metabolism; excretion; organic halogen compounds.

34055 Skin Cancer and Trace Elements. Clark, L. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-43004-01-BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this work is two-fold: (1) to examine the hypothesis that there is a relationship between the etiology of skin cancer and the levels of certain trace elements in blood or hair (elements include selenium, arsenic, cadmium, zinc, copper, and lead); and (2) to examine the hypothesis that occupational exposure to herbicides, pesticides, or fungicides, including those containing arsenic as well as other groups of aromatic or aliphatic hydrocarbons, is a significant risk factor for the development of skin cancer. A case-control design in which subjects from a specific dermatologic clinic practice in the eastern part of North Carolina will be selected is anticipated. Four groups of skin cancer patients of different types will be compared with a group of dermatologic controls (persons with skin diseases other than, and unrelated to, skin cancer). The disease outcome of interest is skin cancer, and the risk factors of interest are selenium level, other trace element levels, and occupational exposure.
Keywords: skin diseases; neoplasms; elements; pesticides; biological effects; synergism; etiology.

34056 Fetal Wasteage and Chemical Exposure. Brown, S.M. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-44003-02-BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to examine the variations in response of pregnant women when exposed to any of a number of defined environmental mutagens and clastogens. At the current time a survey instrument is being prepared under contract for interviewing mothers and fathers of spontaneous abortuses and controls in order to assess exposure in occupation, household, personal habits, or other vehicles. The disease outcomes of interest are spontaneous abortion, anatomic, or cytogenetic abnormality of fetal tissues. A literature review has been completed and preliminary interview instrument developed. A number of experts in the field have been consulted to solicit expert advice in development of the protocol. A contract is currently being awarded for development and pretesting of the survey instrument to be used. The proposed course of study would be three years, commencing approximately January 1, 1980.
Keywords: mutagens; carcinogens; biological effects; man; fetuses; abortion; response modifying factors; malformations.

34057 Genetic Effects, Reproductive Outcomes, and Birth Defects and Occupational Exposure to Plutonium. Brown, S.M. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-43006-01-BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The principle objective is to examine the reproductive outcomes principally of spontaneous abortion but also congenital defects and perhaps childhood cancer among a cohort of females associated with five federal facilities in which there was significant occupational exposure to plutonium. The work will be performed in two stages. In the first stage, a cohort study of female workers at the five facilities is entertained. The protocol of that study is currently being planned. The second stage would study the same outcomes in the wives or conjugal partners of exposed male workers at these same facilities. An attempt will be made to ascertain the existence of a dose-response relationship, at least for the most common outcome (spontaneous abortion).
Keywords: plutonium compounds; biological radiation effects; women; reproductive disorders; abortion; congenital malformations; fetuses; dose-response relationships; personnel.

34100 Changes in Mammalian Pulmonary Function Produced by Inhaled Environmental Agents. Lam, H.F. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80020-07 EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$66,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Changes in pulmonary function resulting from inhalation of airborne pollutants are being estimated using a whole body pressure plethysmograph constructed for use with small animals. Both acute and chronic exposure to oxidants, singly and in combination with other compounds result in functional changes. Changes in pulmonary mechanics (e.g. resistance, compliance), spirometry (e.g. lung volumes, frequency of breathing), heart rate, and pulmonary morphology will be estimated.
Keywords: lungs; biological functions; inhalation; mammals; air pollution; photochemical oxidants; toxicity.

34101 Effects of Environmental Contaminants on Cardiac Function. Van Stee, E.W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30042-04 EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$15,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is directed toward the detection of functional changes in the cardiovascular system associated with compounds of environmental significance to which toxicologically significant exposure would be expected by inhalation. Carbon disulfide-present in perfusate at concentrations as low as 100 ppM (v/v) has caused contracture in isolated, perfused rabbit hearts under certain experimental conditions. A series of experiments is underway to verify and characterize this phenomenon more fully and, if possible, determine the physiological mechanism of action.
Keywords: cardiovascular system; biological functions; toxicity; carbon sulfides; inhalation; rabbits; heart; physiology.

34102 Development of an Automatic Small Animal Inhalation Facility. Moorman, M.P. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30045-03 EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project involves the design and implementation of a microcomputer based system to monitor and control gas concentrations in a small animal inhalation exposure facility. Included in this effort are the development of hardware, software and operational procedures necessary for the complete utilization of the system. Sulfur hexafluoride is being evaluated for use as a tracer gas in the monitoring of chamber additives and for chamber leak detection.
Keywords: laboratory animals; inhalation; sulfur fluorides; laboratory equipment; tracer techniques; experiment planning; toxicity.

34103 Chemical and Enzymatic Conjugation of Glutathione with Arene Oxides and Epoxides. McKinney, J.D. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ZO1 ES 30050-03 ECB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$48,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Nuclear magnetic resonance (NMR) spectroscopy is being used to investigate the chemical conjugation of specific benzo[a]pyrene oxides and other arene oxides to glutathione, enzymatically and non-enzymatically. The regiospecificity and stereospecificity of the reaction will be determined. Mechanistic elaboration of the binding process is important in understanding, preventing, and predicting the mechanism(s) of action of such compounds. A high pressure liquid chromatography (HPLC) system was developed to

allow analysis of mixtures of glutathione conjugates and to follow their metabolic degradation through several steps down to mercapturic acids.
Keywords: glutathione; epoxides; nuclear magnetic resonance; benzopyrene; metabolism; nmr spectra.

34104 Field Desorption Mass Spectrometry Studies. Hass, J.R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 30064-02 ECB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Adducts of phosphodiesters and polynucleotides with N-acetoxy-2-acetaomido-fluorene were prepared for analysis by field desorption mass spectrometry. Similar adducts of 9-bromomethylbenz(a)anthracene and benz(a)pyrene epoxydihydrodiol will be examined as well. Samples of selected dinucleotides were obtained.
Keywords: mass spectroscopy; adducts; nucleotides; esters; fluorene; anthracene; benzopyrene; epoxides; sample preparation.

34105 Characterization of the Binding of Heavy Metals in Biological Systems. Cox, R.H. (National Institite of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30067-02 ECB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

1H, 13C and metal nuclear magnetic resonance (NMR) spectroscopy is being used to investigate the specific binding character of certain heavy metals using purified biopolymers, their monomer and other isolated and definable biological systems as models. An attempt is being made to correlate binding propensity with toxic effects of the heavy metals. Early work indicates that 207Pb NMR offers a useful probe into the binding of lead.
Keywords: metals; nmr spectra; nuclear magnetic resonance; lead 207; chemical bonds.

34106 Early Detection of Lung Injury. Tombropoulos, E.G. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30085-02 EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Pulmonary lavage is easily obtainable and can be taken at various time intervals from the same animal (large such as dogs) without killing the animal. Pulmonary lavage contains lipoproteins, lipids, proteins, cells including macrophages and enzymes. The majority of these components are synthesized by the lung but some come via the pulmonary circulation, and some originate from bone marrow such as the macrophages. The alveolar macrophages are vital entities of the mammalian immune mechanism (in the latter, capacity macrophages depend upon plasma membrane activity for migration recognition, activation, phagocytosis and attachment to substrate tissue). Thus lavage can be used as a probe for early detection of lung damage, and of lung immune mechanism.
Keywords: lungs; pathological changes; dogs; animals; immune reactions; biochemical reaction kinetics.

34107 Environmental Teratology Information Center (ETIC). Wassom, J.S. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** ERDA-40-524-75. **Contract:** ERDA-40-524-75. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$170,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the project is to establish a teratology information center to: (1) collect reprints of all publications that contain data pertinent to determination of the teratogenic potential of environmental agents or conditions to which man is exposed; and (2) use facilities available at Oak Ridge National Laboratory to extract specific information from relevant references and to develop methodology permitting computer storage and retrieval of this information. To date more than 14,000 pertinent references have been entered into computer storage and 10,000 of these are available online through TOXLINE. A mechanism for extracting information from each reprint containing data and for making this information available on-line is being tested through an additional contract. This information may be used to minimize unplanned duplication of tests, to aid in determination of the teratogenic status of individual agents, and to establish priorities in the planning of future investigations.
Keywords: teratogenesis; information centers; environment; data acquisition; reproduction; automation; toxicity; data base management; toxins; hazardous materials.

34108 Macrophage Function and Environmental Toxicology. Boorman, G.A. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30093-01-EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this study is to develop a panel of tests that will assess macrophage function in animals exposed to toxic environmental agents. Pulmonary alveolar macrophages, resident peritoneal macrophages, and thioglycollate induced peritoneal exudate cells are collected from control B6C3F1 female mice and exposed to polybrominated biphenyl (PBB) and tetrachlorodibenzodioxin (TCDD) and tested for a variety of parameters that involve macrophage function. Specifically macrophages are assessed for acid phosphatase content, ability to phagocytize sheep red blood cells and numbers of macrophages. In addition, two new assays are being studied. A microtiter method for measuring macrophage proliferation by tritiated thymidine uptake has proved to be easy and reproducible. Macrophage cytotoxicity as measured by release of tritiated thymidine from labeled tumor cells is under development. General macrophage tests such as host resistence to Listeria monocytogens and endotoxin sensitivity are also used.
Keywords: macrophages; mice; biological functions; toxic materials; biological effects; brominated aromatic hydrocarbons; organic chlorine compounds; organic oxygen compounds; aromatics.

34109 Effects of Polychlorinated Biphenyl Isomers on Extrahepatic Metabolism of Benzpyrene. Goldstein, J.A. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30094-01-EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study was initiated to examine the effects of two polychlorinated biphenyl (PCB) isomers (2,4,5,2',4',5'-PCB and 3,4,3',4',5'-PCB) and a commercial PCB mixture on the in vitro metabolism of benzpyrene (metabolic profile of benzpyrene metabolites) and covalent binding of benzpyrene to macromolecules in skin and other extrahepatic tissues.
Keywords: aromatics; organic chlorine compounds; biological effects; benzopyrene; metabolism; skin; synergism.

34110 Tumorigenic Potential of NO2 Inhalation in Small Animals Exposed to Heterocyclic Amines. Van Stee, E.W. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30098-01-EBB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Random bred, male Fisher 344 rats, CD-1 mice, and golden Syrian hamsters were exposed to 1 to 2 ppM of NO2 for 6 hr/day, 5 da/wk for 30 weeks. Some of the animals also received 0.1% morpholine in deionized water as their sole source of drinking water. The animals will be held for 50 wk after the 30 wk NO2 exposure period during which time all animals will receive deionized water. Animals will be killed for histopathological evaluation following the postexposure holding period. Future studies will include other heterocyclic amines, e.g., piperazine, 2,6-dimethylmorpholine.
Keywords: nitrogen dioxide; inhalation; morpholines; ingestion; chemical reactions; synergism; carcinogenesis; nitroso compounds; biological effects; rats; mice; hamsters.

34111 Effects of Chronic Exposure to Airborne Environmental Agents. Stone, C.J. (Becton-Dickinson and Co., Research Triangle Park, NC, 27709). **Project number:** N01-4-2164. **Contract:** N01-4-2164. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to conduct studies on the inhalation toxicology of environmental chemicals. This involves both selected gases and solid particulates. During this reporting period, studies were conducted on vinyl chloride, various forms of asbestos and glass wool used for insulation.
Keywords: vinyl monomers; organic chlorine compounds; asbestos; mineral wool; toxicity; inhalation; chronic exposure.

34112 Analysis of Total Organic Chlorine and Bromine Residues in Human Body Fluids and Tissues. Reed, J. (Science Applications, Inc., La Jolla, CA, 92038). **Project number:** NIH-N01-ES-8-2105. **Contract:** NIH-N01-ES-8-2105. **Supported by:** National Inst. of Envi-

ronmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to analyze 1500 to 2000 samples per year of breast milk, formula, blood serum, and tissue for total organic chlorine (TOCl) and bromine (TOBr) of whole fluid or wet tissue of for total soluble organic chlorine (TSOCl) and bromine (TSOBr) content of portions of lipids. The desired detection thresholds range from 5 to 20 ng chlorine and 0.1 to 15 ng bromine/gm milk. The contractor's major efforts to date have included completion of literature searches, performance of NAA on blanks, reagents, and solvents, and development and validation of methodology for desalting human milk serum. It was shown that the originally proposed precipitation desalting technique is not compatible with NAA measurement. A new method was developed based on Bio-Gel P-2 filtration which is compatible. Additional methodology will be developed for milk substitutes (formula) and palcenta tissue extracts. Analyses of the first complete sets of mother's milk and blood are in progress.
Keywords: milk; blood serum; tissues; placenta; organic chlorine compounds; organic bromine compounds; qualitative chemical analysis; quantitative chemical analysis; biological localization.

34113 Analysis of PCB's and DDE in Human Body Fluids and Tissue. Hughes, D.L. (WARF Institute, Inc., Madison, WI, 60616). **Project number:** NIH-N01-ES-7-2141. **Contract:** NIH-N01-ES-7-2141. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to analyze 1000 to 1200 samples per year of breast milk, formula, blood serum and placental tissue for polychlorinated bipheynls (PCB's) and 1,1-bis(p-chloro-biphenyl)-2,2-dichloroethane (DDE). The desired detection thresholds range from 0.5 to 50 ppB depending on the type of sample. The possible effect of transplacental and breast milk transfer of environmental contaminants from mothers to babies is an important and recurring epidemiological question. It has been shown that environmental contamination of breast milk occurs in the United States. Organohalogen pesticides and the polychlorinated biphenyls (PCB's) are widespread contaminants of breast milk. This study provides an integral part of an overall study of the possible widespread contamination of breast milk by environmental contaminants such as PCB's and their effects on infant development and health.
Keywords: aromatics; organic chlorine compounds; pesticides; human populations; metabolism; bioassay; infants.

34114 Chemical Repository for Mutagenicity Screening. Keith, L.H. (Radian Corp., Austin, TX). **Project number:** N01-ES-8-2144. **Contract:** N01-ES-8-2144. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this contract is to establish a repository for 3000 to 4000 compounds which are to be screened for mutagenicity. Available physical--chemical and toxicological information is provided on all compounds and chemical analysis is performed when required. A total of 206 test compounds and 24 controls have been selected for FY 79 testing. To date 160 test compounds and 23 controls have been received by the repository. All chemicals are stored in the contractor's Hazardous Materials Laboratory. Catalog file data (chemical properties, etc.) are compiled as compounds are placed in inventory status. Work is nearing completion on implementing a computerized inventory and data-handling system. Satisfactory survivability tests have been completed and approximately 60 aliquots have been shipped to 3 test labs. A summary of operating procedures for the Hazardous Materials Laboratory has been written. One chemical has been subjected to satisfactory chemical analysis.
Keywords: mutagen screening; toxicity; physical properties; chemical properties; inventories; hazardous materials; data base management.

34150 Preventive Surveillance of Environmental Chemicals for Toxic Potential. Posner, H.S. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-20003-06 OHHA. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$72,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The project uses a variety of techniques for early awareness and attempted reduction of chemical- and physical-agent-mediated health hazards. Some of the projects this year were as follows. The 262 compounds with a vinyl halide subgroup of commercial, contaminant and natural product significance were sorted into several subcategories for comparison with pharmacologic and toxicologic information. Information regarding the safe use of herbicides for the control of marihuana was investigated in coordination with others at NIEHS and in an interagency study group. This has involved mainly the present use of paraquat or the potential use of a 2,4-D ester or another compound as herbicides, and of (+)- limonine dimercaptan and other compounds as an odorant marker. The literature is being monitored with regard to methanol toxicity; the uses and safety of aminimide compounds and health effects of changes in stratospheric ozone, the latter due to anthropogenic influences. Several committees are served, documents from other Government agencies are reviewed and requests for information are answered.
Keywords: chemical effluents; toxicity; health hazards; vinyl monomers; plastics; herbicides; methanol; ozone.

34151 Surveillance of Potential Environmental Health Hazards. Damstra, T. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-20004-05 OHHA. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The objectives of this long-term project are: (1) to compile an index of associations between organ system diseases and symptoms in humans and exposure to environmental and occupational chemicals; and (2) to assess the practicality and validity of using neurological and behavioral tests as early indicators of toxicity and as surveillance tools.
Keywords: health hazards; human populations; chemical effluents; neurology; behavior; biological indicators; toxicity.

34152 Identification and Evaluation of Environmental Health Hazards: Chemicals and Chemical Carcinogens. Jurgelski, W. Jr. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-20007-02 OHHA. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: Coal(100) **R and D categories:** Health effects assessments.

The objective of this project is to identify and evaluate real and potential health hazards in the environment with emphasis on chemicals both as toxicants and as carcinogens.
Keywords: health hazards; chemical effluents; carcinogens; mutagen screening; coal mining; coal miners.

34153 Identification of Potential Environmental Health Hazards. Duke, J. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-20009-01-OHHA. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim is to identify and evaluate potential health hazards in the environment from exposure to chemicals by an in-depth search of the literature. The mechanism of action of the toxicant is the ultimate goal of this endeavor. A correlation was made between chemical structure and carcinogenic activity (potency, target organ specificity) in two species, two sexes based largely on information derived from the NCI bioassay data collection. This compilation is helpful in suggesting carcinogenic activity in closely related chemicals which have not been on test.
Keywords: toxic materials; biological effects; health hazards; reviews.

34154 Appraisal of Environmental Exposure to Heavy Metals. Smith, I.C. (Midwest Research Inst., Kansas City, MO, 64110). **Project number:** NIH-NIEHS-78-2153. **Contract:** NIH-NIEHS-78-2153. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Health effects assessments.

The objectives of this program are to: (1) identify sources and routes of human exposure to heavy metals as a result of the various steps and industrial operations involved in the commercialization, utilization, and disposal of metals and their compounds; (2) examine and present available information on the toxicology of the metal and its compounds, and to identify analytical methods and their limitations for quantitative measurement of metals in environmental and biological media; and (3) forecast trends in metal production that may produce increased environmental entry and exposure to metals.
Keywords: metals; environmental impacts; human populations; environmental exposure pathway; toxicity; forecasting; quantitative chemical analysis.

34155 Fate of Heavy Metals and Heavy Metal Complexes in Soils and Plants. Wildung, R.E. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** NIH-NIEHS-78-2150. **Contract:** NIH-NIEHS-78-2150. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of these investigations are to determine using advanced radiotracer, spectroscopic, and chromatographic techniques: (1) the rate and extent of uptake of metals from soils by representative grass and broadleafed plants; (2) the translocation of metals in plants; (3) the effect of metals on soil microbiota and soil microbial processes; (4) the nature of metal bond types and chemical forms of metal metabolites in plant and microbial tissues; and (5) the potential for soil formation of organometal complexes and subsequent intake of these compounds by plants. Implicit in these objectives is the development of suitable methods for determining the chemical forms of metals in soils, plants, and microbial tissues. The metals are nickel, cadmium, chromium, and thallium, and the plants are soybeans.

Keywords: metals; complexes; soils; plants; translocation; microorganisms; cadmium; nickel; chromium; thallium; soybeans; uptake.

34200 Cytophysical Studies in Mutagenesis. Mendelsohn, M.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** MC-03768. **Contract:** MC-03768. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** HEW-$230,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Development of system for monitoring of the human population for mutations in vivo in single cells depends on the detection of a rare event in a single cell which is most effectively done by using flow systems. The scope of this contract is to develop such systems for red blood cells and sperm. Many compounds with widespread distribution in man's environment are known to be mutagenic or carcinogenic in laboratory test organisms. Man's constant contact with mutagens may pose more danger to the genetic health of the human population than does radiation. Nevertheless we do not have available today a monitoring system for the human population. Through collaboration of our in-house research, University of Washington, and this contract, we hope to develop such systems.

Keywords: mutagenesis; biological models; cytological techniques; cell flow systems.

34201 Mutation Studies Using Hemoglobin and Monospecific Antibodies Against Hemoglobins. Ansari, A.A. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 65002-02 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The goal of this project is to develop and test systems that could be used to study mutagenesis in mammals using single cells. Monospecific antibody against mouse hemoglobins has been developed. Techniques have been worked out for making red cell smears and fixing the cells quantitatively for staining.

Keywords: mutagenesis; biological models; hemoglobin; bioassay; sample preparation.

34202 Mechanisms of Sperm Morphology Mutations in PL Mice. Burkhart, J.G. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-65008-01-LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project was to provide understanding about the mechanisms of sperm differentiation that may be related to induction of sperm morphology mutations in mice and humans. Homozygous PL mice produce a wide range of normal and abnormal sperm. We are studying (1) the comparative morphology of normal and abnormal sperm, (2) ultrastructural mechanisms of differentiation that cause the morphology mutations, and (3) the inheritance of the trait. A high frequency of sperm found the inbred homozygous PL mice range as abnormal in comparison with other inbred strains. Some of the abnormalities involve misshapen heads; however, a 27.5% of the sperm produced are headless and have mitochondria that are condensed into a mass at the caudal end of the mid-piece region; all sperm with tails exhibit relatively normal motility. The frequency of the headless variants in heterozygous F1 and F2 progeny indicates the characteristic is mainly recessive but influenced by the female. Electron microscopy of the testes provides evidence that the abnormal sperm morphologies in PL males results from a failure of the paired centrioles to attain a normal position on the nucleus relative to the acrosome before implantation. Future investigations in this area will involve correlation of sperm morphology mutations with quantitative DNA measurements and treatment with mutagenic agents.

Keywords: spermatozoa; mice; morphology; genetics; congenital malformations.

34203 Detection of Translocation Carriers by DNA Measurement in Sperm. Burkhart, J.G. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-65009-01-LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to develop methods to detect translocation carriers in populations of mice treated with potential mutagens by evaluating the DNA distributions of sperm. The Axiomat scanning microscope is being used to quantitate the DNA fluorescence of single sperm and spermatids. The measured distributions of DNA fluorescence are being evaluated within and between normal mice and those carrying known translocations. Work has begun to examine the feasibility of automatic systems of measurement and analysis. At present it has been possible to measure DNA distributions of mature sperm in normal DBA/2J mice and in special strains that carry Robertsonian translocations. The variances of the DNA fluorescence distributions in sperm populations have been found to be significantly greater in the translocation carriers in comparison with normal DBA/2J mice. Future studies will be directed towards maximizing the resolution of the system. In addition F1 males derived from parents treated with compounds known to induce chromosome abnormalities will be evaluated. Data will be correlated to other tests used to detect translocations such as the fertility test and cytogenetic analysis.

Keywords: mutagen screening; spermatozoa; gene recombination; dna; electron microscopy; measuring methods; mice.

34204 Translocation and Sperm Abnormality Induction by N-Isopropyl-alpha(2-methylhydrazino)-p-Toluamide Hydrochloride (Procarbazine Hydrochloride) in Mouse Spermatogonia. Sharma, R.K. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-65010-01-LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The present study was attempted to test whether the treatment of spermatogonial cells with procarbazine induces reciprocal translocations or sperm abnormalities. No translocations were observed in 840 spermatocytes of control animals or 680 cells of animals treated with 400 mg/kg. Only one translocation was observed among 1000 spermatocytes of animals treated with 100 mg/kg. A significant increase in the proportion of sperm with abnormal heads was observed at 400 mg/kg but not at 100 mg/kg.

Keywords: spermatozoa; genes; translocation; biological effects; mice; hydrazine; amides.

34240 Toxicity of Selenium, Alone and in Combination with Silver, in Rats. Cabe, P.A. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 90000-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The present work looked for a detoxification interaction between selenium and a relatively non-toxic metal, silver, in rats. Since metals, including selenium, have been reported to have neurotoxic effects, a limited set of neurobehavioral measures was also taken, concentrating primarily on motor strength and reflex measures. Body weights for the selenium alone group were depressed from the third week of dosing on, although food consumption was elevated for those animals. Food consumption for the silver/selenium group was also typically elevated though not as markedly. Water consumption was decreased consistently for all dosed animals. That body weights for the silver/selenium and silver alone groups never differed from controls suggests that silver does have some protective effect against selenium toxicity. The motor function tests showed no consistent pattern. A parallel experiment assessed the interaction of arsenic and selenium on general health and motor function. Arsenic and selenium in combination killed 7/10 animals. Consumption measures showed consistent effects but motor function was not affected.

Keywords: toxicity; selenium; silver; rats; synergism; neurology; behavior; metabolism; biological effects; consumption rates; food; drinking water; muscles; reflexes; nervous system.

34241 Effects of Acrylamide on Food and Water Consumption and Spontaneous Activity of Rats. Squibb, R.E. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 90001-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$15,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of these studies is to determine the effects of chronic exposure to acrylamide on food and water consumption and spontaneous locomotor activity in domiciliary cages. Attempts will

be made to measure changes in each behavioral variable as a function of dose and length of exposure to acrylamide, age and sex of rat. Behavioral dysfunction and interaction of organismic variables will be associated with physiological and neurochemical measures.
Keywords: food; water; behavior; rats; neurology; physiology; acrylamide; toxicity; biological effects.

34242 Effects of Developmental Exposure to Polychlorinated Biphenyls on Neurobehavioral Functioning of Mice. Tilson, H.A. (National Institute of Environmental Health Services, LBNT, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 90003-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$6,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of these experiments is to determine the neurobehavioral effects of prenatal exposure to 3,4,3',4'-tetrachlorobiphenyl (PCBs) in mice. Offspring of mothers given PCBs on days 6 to 13 of gestation are being assessed for neurobehavioral deficits for up to 1 year after birth.
Keywords: organic chlorine compounds; biphenyl; teratogenesis; mice; behavior; neurology; aromatics.

34243 Neurobehavioral Assessment of Rats Given Carbon Disulfide. Tilson, H.A. (National Institute of Environmental Health Sciences, LBNT, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 90004-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$9,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this study is to assess changes in neurobehavioral functions of rats at various times during and after exposure to carbon disulfide by inhalation. Changes in the functioning of catecholaminergic receptors will also be determined in animals dosed with carbon disulfide.
Keywords: neurology; behavior; rats; carbon sulfides; toxicity.

34244 Neurobehavioral Effects of Chronic Polybrominated Biphenyls in Rats. Tilson, H.A. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 90010-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Lab. of Behavioral and Neurological Toxicology. **Funding:** NIEHS-$24,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Polybrominated biphenyls (PBB) have been reported to produce clinical signs of neurological toxicity in humans and neurobehavioral deficits in rats in relatively short exposures. The present work was intended to assess neurobehavioral consequences of chronic (six month) exposure to a commercial mixture of PBB (Firemaster FF-1). Rats received 0.3, 1.0, or 3.0 mg/kg body weight of FF-1 or corn oil vehicle. Both male and female rats were tested in a battery designed to screen for neurobehavioral dysfunction. Tests included: body weight, motor activity, forelimb grip strength, hindlimb strength, startle to air puff, and rectal temperature. Shock escape latencies and acquisition of shock avoidance were tested at the end of six months of dosing.
Keywords: brominated aromatic hydrocarbons; biological effects; rats; behavior; chronic exposure.

34245 Neurotoxicological Effects of Polybrominated Biphenyls in Rats and Mice. Tilson, H.A. (National Institute of Environmental Health Sciences, Laboratory of Behavioral and Neurological Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 70805-03 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This is a completion report of work that was in progress at the time of the last reporting. Polybrominated biphenyls (PBB) have been recognized as an environmental hazard following the inadvertent mixture of PBB to animal feed. Rats and mice were tested after 30 days of dosing by gavage with Firemaster FF-1 (0.03 to 30 mg/kg), a commercial PBB-containing mixture, with hexabromobiphenyl (HBB; 0.168 to 16.8 mg/kg), the major PBB component, or with corn oil vehicle, and 30 days after dosing ceased. Effects observed included decreases in body weights, open-field activity, forelimb grip strength, and muscular reflexes. Loss of visual placement and hypothermia were seen in some animals. FF-1 was generally more potent than HBB. Rats were more affected than mice. Rats did not recover as well (or worsened) relative to mice during post-dosing. The results suggest neurobehavioral deficits may be produced by PBB at levels lower than those which produce clinical signs of toxicity.
Keywords: neurology; brain; behavior; central nervous system; rats; mice; rodents; toxicity; organic bromine compounds; aromatics.

34246 Neurobehavioral Toxicity of Developmental Exposure of Japanese Quail to Microwave Irradiation. Cabe, P.A. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-90009-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The long-term neurobehavioral effects of perinatal exposure of Japanese quail eggs (Coturnix coturnix japonica) to 2450 MHz CW microwave irradiation at a power density of 5 mW/sq cm for the first 12 days of incubation will be assessed in this experiment. Measures include sexual and reproductive behaviors, a battery of behavioral and neurological measurements, learning and retention, and baseline performance on an operant schedule. Work already completed tentatively suggested differences on learning measures. Results from this study will be used to determine the usefulness of the quail as a subject for behavioral teratological research and for the study of physical factors such as irradiation. This experiment will also be the basis for future investigations concerning the effects of microwave irradiation on neurobehavioral development. Pilot work completed to date suggests that shuttle escape-avoidance performance and acquisition of an autoshaped keypeck response may discriminate between exposed and control animals. Body weights have not been seen to be affected and spontaneous activity has shown no difference. Operant baseline performance under a random-interval schedule of reinforcement is currently under test.
Keywords: microwave radiation; biological effects; birds; behavior.

34247 Effects of In Utero Exposure to PBBs on Neurobehavioral Development of Mice. Tilson, H.A. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-90014-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Pregnant female mice were dosed every other day during gestation and until weaning with 3 or 10 mg/kg of PBBs. Male and female offspring were tested at 30, 90, and 120 days of age in a battery of neurobehavioral tests designed to assess a variety of sensorimotor functions and learning abilities. Binding characteristics of brain catecholamine systems were assessed.
Keywords: mice; behavior; brominated aromatic hydrocarbons; biological effects; teratogenesis; pregnancy.

34248 Effects of Organic and Inorganic Derivatives of Heavy Metals on Binding of Spiroperidol to Striatal Membranes. Agrawal, A.K. (NIEHS, P.O. Box 12233, NC, 27709). **Project number:** Z01-ES-90017-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Health effects assessments.

Many heavy metals have been shown to affect neurotransmitter function. Levels of neurotransmitters and their turnover rates have been found to be altered. No data exists on the effect of metals on postsynaptic binding events. This work involves measurement of effects of organic and inorganic derivatives of lead and mercury upon neurotransmitter receptors. This locus is a critical and often rate-limiting area of nerve function. In vivo and in vitro effects of these metals will be assayed. The developmental aspects of metal effects upon receptor characteristics is of special interest in view of the vulnerability of the immature nervous system to these neurotoxic compounds.
Keywords: elements; biological effects; nerve cells; biological functions; receptors; lead compounds; mercury compounds.

34249 Test Battery for the Neurobehavioral Assessment of Potential Neurotoxins. Pryor, G.T. (Stanford Research Inst., Menlo Park, CA, 94025). **Project number:** N01-ES-8-2154. **Contract:** N01-ES-8-2154. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The general objectives of the research are to (1) determine the steps necessary for selecting doses to be used in studies involving repeated administration of neurotoxic chemicals and comparison standards in low concentrations; (2) determine the ability of each of a set of neurobehavioral procedures, selected by NIEHS, to detect the presence of an expected neurotoxic effect and determine the capability of each test to provide a negative reading when an effect is not expected; and (3) generate a profile of effects for each substance so that tests assumed to measure the same or similar functions can be compared for relative sensitivity (e.g., cumulative dose required to produce a significant effect). To date, the 7-day LD50 values for six of nine compounds and the CTD for three of

nine compounds have been determined. A 90-day repeated dosing study for three compounds will soon be initiated.
Keywords: neurology; behavior; toxic materials; chronic exposure; bioassay.

34280 Cytophysiological Studies in Mutagenesis. Mendelsohn, M.L. (Lawrence Livermore Laboratory, Livermore, CA, 94550). **Project number:** IAA-NIEHS/LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$317,000.
Related energy source: medical applications(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Development of system for monitoring of the human population for mutations in vivo in single cells depends on the detection of a rare event in a single cell which is most effectively done by using flow systems. The scope of this contract is to develop such systems for red blood cells and sperm. The somatic mutation frequency for Hb-A to mutate to Hbs can be determined in man by using fluorescent antibodies. The mutations are rare and it is important to develop automatic counting systems for these rare cells. This will be done by using the flow techniques. It is possible to base a lot of mutation testing systems in somatic cell and in sperm in vivo on detection of variant dehydrogenases. At the present time nitro bluetetrazolium are used to detect the dehydrogenases and to find the variant cell. All cell sorters are based, however, on detection of fluorescent signals. It is, therefore, important to develop dehydrogenase stains which can fluoresce. Part of the effort in this contract is to attach a fluorescent molecule to the tetrazolium molecule so a fluorescent dehydrogenase stain can be developed. Detection of transmissible translocations is a very important tool for establishing risk of chemicals for the human population. At the present time the detection of translocations in mice after treatment of the parent requires a complex breeding program. During the meiosis the mouse, heterozygotic for translocation, will produce sperm with varying amounts of DNA. Techniques will be developed to measure the DNA in single sperm. An increase in variance will indicate presence of a translocation. Techniques have been developed which make it possible to stain red blood cells with fluorescent antibodies in solutions. This is an important step forward toward automatic cell counting.
Keywords: mutagenesis; biological models; human populations; mutations; erythrocytes; cell cultures.

34281 Environmental Mutagen Information Center. Wassom, J.S. (Oak Ridge National Laboratory, Environmental Mutagen Information Center, P.O. Box Y, Oak Ridge, TN, 37830). **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$269,000; EPA-$31,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The mission of the Environmental Mutagen Information Center (EMIC) is to collect, organize, and disseminate chemical mutagenesis information. EMIC's data file at the end of March 1978 contained 22,100 bibliographic entries. Of these, approximately 21,000 have been indexed with respect to agent(s), orgaism(s), and Chemical Abstract Service Registry Number(s). The Center processes requests for information at a rate of 2 to 3 per day. These requests come primarily from governmental agencies in the United States or government supported research in universities. Several requests from other countries are also received. The EMIC data band can now be screened by TOXLINE. EMIC will continue to monitor the world scientific literature for reports on chemical mutagenesis. It will issue its annual literature survey in the middle of the fiscal year. This report will include an index to test organisms or test objectives as well as indexes for agents and selected title keywords. As great a portion as possible of EMIC's total bibliographic entries will be keyworded with respect to agent, test organism, and test object. EMIC will continue to answer selected requests for special information for the scientific, educational, and industrial communites. Tabular extracts of the data from literature will be added to the data file as they are prepared in conjunction with the timely state-of-the-art reports on subjects of current scientific interests.
Keywords: mutagens; information centers; environment; chemical effluents; toxicity; mutagenesis.

34282 Detection of Point Mutations in Somatic Cells. Stamatoyannopoulos, G. (University of Washington, School of Medicine, Seattle, WA, 98195). **Project number:** N01-ES-4-2151 LBG. **Contract:** NIH-NIEHS-74-2151. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$167,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It is likely that an increase in the mutation rate in the human population would be detrimental, yet there is no system developed to monitor the human population for point mutations. The purpose of this investigation is to develop a simple system to measure point mutations in readily accessible human somatic cells. It is likely that the somatic mutation rate would reflect the germ cell mutation rate and the rate of introduction of genetic defects into the human population. Many different types of hemoglobin mutations exist in the human population. Some of these are point mutations in the alpha- and beta-chain. Since such mutations occur in the germinal tissue, it is reasonable to assume that they also occur in the stem cells for the red blood cells (RBC). This type of mutation should result in an RBC which would contain an aberrant hemoglobin. By using a monospecific antibody to a number of aberrant hemoglobin types, such cells should be detected in samples from normal individuals after reaction of the antibodies with various fluorescent dyes. Antibodies are being produced against HbS, HbC, HbO Arab, HbE, HdQ India, Hb Ottawa, Hb Hasharon, Hb Cranston, Hb Wayne, and Hb Constant Spring.
Keywords: mutagen screening; human populations; blood; animal cells; bioassay.

34283 Development of a Polygenic Assay for Point Mutations in Mice. Crenshaw, J.W. (Georgia Institute of Technology, School of Biology, Atlanta, GA, 30332). **Project number:** NIH-N01-ES-5-2135 LBG. **Contract:** NIH-N01-ES-5-2135. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$77,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this contract is to investigate mutagenic effects in mice of some known mutagens, as measured by mean and variance changes in polygenic characters. The contractor is investigating the effects of mutagen-induced polygenic mutations on a series of traits in F1 and F2 generation progenies descended from mutagenized males of inbred strains of mice. Progeny are examined for traits such as age of eruption of incisors, body weight, sex ratio, righting response, and hematocrit. Different strains and mutagens are studied. Results have been mixed in experiments conducted to date. Characteristics subject to change as a result of mutation at any of a number loci may be useful to the detection of mutagenic activity associated with environmental substances. This approach is in contrast with other work which attempts to detect mutagenic change in characters controlled by individual specific genes.
Keywords: mice; mutations; bioassay; mutagenesis; biological models.

34284 Development of a New Mouse Strain to Maximize Sensitivity of a Point Mutation Assay. Roderick, T.H. (Jackson Laboratory, Bar Harbor, ME, 04609). **Project number:** NIH-N01-ES-5-2159. **Contract:** NIH-N01-ES-5-2159. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This contract is for the construction of a special strain of mice which differs to the maximum practical extent for alleles at many loci from the standard DBA/2J strain. Variant alleles not found in either DBA/2J or C57BL/6J are introduced into the C57B1/6J background genotype by mating and repeated backcrossing, the latter being conducted with appropriate monitoring to assure the continued presence of existing allelic differences between the two strains. Electrophoretically expressed enzyme characteristics are presently being utilized. A series of matings and backcrosses have been conducted, but a strain with any significant advantage over C57BL/6J is yet to be developed. There is no practical system presently available with which it is possible to detect systematically and efficiently newly induced point mutations and to study their biological effects in mammals. This contract serves the purpose of assisting the development of such a capability.
Keywords: mice; mutagen screening; sensitivity; mutation frequency; genotype; mutagenesis; biological models; mammals.

34285 Use of Male Germinal Tissue in Detection of Mutational Events. Malling, H.V. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60019-06 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim of this project is to develop systems for measuring the frequency of point mutations in male germinal tissue. These systems would have the advantage of testing the human population by means of readily available samples, i.e., spermatozoa. At present enzyme histochemical methods are being developed to detect point mutations in male mice. The histochemical staining technique has been quantized for glycerophosphate dehydrogenase and succinyl dehydrogenase. Techniques have been developed for selective staining of sperm containing thermo-resistant or urea-resistant glycerophosphate dehydrogenase. Mutation rfrequencies have been determined after treatment of the male mice with procarbazine.
Keywords: mutations; spermatozoa; germ cells; males; human populations; mutation frequency; succinic acid; dehydrogenases; mice; mutagenesis; dna.

34286 Study of Mutation by Using Sperm Specific Enzyme LDH-X. Ansari, A.A. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-65007-02 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project was undertaken to study mutagenesis using monospecific antibodies against the sperm specific enzyme, lactate dehydrogenase-X. A monospecific antibody has been prepared from rabbit anti-serum that reacts with rat sperm and not with mouse sperm. Using this antibody in a sandwich fluorescent antibody technique, the frequency of spontaneous mutation of mouse LDH-X in the DBA/2 mouse to rat kind LDH-X molecule has been estimated to be 0.4 x 10/sup -6/. The induced mutation frequency shows an upward trend upon treatment of the mice with increasing dosage of procarbazine.
Keywords: mutation frequency; mutagenesis; lactate dehydrogenase; rats; spermatogenesis; biological models; mice; biochemical reaction kinetics; mutations; antibodies.

34287 Effects of 60 Hz Fields on the Mammalian Central Nervous System. Adey, W.R. (Veterans Administration Hospital, Loma Linda, CA, 92354). **Project number:** NR-201-219. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to determine the effects of 60 Hz fields from high voltage transmission lines on the central nervous system of mammals. Environmental field conditions similar to those found in the vicinity of high voltage transmission lines will be simulated. These fields gradients will range from 1 to 2000 volts/meter. The effects of these fields on the biological rhythms in rats will be evaluated. The effects on the neuroendocrine mechanism in rats will be examined by using 17-hydroxysteriods, calcium, phosphorus, vanilmandelic acid and other urinary indicators of biorhythmicity.
Keywords: power transmission lines; central nervous system; rats; hvdc systems; biological effects; biological stress; physiology; electric fields.

34288 Effects of Microwave Radiation on the Nervous System. Gandhi, O.P. (University of Utah, College of Engineering, Salt Lake City, UT, 80026). **Project number:** N01-ES-6-2146 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$120,000.
Related energy source: nuclear fusion(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to determine the effects of long-term, low-level exposure to 915 and 2450 MHz microwave radiation on the central nervous system and behavior. Male rats will be exposed to a CW plane wave microwave field at frequencies of 915 and 2450 MHz and power density of 5 Mw/sq cm. The animals will be exposed for 8 hours a day, 5 days a week for 16 weeks. The following measurements will be made: (1) biochemical analysis of the cholinesterase activity of the blood, the SH group in the blood, and ketosteriods in the urine; (2) behavior such as rodent activity, water and food intake; and (3) EEG. An assessment of rat performance on multiple fixed ratio-differential reinforcement of low response rates (FR-DRL) reward schedule was performed. Preliminary analysis of the data indicates a drop in the responses per second on the FR component of the schedule in the exposed animals. Hematological and serum chemistry and urine chemistry has been carried out on the animals. Only one parameter, total free sulfhydryl groups, showed a difference (increase) between the irradiated and sham irradiated animal groups. EEG measurements have been made but the data analysis has not been completed.
Keywords: microwave radiation; biological effects; central nervous system; biological stress; rats; males; blood; behavior; diet; intake; water; food; brain; pathological changes.

34289 Microwave Exposure Systems and Microwave Dosimetry. McRee, D.I. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-50014-09 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$45,000.
Related energy source: nuclear fusion(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the objective of this project to develop microwave exposure systems for bioeffects research and to develop and test techniques for measuring energy absorption. The waveguide system for exposing isolated neurons to 2450 MHz microwave radiation has been modified so that longer survival times and constant temperatures of the nerves during exposure could be achieved. Small thermistor probes have been used to measure deep colonic temperatures in pregnant mice during exposures to 2450 MHz microwave radiation. Using the temperature profiles measured in the dead animals to calculate average absorption rates, the results agreed well with both calculated and measured whole body absorption reported in the literature. A system for exposing groups of marine animals to different intensity levels simultaneously without significant perturbation of the microwave field by the location and orientation of the animals has been developed and tested. A system to expose localized areas or organs in animals has been assembled for use in physiological studies.
Keywords: microwave radiation; radiation doses; bioassay; mice.

34290 Effects of Microwaves on Neural Response. McRee, D.I. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 22709). **Project number:** Z01 ES-50015-05. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: nuclear fusion(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to determine the effects of microwave radiation on neurological response. Isolated neurons such as the abdominal ganglion of the Aplysia, lobster ganglia, the sciatic nerves of frogs and the saphenous nerves of cats will be exposed to CW, pulsed, and modulated microwave radiation in the specific absorption rate range of 0 to 100 mW/g. Fatigue and recovery of the neurons under different modes of stimulation will be studied. The basic mechanisms of interaction will be investigated in cases where changes occur. Experiments to determine if continuous wave, 2450 MHz microwave radiation increases the fatigue rate or changes the vitality of the frog sciatic nerve were completed. The frog sciatic nerves were exposed in a waveguide to specific absorption rates of 100 W/kg, 50 W/kg, 20 W/kg, 10 W/kg, and 5 W/kg. The nerves were stimulated with twin pulses (separated by 5 ms interval) at a repetition rate of 50 pps in order to accelerate the rundown time. Distinct changes in the excitability and refractoriness of the exposed nerve were seen in comparison to the control nerves for specific absorption rates of 10 mW/g and above.
Keywords: microwave radiation; biological effects; neurology; behavior; frogs; lobsters; biological models.

34291 Effects of 2450 MHz Microwave on the Embryonic Development of Japanese Quail. McRee, D.I. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-50017-06 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: nuclear fusion(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to determine the effects of 2450 MHz CW microwave radiation on the embryological development of Japanese quail and the subsequent growth, reproduction, and immunological response of the mature quail which had been exposed during the developmental period. Fertilized Japanese quail eggs were exposed to 2450 MHz CW microwave for various periods of embryonic development at power densities of 30 mW/square centimeters and 5 mW/square centimeters. The effects of exposure on hatchability, gross deformities and hematological parameters were measured in the 2-day-old quail. No differences were found in the hatchability or development in the controls and exposed quail. The quail were then placed in regular feeding and housing facilities and were not exposed to any microwave radiation after hatch. Reproductive performance in the quail was monitored from 6 through 22 weeks of age. Non-exposed controls of both sexes, as well as exposed females, performed normally. However, a decreased percentage of fertile eggs was produced by control or exposed females when paired with exposed males. Mating behavior was normal in both exposed and non-exposed males. No changes in immunological response was detected in the 6-week-old quail.
Keywords: microwave radiation; biological effects; embryos; birds; animal growth; reproduction; immunology; physiology.

34320 Study of Recessive Lethal Mutations Induced in Mice by Chemical Mutagens. Sheridan, W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60042-04 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies are being conducted of the transmission of recessive lethal mutations which were induced in mice by chemical mutagens. Backcross progeny between offspring of lethal bearing animals and their daughters are used to detect the presence of recessive lethals. An increase in fetal mortality is used as indicator of the lethal. The induction of recessive lethal mutations by a chemical has previously been demonstrated in this project. No adequate study of this class of mutation has been conducted with regard to heterozygous effects. It is our purpose to investigate what might be the mode of action and long-term effects of such mutations on animals.

Keywords: mice; mutagenesis; lethal mutations; chemical effluents; toxicity; genetic effects; biological models.

34321 Effects of Chromosomal Aberrations on Embryonic Development. Sheridan, W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60059-03 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is designed to study the effects of chromosomal aberrations on fetal mortality and development. Comparisons will be made between in vivo effects and effects on mouse embryos grown in culture. Chemical mutagens are known to be capable of inducing chromosomal aberrations such as translocations which may be transmitted to the next generation. Increased rates of fetal death are usually observed among offspring to translocation heterozygotes. It is our purpose to investigate the rates of transmission of such aberrations and the processes of fetal mortality by direct observation of the development of embryos.
Keywords: chromosomal aberrations; embryos; mice; mortality; genetic effects.

34322 Molecular Characterization of Isozymes and Mutant Enzymes in Mammals. Li, S. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60062-03 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$120,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The amino acid composition and tryptic peptide maps of three isozymes, LDH-M, LDH-H and LDH-X, purified from mouse muscle, heart and testis, respectively, have been compared. The testicular isozyme LDH-X has also been purified from both rat and hamster and its amino acid composition determined in each case. Isozyme LDH-M has also been purified from horse muscle, and its enzymatic properties, amino acid composition and tryptic peptide map determined.
Keywords: enzymes; molecular structure; mammals; mutagenesis; biological models.

34323 Amino Acid Sequence of Mouse Sperm Lactate Dehydrogenase. Li, S. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60063-03 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$168,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The sperm-specific lactate dehydrogenase from mouse has been cleaved into small paptides by CNBr and trypsin. These peptides are being purified by gel filtration and ion-exchange chromatography. Amino acid sequences of some purified peptides are being determined. Thus far, two-thirds of the 300 residues have been sequenced.
Keywords: amino acids; mice; spermatogenesis; lactate dehydrogenase; biological models; mutagenesis.

34324 Primary Structure Characterization of Mouse Muscular Lactate Dehydrogenase. Nakashima, Y. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60064-03 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Lactate dehydrogenase from mouse muscle has been fragmented into small peptides by chemical and enzymatic procedures. These peptides are being purified by gel filtration and ion-exchange chromatography. Amino acid sequences of some pure peptides are being determined. Thus far, more than one third of the 330 residues have been sequenced.
Keywords: mice; muscles; lactate dehydrogenase; molecular structure; chemical analysis; enzymes; mutagenesis; biological models.

34325 Biochemical Studies of Mouse Enzymes, II: PGK-B Variants. Lee, C.Y. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60087-02 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Three genetic variants of 3-phosphoglycerate kinase-B (a sperm-specific isozyme) were purified respectively from DBA/2J, C3H/HeJ, and C57BL/6J mice, and their kinetic properties were compared. Stability of the enzymes was compared at high temperatures, extreme pH's or in the presence of urea and iodoacetate.
Keywords: phosphotransferases; biochemical reaction kinetics; mice.

34326 Biochemical Studies of Mouse Enzymes, I: Phosphoglucose Isomerance. Charles, D. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60091-02 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$54,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Genetic variants of phosphoglucose isomerase were purified respectively from muscle extract of DBA/2J and C57BL/6J mice. Structural and kinetic properties of these two electrophoretic variants were compared under different experimental conditions in an attempt to find any other biochemical differences.
Keywords: enzymes; biochemical reaction kinetics; mice; muscles; isomerases; mutagenesis; biological models.

34327 Biochemical Mutations in Drosophila Induced by Chronic Irradiation. Langley, C.H. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** 201 ES-60092-02 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

An analysis of mutants recovered after 1000 lines of a balanced lethal strain of Drosophila melanogaster were exposed to chronic low-dose (8.7 rad/hr) -irradiation was carried out. The following mutants were recovered: Got-2, 1; -Gpdh, 6; cMdh, 2; Adh, 0; Dip-A, 0; Hex-C, 4; and -Amy, 0. These represent 7 independent mutation events. Only one of these was associated with a chromosomal aberration (deficiency). Of five which could be analyzed for CRM production, three were CRM-positive. These results suggest that the majority of mutants induced by low-dose-rate -irradiation are point mutations.
Keywords: drosophila; biochemical reaction kinetics; biological radiation effects; mutations; radioinduction; chronic irradiation; low dose irradiation; chromosomal aberrations.

34328 BrdU-Dye Studies of Meiotic Recombination. Allen, J.W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60094-02 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In vivo 5-bromodeoxyuridine (BrdU)-dye methodology is utilized for a variety of cytogenetic studies in rodent germ cells. Analyses of spermatogonial DNA replication and sister chromatid exchange (SCE) patterns are accomplished, and meiotic exchanges are visualized in 1 degree and 2 degree spermatocytes. Together, these studies can form a system for interpreting details of meiotic recombination. Mutagen effects upon SCE and/or meiotic exchange will be examined.
Keywords: sister chromatid exchanges; bioassay; rodents; germ cells; dna replication; meiosis; biological models; mutagenesis.

34329 Sister Chromatid Exchange Analyses in Rodent Fetal Tissues. Allen, J.W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60095-02 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$54,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In vivo sister chromatid exchange (SCE) analyses have been extended to rat fetal as well as maternal tissues. SCE induction effects from selected mutagens/teratogens are being examined after maternal drug metabolism and transplacental passage to various fetal tissues. In some instances, in vitro methodology is also employed in order to study direct effects from the parent compound, and also from known metabolites. The system should allow for sensitive cytological assessment of comparative drug damage at various maternal-fetal interaction stages.
Keywords: rodents; fetuses; tissues; sister chromatid exchanges; drugs; metabolism; mutagenesis; teratogenesis; biological models; in vivo.

34330 Comparison of Rates of Induction of Point Mutations and Chromosome Aberrations in Cultured Cells. Sheridan, W. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60096-02-LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In order to assess the utility of various test systems, different aspects of their potential should be explored. If one type of genetic damage is more easily detected within a system, this might be the criterion of choice. Using the mouse lymphoma cell line L5178Y, mutations at the TK locus were induced by chemical treatment. Studies utilizing the same mutagens are conducted on the frequencies of induction of chromosomal damage and aberrations and compared with the point mutation frequency.

Keywords: cell cultures; mice; lymphomas; mutagens; biological effects; chromosomal aberrations.

34331 Induction of Sister Chromatid Exchanges (SCE) by Ethyl Carbamate in Various Mouse Tissues. Roberts, G. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-61002-01 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Differences in baseline and drug-induced frequencies of SCE between somatic and germ cells have been demonstrated. This capability of the SCE test was utilized to determine the relative sensitivity of various mouse tissues to the carcinogen ethyl carbamate. 5-Bromodeoxyuridine (BrdU)-dye methodology was utilized for examining SCE in vivo and in vitro. The extent of SCE induction in the tissues used correlates well with their known sensitivity to this agent with respect to the induction of carcinogenic and mutagenic endpoints.

Keywords: carbamates; biological effects; chromosomal aberrations; mice; tissue cultures; mutagenesis; in vivo; in vitro.

34332 Surveys of Genetic Variation Utilizing Two-Dimensional Electrophoresis. Langley, C. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-61004-01 LAG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Two-dimensional electrophoresis as described by O'Farrel in 1975 has been applied to the identification and estimation of genic variation in various animal species. After surveying two Drosophila species, mice and humans, for electrophoretic variation in the most abundant proteins, it can be concluded that previous estimates of the naturally occurring levels were overstated. The general conclusion of these studies is that the level of variation revealed by two-dimensional electrophoresis is less than that observed by earlier allozyme/isozyme techniques. Although there may be some sensitivity difference between the techniques, it seems more likely that biases in the selection of loci surveyed in previous studies accounts for the discrepancy. The survey of genetic variation with two-dimensional electrophoresis will be concluded this year with some investigations of rates of molecular evolution in Drosophila and mice.

Keywords: electrophoresis; genetic variability; measuring methods; evaluation; drosophila; mice; man.

34360 Environmental Mutagenesis Testing Development Program. Zeiger, E. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** 201-ES-60052-03 LMG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$162,000.

Related energy source: medical applications(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the Environmental Mutagenesis Test Development Program are twofold. The first is the development of an integrated program for the routine testing of large numbers of chemicals for mutagenicity. This includes such diverse factors as test-system validation, identification and development of new test methods, development of an increased understanding of mutagenesis and development of a strategy and an organizational structure for conducting a large scale testing program and interpreting the results obtained. The second objective is implementation: to test up to 1000 commercial and environmental chemicals per year for mutagenicity.

Keywords: mutagenesis; biological models; chemical effluents; toxicity.

34361 Development of a System for Detecting Lethal Mutations in Mice. Roderick, T.H. (Jackson Laboratory, Bar Harbor, ME, 04609). **Project number:** N1H-N01-ES-4-2156 LEM. **Contract:** NIH-N01-ES-4-2156. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$75,000..

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

At present no efficient test system exists for detection of point mutations in mammals. The aim of the contract is to develop strains of mice, carrying marked inverions, which may be used in studies of induction of point mutations. Theoretically these tests will be comparable to the system presently used in Drosophila. The prime goal is to induce inversions in as many chromosomes of the mouse as possible and combine them in a number of strains to be used as tester stocks. The contractor induces chromosome breaks and inversions by means of radiation and/or chemical agents. He mates the treated animals and in the F1 does cytological analysis of one testis of each individual male. If a significant increase in anaphase bridges appears, this is taken as an indication that the animal may carry an inversion; and he is mated to get offspring for further study. Following cytological and linkage studies to characterize the aberration, a decision is made as to the utility of the inversion and appropriate marker genes are introduced into the stock.

Keywords: mutagenesis; biological models; bioassay; mutations; mice.

34362 Microbial Mutagenesis Testing. Speck, W. (Case Western Reserve Univ., Cleveland, OH). **Project number:** N01-ES-9-2136. **Contract:** N01-ES-9-2136. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this contract is to test a total of 225 environmental and commercial chemicals for mutagenicity using Salmonella typhimurium tester strains in 3 laboratories. Substances found mutagenic in Salmonella will be selected for testing in mammalian and Drosophila systems. The testing aspects of these contracts have just gotten underway and complete results are not yet available. It is expected, however, that testing will proceed rapidly.

Keywords: microorganisms; mutagen screening; mutagenesis; biological models; salmonella; mammals; drosophila.

34363 Microbial Mutagenesis Testing. Haworth, S. (EG and G Mason Inst., Rockville, MD). **Project number:** N01-ES-9-2137. **Contract:** N01-ES-9-2137. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this contract is to test a total of 225 environmental and commercial chemicals for mutagenicity using Salmonella typhimurium tester strains in 3 laboratories. Substances found mutagenic in Salmonella will be selected for testing in mammalian and Drosophila systems. The testing aspects of these contracts have just gotten underway and complete results are not yet available. It is expected, however, that testing will proceed rapidly. These contracts will allow the NIEHS to rapidly screen large numbers of chemicals for mutagenicity in a relatively short time and at relatively low cost. Mutagenicity in this system correlates strongly with carcinogenicity and heritable mutations in rodents. The chemicals found mutagenic, therefore, will be given the highest priority for chronic toxicological and carcinogenesis testing by the National Toxicology Program.

Keywords: microorganisms; mutagenesis; salmonella typhimurium; chemical effluents; mammals; drosophila; mutagen screening; rats; toxicity; carcinogenesis; biological models.

34364 Microbial Mutagenesis Testing. Simmon, V.F. (SRI International, Menlo Park, CA). **Project number:** N01-ES-9-0001. **Contract:** N01-ES-9-0001. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this contract is to test a total of 225 environmental and commercial chemicals for mutagenicity using Salmonella typhimurium tester strains in 3 laboratories. Substances found mutagenic in Salmonella will be selected for testing in mammalian and Drosophila systems.

Keywords: salmonella typhimurium; mutagen screening; mutagens.

34365 Development of New and Improved Salmonella Test Methods. Zeiger, E. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60103-01 LMB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Salmonella typhimurium tester strains are widely used for routine testing of unknown chemicals for mutagenic activity. This project is attempting to characterize such factors as the growth kinetics of the strains during the assay, effects of various growth media on the mutagenic response, and the kinetics of the mutagenic response in host-mediated assay systems.

Keywords: mutagen screening; salmonella typhimurium; response modifying factors; reaction kinetics; bioassay.

34400 Effects of Environmental Agents on Male and Female Reproductive Tract Function. Davis, J. (Endocrine Labs. of Madison, Inc., Madison, WI, 53707). **Project number:** N01-ES-6-2111 LET. **Contract:** N01-ES-6-2111. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$245,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A series of experiments are described which will provide information on the effects of 36 selected xenobiotics (10 per annum) on the fertility of mice (male and female) following prenatal or postnatal exposure, and determine if levels of reproductive hormones have deviated from the norm or if a pathologic condition exists in mice whose reprodcutive capacity has been altered. Information will be obtained on the possible developmental toxicity of these chemicals, including transplacental carcinogenesis.
Keywords: male genitals; female genitals; dynamic function studies; fertility; mice; reproduction; toxicity; chemical effluents; fetuses; embryos; organic chlorine compounds; organic bromine compounds.

34401 Physiological Effects of Arsenic, Cadmium, and Copper on Marine Shellfish. Engel, D.W. (National Marine Fisheries Service, Beaufort, NC, 28516). **Project number:** NOAA-015-77-EI-AR-1 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$80,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This study was undertaken to determine the physiological, biochemical, and ultrastructural effects of arsenic, cadmium, and copper on tissues of marine shellfish in comparison with those previously observed in mammals. Evaluation of pharmacokinetic and toxicological differences in comparison to similar doses of Cd administered as mammalian cadmium-thionein, oyster cadmium-binding protein or Cd/sup +2/ is to be accomplished. An apparently inducible cadmium-specific metal binding protein from oysters exposed to cadmium seems responsible for the known bioaccumulation of cadmium by these organisms and appears to play a role in determining cadmium toxicity.
Keywords: physiology; arsenic; cadmium; copper; toxicity; ultrastructural changes; oysters; biochemistry; water pollution; food chains; diet.

34402 Study of Developmental Disorders in a Model of Embryo Culture During Organogenesis. Sanyal, M.K. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70010-03 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To aid in the laboratory assessment of teratogens and the understanding of the molecular mechanisms underlying teratogenesis, an in vitro culture system for rat embryos has been developed. Rat conceptuses of pregnancy day 10 can be grown continuously for 96 hrs with extensive differentiation of major organs. Utilizing this embryo culture, nutritional and hormonal requirements for embryonic development are being studied, and the system's predictiveness for chemical teratogens is being tested. A microsomal enzyme activating system has been coupled to the embryo culture system which allows the detection of indirect acting teratogens.
Keywords: rats; embryos; teratogenesis; cell differentiation; biological models.

34403 Regulation of Gene Expression During Differentiation. Carter, D.B. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70047-03 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The protein-mapping technique of O'Farrell is being used to study the synthesis of total protein in embryonic and postnatal mouse genital tracts. Normal differentiation in Mullerian and Wolffian ducts from mouse fetuses beginning with day 14 through birth is being followed by 35S-methionine incorporation into protein. High resolution maps of immature and mature mouse uteri are also being developed to establish end points of differentiation. There are approximately 400 protein spots detectable in each pattern developed thus far. Some 5% of the detectable proteins are either sex or developmental stage specific. The effects of prenatal and postnatal diethylstilbestrol on fetal and immature uteri protein synthetic patterns will be assessed.
Keywords: cell differentiation; sulfur 35; mice; fetuses; proteins; genetic mapping.

34404 Effects of Prenatal Exposure to Foreign Chemicals on Genital Tract Function. McLachlan, J.A. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70060-06 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$150,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The long range goals of this project are: (1) to evaluate the effects of prenatal exposure to environmental chemicals on the subsequent reproductive capacity of the offspring; (2) to investigate the mechanisms involved in the production of subfertility in mammals as a result of their in utero exposure to foreign chemicals; (3) to assess the transplacental carcinogenic potential of these compounds; (4) to study the physiologic disposition and metabolism of these compounds in the pregnant animal and fetus; (5) to study chemico-biological interactions of transplacental toxicants, with special emphasis on structure-activity relationships; (6) to determine if prenatal exposure to environmental agents can alter the cytoplasmic receptors for steroid hormones in reproductive tract tissues; (7) to develop and utilize organ culture systems to study the effects of environmental chemicals on the fetal ovary and reproductive tract in vitro; and (8) to evaluate the above animal models as predictors of human response. Special attention is given to diethylstilbestrol (DES).
Keywords: embryos; reproductive disorders; reproduction; fertility; metabolism; physiology; chemical effluents; males; females; pathological changes; carcinogens; ovaries; biological models; biological effects; female genitals; male genitals; toxicity; estrogens; stilbestrol; teratogenesis; polyphenols.

34405 Role of Chemical-Receptor Interactions in Reproduction and Transplacental Toxicity. Korach, K.S. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70065-03 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The main objectives of this project are to determine whether DES is metabolized to biologically and hormonally inactive metabolities; to test the hypothesis that certain chemicals are transplacental toxicants due to their relative binding to plasma/receptor proteins particularly alpha-fetoprotein; to investigate some of the biochemical mechanisms which contribute to results of prenatal exposure of hormonally active environmental chemical in the mouse; to determine the molecular locus of transplacental toxicity using structure-function relationships of different environmental chemicals; and to determine a biochemical marker for transplacental toxicity. These objectives are being studied by using refined biochemical techniques of hormone receptors and hormone action. The basic physiological effects on hormone synthesis and hormone levels will be studied using chemical extraction techniques and radioimmunoassays. Experiments to determine the carcinogenic nature of hormonally active environmental chemicals will be conducted in vivo.
Keywords: reproduction; toxicity; placenta; translocation; receptors; hormones; solvent extraction; radioimmunoassay; biosynthesis; fetal membranes; chemical effluents; teratogenesis.

34406 Transplacental Pathology of Environmental Chemicals. Dixon, R.L. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70070-03 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Three chemicals, methyl-n-butyl ketone, enflurane (ethrane), and ethchlorvynol (Placidyl), were studied initially. Postnatal effects observed were generally associated with changes in blood chemistry parameters and behavioral tests. However, these effects, although statistically significant, often lacked a dose or temporal relationship which complicated the assessment of their biological importance. There was no significant histopathology or carcinogenicity associated with any of these treatments. A more recently initiated experiment which sought to determine the possible postnatal effects associated with prenatal benzene exposure was terminated due to a mycoplasma infection outbreak in the animal colony.
Keywords: organic compounds; aromatics; pathological changes; teratogenesis; carcinogenesis; toxicity; benzene; placenta; membrane transport.

34407 Study of Toxic Effects of Environmental Chemicals on Spermatogenesis. Lee, I.P. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70080-06 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$240,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

These studies seek to assess the effects of environmental agents on spermatogenesis. Agents are tested, test systems validated

and new approaches to toxicity testing proposed: (1) examine germ cell repair and DNA synthesis as indicators for chemical mutagenesis; (2) utilize an integrated approach to study toxic effects on reproductive function; and (3) investigate the toxication-detoxication of polycylic hydrocarbons in gonadal tissue. To date, selected mutagens, trace metals, TCDD, N2O, Freon 22 and DBCP have been studied. A new sensitive alkaline elution analysis of germ cell DNA appears useful as a predictor of environmental agents which damage DNA. A DNA deficient mouse strain has been sought. Biochemical and toxic effects of environmental agents on rodent spermatogenesis are also studied by an integrated approach using spermatogenic marker enzymes, plasma FSH, LH, testosterone, histologic changes, and the in vitro perfusion of testis with selected environmental chemicals. These biochemical and toxic effects were correlated to functionality of spermatozoa through serial mating studies. These studies contribute to an improved understanding of mechanism to toxicity, the reliability of laboratory animal toxicity tests for mutagenic and reproductive effects and validity of their extrapolation to humans.
Keywords: toxicity; spermatozoa; chemical effluents; biochemical reaction kinetics; spermatogenesis; dynamic function studies; mutagens; biological repair; genetic effects; rabbits; mice.

34408 Development of In Vitro Models for Assessing Reproductive Toxicity. Hall, J.L. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70085-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Heterologous (human sperm/hamster egg) in vitro fertilization was used to assess fertilizing capacity of human males. These studies identified certain individuals as subfertile who have routinely determined normal sperm number, motility and morphology. This approach demonstrated that the usual parameters of semen analyses are unsure predictors of male subfertility; only the most extreme semen abnormalities reliably indicate subfertility. Thus, the in vitro penetration of laboratory animal ova by human sperm appears to be an improved technique to assess human fertilization potential. The epidemiologic application of this noninvasive, fast and relatively inexpensive technique is being explored.
Keywords: in vitro; biological models; toxicity; reproduction; human populations; hamsters; eggs; males; epidemiology.

34409 Morphologic and Biochemical Effects of Toxic Metals. Fowler, B.A. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70200-06 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$276,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

When animals are exposed to different trace metals for prolonged time periods, each metal produces a biological response profile which specifically characterizes exposure to that metal. The objectives of these studies are to assess and characterize response profiles based on a thorough understanding of subcellular mechanisms of metal toxicity and specifically to: (1) define and correlate ultrastructural and biochemical responses in vivo which characterize exposure to toxic trace elements following prolonged exposure; and (2) develop early, specific, and sensitive biochemical testing procedures that may be used to evaluate human populations exposed to environmentally important trace elements. Specific metals and areas of interest include the biochemical effects of cadmium, manganese, arsenic, mercury, selenium, and lead on mitochondrial, microsomal and lysosomal structure and function. Enzyme activities associated with mitochondrial membranes have been found to show early and pronounced changes in mitochondria of rats and mice following prolonged exposure to arsenic. Further development of these biochemical response profiles should permit a more basic understanding of the cellular mechanisms of metal toxicity and development of metal-specific biochemical testing procedures which accurately assess a biological response to these agents prior to overt toxicity.
Keywords: toxicity; trace amounts; cadmium; manganese; arsenic; mercury; selenium; lead; mitochondria; dynamic function studies; biochemistry; rats; mice; chronic exposure; pathological changes.

34410 Gastrointestinal Function and Toxicology. Schiller, C.M. (National Inst. of Environmental Health Sciences, P. O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70132-01 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The development of the functions of the small intestine in normal and environmentally, nutritionally and hormonally-stressed animals will be studied. The current functional and toxicological studies that relate to developing and adult animals are: (1) ontogeny of intestinal enzymes and isozymes involved in energy metabolism, i.e., lactate dehydrogenase, NAD-and Fp-glycerol 3-phosphate dehydrogenases, glutamine metabolizing enzymes, gluconeogenic enzymes, and beta-glucuronidase; (2) characterization of the morphology and metabolism of natural and foreign substances in isolated intestinal absorptive cells; and (3) monitoring the response of key intestinal enzymes to in vivo treatment with colon-specific carcinogens, polyhalogenated aromatics and heavy metals.
Keywords: gastrointestinal tract; biological functions; ontogenesis; enzymes; dose-response relationships; carcinogens; aromatics; organic chlorine compounds; elements; morphology; metabolism.

34450 Microsomal Mixed-Function Oxidase Systems: Specificity and Function. Philpot, R.M. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80001-06 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research project is to assess the factors responsible for differences in the substrate specificities among cytochrome P-450-dependent microsomal mixed-function oxidase systems (MFO) from various sources. Present work involves the purification of cytochrome P-450, NADPH-cytochrome c reductase, and lipid fractions from rabbit pulmonary and hepatic microsomes. The cytochrome P-450s are being examined by uv-visible spectroscopy, electron paramagnetic resonance spectroscopy, SDS-gel electrophoresis, and by activities in reconstituted systems. Structural and immunological properties of the cytochromes are also being investigated. The long-range objective of this work is to determine the influence of: (1) multiple forms of the enzymic components of the MFO system; (2) endogenous compounds; and (3) exogenous compounds (inhibitors and inducers) on the substrate specificities of MFO systems from different tissues and species.
Keywords: cytochrome oxidase; biochemical reaction kinetics; rabbits; lungs; liver.

34451 Enzymes Metabolizing Chemicals: Chemical and Physiological Effectors of These Systems. Devereux, T.R. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80002-09 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the long-range purpose of this project to study how various chemicals and physiological changes affect xenobiotic metabolism by the body. This laboratory has concentrated its effort on the lung as a target organ for exposure to environmental stresses. Present studies include isolation of rabbit lung cell types for the purpose of studying localization of xenobiotic metabolism within the lung and toxication-detoxication mechanisms in individual cell populations. The following model enzyme systems are being used for study of individual xenobiotic metabolic pathways in lung cell populations: coumarin hydroxylase, 7-ethoxy-coumarin deethylase, benzo(a)pyrene hydroxylase, and N,N-dimethylaniline N-oxidase. Different lung cell fractions (mixed cell population) appear to have different metabolic profiles indicating possible differences in cytochrome content in the cell types. Cell fractions containing alveolar type II cells and nonciliated bronchiolar epithelial cells (Clara cells) are being further purified for detailed studies of mixed-function oxidase activity.
Keywords: enzymes; metabolism; chemical effluents; physiology; lungs; rabbits; hydroxylase; benzopyrene; cytochrome oxidase; toxicity.

34452 Xenobiotic-Metabolizing Activity in Skin and Its Response to Environmental Agents. Pohl, R.J. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80003-06 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$54,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The project is designed to elucidate the role of xenobiotic-metabolizing enzymes in skin as mediators of toxicity of environmental agents. Mixed-function oxidase (including aryl hydrocarbon hydroxylase), glutathione S-transferase and UDP-glucuronyltransferase activities are measured in pieces of whole skin or epidermis, or in microsomes or cytosol from skin of hairless mice (Hrs/J) after exposure of the mice to ultraviolet radiation, polycyclic hydrocarbons, chlorinated hydrocarbons, etc. The wavelength of maximum absorbance in the carbon monoxide spectra of reduced cytochrome P-450 is identified after separating the cytochrome from contaminating mitochondrial pigments.
Keywords: metabolism; enzymes; skin; toxicity; hydroxylase; mice; ultraviolet radiation; polycyclic aromatic hydrocarbons; organic chlorine compounds; carbon monoxide; cytochrome oxidase.

34453 In Vitro Metabolism of Xenobiotics by Selected Marine Species. Bend, J.R. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80005-06 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$144,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We are investigating the biotransformation of foreign organic compounds in hepatic and extrahepatic tissues of vertebrate and invertebrate marine species from coastal Maine and Florida. Both cytochrome P-450-dependent microsomal mixed-function oxidases and alkene and arene oxide-metabolizing enzymes (epoxide hydrase and glutathione S-transferases) are being characterized in control fish and in fish preexposed to environmental contaminants such as polycyclic aromatic hydrocarbons, dioxins or polyhalogenated biphenyls.
Keywords: in vitro; metabolism; aquatic organisms; vertebrates; invertebrates; coastal regions; maine; florida; alkenes; organic compounds; metabolism; fishes; aromatics; pesticides; polycyclic aromatic hydrocarbons; organic halogen compounds.

34454 Pollutants: Uptake, Distribution, Metabolism, Excretion and Storage Sites in Marine Species. Bend, J.R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80006-08 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$54,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The long-range objectives of this project are to study the in vivo uptake, distribution, metabolism, and excretion of single, purified radiolabeled environmental contaminants, such as 2,4,5-trichlorophenoxyacetic acid, polychlorinated biphenyl isomers, and hydrocarbons, in vertebrate and invertebrate marine species that serve as human food sources. The role of environmental temperature and exposure to other pollutants on the processes involved are also investigated. Particular attention is focused upon potential carcinogens, mutagens, teratogens, and cytotoxins that may occur as food residues due to exposure of aquatic animals, including hydrocarbons from petroleum, pesticides, and polyhalogenated biphenyls.
Keywords: uptake; hydrocarbons; organic chlorine compounds; aromatics; fishes; aquatic organisms; metabolism; vertebrates; invertebrates; distribution; excretion; pesticides; petroleum.

34455 Hepatic and Extrahepatic Conjugation and Oxidation Metabolic Pathways for Xenobiotics in Mammals. Bend, J.R. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80007-08 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$300,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Several arene and alkene oxides are known to react covalently with macromolecules, including nucleic acids, and to transform cells in vitro, suggesting their role as ultimate carcinogens, mutagens, and cytotoxins. We are studying the mixed-function oxidases, which convert unsaturated hydrocarbons to epoxides, and the further metabolism of arene and alkene oxides by soluble fraction glutathione S-transferases and microsomal epoxide hydrase in hepatic and extrahepatic tissues. The relative quantitative importance of the two pathways for epoxide metabolism is being studied in vitro in intact pulmonary cells, and in isolated perfused rat liver and rabbit lung preparations.
Keywords: liver; biological pathways; mammals; metabolism; alkenes; mutagenesis; biological models; perfused tissues.

34456 Role of Altered Membrane Function in Xenobiotic Toxicity. Pritchard, J.B. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80031-03 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$66,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Many aquatic animals are highly sensitive to certain xenobiotic compounds. Such organisms are used as models to identify those physiological processes most sensitive to environmental pollutants. Particular emphasis is placed on membrane functions which underlie these processes. We have utilized as model systems the blue crab (Callinectes sapidus) which is extremely sensitive to organochlorine pesticides, particularly at low environmental salinity where its survival depends on its ability to osmoregulate. The objective is to establish the mechanism(s) responsible for the sensitivity of crustacea to organochlorine compounds. Parameters examined include: (1) the levels of Na,K-ATPase in the gills after adaptation to various environmental salinities; (2) the ouabain binding characteristics of the enzyme; (3) the activity of Na,K-ATPase enzyme after administration of DDT both in vitro and in vivo; (4) the model of inhibition of the enzyme in vitro; and (5) the ability of the intact animal to maintain hemolymph osmolality and ion levels after intravascular administration of DDT.
Keywords: toxicity; crustaceans; aquatic organisms; physiology; organic chlorine compounds; sensitivity; enzyme inhibitors; ddt; osmosis.

34457 Excretion of Xenobiotics by Selected Marine and Terrestrial Species. Pritchard, J.B. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80032-03 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Marine and terrestrial vertebrates are used to examine the role of organic ion transport in the renal and hepatic excretion of environmental contaminants such as DDT and 2,4-dichlorophenoxyacetic acid (2,4-D). Topics under investigation include examination of: (1) the importance of renal and hepatic organic anion transport in the rate of elimination of xenobiotics or their metabolites; (2) the interference of foreign compounds with elimination of endogenous wastes or toxins; (3) the role of intracellular binding proteins, such as glutathione S-tranferases, in transport and toxicity of organic ions; and (4) the influence of membrane transport-related cellular accumulation in the development of the xenobiotic toxicity in target organs, e.g., brain, as well as from the whole organism, is also characterized.
Keywords: hydrocarbons; metabolism; excretion; vertebrates; metabolites; proteins; chemical bonds; pesticides; organic chlorine compounds; ddt; toxins; fishes.

34458 Carcinogenic Effects of Petroleum Hydrocarbons on Selected Marine and Estuarine Organisms. Felton, S.P.; Miller, B.S. (Univ. of Washington, Fisheries Research Inst., Seattle, WA). **Project number:** NIH-N01-ES-7-2101. **Contract:** NIH-N01-ES-7-2101. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) to compare incidence of tumors, particularly epidermal papillomas, in exposure and control groups of selected flatfish species in response to exposure to benzo(a)pyrene (BaP) and/or its electrophilic derivatives; and (2) to qualitatively examine the histopathology of comparable tumors occurring in both exposure and control groups. Progress to date has shown that exposure of young flatfish to BaP in water (1 g/l or by intraperitoneal injection of 2.5, 5 or 10 mg/kg) produces an initial induction of liver AHH activity which declines by 4 and 6 months to levels below those of controls. Studies now in progress are concerned with elucidating the nature of the wide inter-animal response to BaP and possible relationships to carcinogenesis in the animals.
Keywords: petroleum; aquatic ecosystems; carcinogenesis; seawater; estuaries; benzopyrene; toxicity; fishes; liver; physiology.

34500 Cultured Epidermal Cells as a Model for Skin Carcinogenesis. Sisskin, E.E. (National Institute of Environmental Health Sciences, Laboratory of Pulmonary Function and Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-25000-02 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$75,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The vast majority of human neoplasma is thought to be due to environmental factors. There is overwhelming evidence that skin cancer, one of the most commonly occurring human cancers, is usually due to exogeneous insult. The cells that are most likely to be progenitor cells for this carcinoma are the basal cells, which are rapidly dividing and/or differentiating, and as such make an excellent target cell for carcinogenic agents. The purpose of this work is: (1) to develop an in vitro system consisting of dividing, basal cells isolated from epidermis; (2) to induce these cells to undergo neoplastic transformation in vitro following treatment with environmental carcinogens and/or promoters; (3) to determine whether the two-stage model of carcinogenesis is a universal phenomenon, common to animals other than the mouse; (4) to isolate cells from skin papillomas and carcinomas induced in vivo; and (5) to compare the cellular properties of epidermal cells at various stages after in vitro treatment with carcinogens to cells derived from papillomas and carcinomas. The work will be done with inbred Syrian hamsters.
Keywords: skin; cell cultures; epidermis; carcinogenesis; biological models; human populations; mice; hamsters.

34501 In Vitro Carcinogenesis and Promotion Studies. Steele, V.E. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-25002-02 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The major aim in these studies is to study various phases of respiratory tract carcinogenesis at the cellular level using in vitro model systems. The metabolism of benzo(a)pyrene (BP) to oxidative and conjugated metabolites in tracheal epithelial cells was studied at different levels of tissue organization. Tracheal organ cultures, in which the normal histiotypic organization was maintained, were studied as well as primary tracheal epithelial cultures and a nontumorigenic and a tumorigenic tracheal epithelial cell line.
Keywords: in vitro; carcinogenesis; biological models; benzopyrene; epithelium; tumor cells; trachea.

34502 Tumor Induction Studies with the Tracheal Transplant Model. Topping, D.C. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-25003-02 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The fate of carcinogen induced metaplastic-dyplastic lesions induced by airway mucosa was studied. It was found that the great majority of lesions induced by a brief carcinogen exposure is reversible and does not develop into invasive carcinomas. A problem of great theoretical and practical importance in environmental carcinogenesis is whether morphological or other markers exist to signal the appearance of preneoplastic cells, i.e., cells that are precursors of cancer. In the respiratory tract mucosa of humans and animals exposed to products of incomplete combustion of organic materials and to other carcinogenic substances, histopathological alterations have been described which are thought to represent precursors of neoplasias.
Keywords: tumor cells; carcinogens; biochemical reaction kinetics; carcinogenesis; combustion products; toxicity; hydrocarbons; neoplasms; respiratory tract cells.

34503 Establishing Pulmonary Epithelial Cells in Culture. Wu, R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ZOL ES 25004-02 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Research efforts are directed toward investigating the life cycle and basic functions of each type of pulmonary epithelial cells in a well-defined in vitro situation. A major objective of the research is to develop conditions for the long-term cultivation of normal, differentiated epithelial cells. Such a culture offers a model system to investigate the mechanism of cell differentiation, as well as the repair of injury and the pathological response of cells to environmental toxic substances. The success in culturing normal epithelial cells from the respiratory tract is very limited, since most epithelial cells in the conventional culture condition are short lived and cellular basic functions are rapidly lost. Our approach is on one hand to eliminate those unnecessary factors from the conventional culture condition and on the other hand, to provide only required elements for cells. The first study of these series is to replace serum by the needed hormones and growth factors. Our results indicate that tracheal epithelial cells can be continuously maintained in a hormone-supplemented medium. These hormones and factors needed for tracheal cell cultures are insulin, epidermal growth factor and transferrin.
Keywords: epithelium; lungs; cell cultures; cell cycle; cell differentiation; pathological changes.

34504 Synthesis of Polypeptide Hormones and Prohormones by Normal and Neoplastic Lung Epithelium. DiAugustine, R.P. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80033-03 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$240,000.
Related energy source: Coal(35); oil and gas(35); nuclear fission(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The lung epithelium of mammals is known to contain neuroendocrine-like cells and neuroepithelial bodies. Dense-cored or neuroendocrine-type granules have been previously identified in both of these structures. We are attempting to identify known polypeptides hormones in the normal and neoplastic lung epithelium of various species. Although no corticotropin immunoreactivity was identified in normal lungs by immunohistochemical methods, this hormone was identified in cultured cells obtained from hamsters treated with diethylnitrosamine. These cells were also argyrophilic and contained numerous dense-cored vesicles, properties observed in human bronchial carcinoids and in some human small cell carcinomas. These results contrast with those obtained with chemically-induced rodent squamous cell carcinomas. Such tumors exhibited neither immunohistochemical evidence for corticotropin nor cells containing dense-cored vesicles. We are presently investigating the regeneration of tracheal epithelial cells in order to identify pluripotent or progenitor cells for lung neuroendocrine cells and related neoplasias.
Keywords: lungs; neoplasms; hormones; polypeptides; biosynthesis; epithelium; mammals; rodents; man.

34505 Co-oxygenation of Xenobiotics by the Prostaglandin and Thromboxane Synthetase. Eling, T.E. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80035-03 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$96,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the long-range goal of this project to study the co-oxygenation of chemicals, i.e., benzo(a)pyrene (BP) 7,8-diol during the metabolism of arachidonic acid (AA) by guinea pig lung, ram seminal vesicle, mouse skin, microsomes and cells grown in tissue culture. BP-7,8-diol was oxidized to 7,10/8,9 tetrol by prostaglandin synthetase by all the tissues examined. Electrophilic metabolites of BP-7,8 diol were formed since BP-7,8 diol was covalently bound to protein. Significance of this metabolic activation in relation to cell transformation is being examined.
Keywords: benzopyrene; metabolism; arachidonic acid; lungs; guinea pigs; sheep; male genitals; mice; skin; tissue cultures; cell proliferation.

34506 Prostaglandins in Tumor Promotion. Eling, T.E. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-25012-01 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the long range goal of this project to determine whether tumor promotion by various agents, e.g., phorbol esters, proceeds via the release of arachidonic acid (AA) and the subsequent synthesis of prostaglandins (PG). We have examined several fibroblasts and chosen the mouse embryo fibroblast (10T 1/2) as a model system. PG production by these cells was examined with respect to cell growth and cell density. The kind of PG produced by 10T 1/2 was dependent on the number of passages. Phorbol esters (TPA) altered cell growth and PG production. If a correlation can be determined between PG release and tumor promotion, we will have established a basis for the development of a test system for screening environmental tumor promoters.
Keywords: prostaglandins; biosynthesis; oncogenic transformations; fibroblasts; mice; embryos; biological models; growth; neoplasms; esters; biological effects.

34507 Effects of Perinatal Exposure to Gaseous Pollutants on Lung Development. Plopper, C.G. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-25010-01 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

While the pulmonary damage resulting from acute, short-term exposure to components of photochemical smog have been well characterized biochemically, morphologically and physiologically in adults, very little information is available concerning the mechanisms by which the respiratory system adapts to continual insult over the lifetime of an organism. The goal of this work area will be to elucidate the nature of the interactions between the cells of the growing lung and environmental irritants. The emphasis will be on pulmonary reactions occurring over the entire life span of the organism (prenatal to death) in response to gases at realistic environmental concentrations. The first phase is to characterize the normal cellular events during prenatal and early postnatal development of the mammalian lung of a non-human primate (M. mulatta). Once the usefulness of the rhesus monkey as a model for studies of pollutant effects on lung development is established, specific protocols will be developed to evaluate pollutant effects on alveolarization, cellular maturation and overall lung growth and repair phenomena.
Keywords: smog; biological effects; lungs; monkeys; biological models; dose-response relationships; chronic exposure.

34508 Cellular and Molecular Mechanisms of Neoplastic Progression. Barrett, J.C. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-25001-02 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this study is to elucidate the cellular and molecular mechanisms of neoplastic development and to understand how environmental agents influence the progression of normal cells to malignancy. The specific aims of the research are: (1) identifica-

tion of preneoplastic stages during neoplastic development; (2) determination of the role of somatic mutation in a multi-stage model of carcinogenesis; (3) elucidation of whether benign neoplastic cells progress to malignant cells; and (4) understanding the biochemical basis of cellular invasion. The studies involve model systems of oncogenesis which employ fibroblasts and epithelial cells in culture.
Keywords: cell cultures; oncogenic transformations; carcinogenesis; biological models.

34550 Extrapolation of PCB Deposition. Sipes, I.G. (University of Arizona, Tucson, AZ). **Project number:** NIH-N01-ES-2111. **Contract:** NIH-N01-ES-2111. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$109,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to obtain information on the disposition of polychlorinated biphenyls (PCBs) in dogs and monkeys and to use this knowledge in the further development of a pharmacokinetic model which will predict for a number of species the distribution, accumulation, and excretion of PCBs and other chlorinated xenobiotics after different dose levels and routes of exposure. The distribution, accumulation, metabolism, and excretion of 14C-labeled PCBs (4,4'-dichloro-, 2,4,5,2',4',5'-hexachloro-, 2,3,6,2',3',6'-hexachloro-biphenyl) will be studied in Beagle dog and Fasciculous monkey. All major tissue and excreta (urine and feces) are sampled at various times after administration of the PCB. Biliary studies are also to be conducted to determine the necessary pharmacokinetic parameters needed for modeling. Flow rate to the major organs will be determined in the monkey by means of microsphere technique. The results are: (1) The half-life of a PCB in the dog or the monkey is inversely proportional to the rate of metabolism of that PCB; (2) the dog is much better able to metabolize PCBs than is the monkey or even the rat; (3) chlorination in the para position greatly inhibits PCB metabolism by the monkey, but not by the dog; (4) PCBs with adjacent unsubstituted meta and para positions are readily metabolized by the monkey; and (5) the major tissue depots for unmetabolized PCBs are the fat and skin in both the monkey and the dog.
Keywords: organic chlorine compounds; aromatics; metabolism; dogs; monkeys; carbon 14 compounds; drugs; biochemical reaction kinetics.

34551 Pharmacokinetics of Chlorinated Xenobiotics. Matthews, H.B. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80016-06 LPK. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$150,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Previous work in this laboratory has described the absorption and tissue distribution of halogenated hydrocarbons and the importance of metabolism to the excretion of these compounds. The results of current studies demonstrate that adjacent unsubstituted carbon atoms in the meta-para positions of polychlorinated biphenyls (PCBs) facilitate their metabolism via arene oxide intermediates and results in greater binding to subcellular macromolecules. Other current work demonstrates that the adipose tissue is not a well mixed pharmacokinetic compartment and that this fact may result in inaccurate extrapolation of disposition data from acute to chronic studies.
Keywords: organic chlorine compounds; hydrocarbons; metabolism; aromatics; tissue distribution; excretion.

34552 Pharmacokinetic Parameters in Carcinogenesis: Their Alteration by Anti-Carcinogenic Agents. Anderson, M.W. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-35003-01 LPK. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Numerous studies suggest that the in vivo metabolism of benzo(a)pyrene (BP) and other carcinogens is altered when animals are pretreated with anticarcinogenic agents such as butylated hydroxy anisole (BHA). Based on these observations, we have initiated studies to determine the type and amount of in vivo metabolic alteration and DNA binding of BP in animals pretreated with BHA. At present, the profiles of the glucuronide and sulfate conjugates in the bile have been determined in control and BHA treated animals. No sulfate conjugates were detectable in control or treated animals. Glucuronide conjugation accounted for 30% of the dose in control or treated animals; BHA pretreatment altered the profile of the glucuronide metabolites. The amount of 6-hydroxy BP was decreased in BHA treated animals and the amount of 4,5-dihydrodiol BP was concomitantly increased. This could have implications as to the anti-carcinogenic action of BHA since 6-hydroxy-BP has been suggested to be a carcinogenic metabolite of BP. Recycled metabolites of BP were also decreased by BHA pretreatment.
Keywords: benzopyrene; metabolism; response modifying factors; carcinogenesis; in vivo; anisole.

34553 Metabolism of Polychlorinated Biphenyls. Matthews, H.B. (NIEHS, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80014-06 LPK. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Most polychlorinated biphenyls (PCBs) are readily absorbed from the intestines of higher animals, but metabolism to more polar compounds is a prerequisite to PCB excretion. The retention of PCBs is inversely proportional to the rate of metabolism. It is the position and not necessarily the degree of chlorination that determines the rate of PCB metabolism. Two adjacent, unsubstituted carbon atoms are required for a rapid rate of PCB metabolism because their presence facilitates oxidative metabolism, probably via an arene oxide intermediate. However, PCBs without two adjacent unsubstituted carbon atoms may be metabolized via an arene oxide intermediate by shifting a chlorine, using the NIH shift, or by directly inserting a hydroxyl group into the meta position. The major metabolites of PCBs are mono- and di-hydroxylated derivatives which are excreted as glucuronide conjugates.
Keywords: chlorinated aromatic hydrocarbons; metabolism; retention; biochemical reaction kinetics; excretion.

34554 Extrapolation of PCB Disposition. Sipes, I.G. (Univ. of Arizona, Tucson, AZ). **Project number:** NIH-N01-ES-2111. **Contract:** NIH-N01-ES-2111. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to obtain information on the disposition of polychlorinated biphenyls (PCBs) in dogs and monkeys and to use this knowledge in the further development of a pharmacokinetic model which will predict for a number of species the distribution accumulation and excretion of PCBs and other chlorinated xenobiotics after different dose levels and routes of exposure. The stipulations of this contract have now been fulfilled and the contract will be terminated. The data obtained from the contract is quite good and there is an ongoing effort to use this data in the construction of a physiological pharmacokinetic model which will allow the extrapolation of the disposition of PCBs to several species.
Keywords: chlorinated aromatic hydrocarbons; dogs; monkeys; metabolism; biochemical reaction kinetics; distribution; biological accumulation; excretion; pharmacology; mathematical models.

34600 Toxicants and Avian Cell Growth and Metabolism. Wilson, B.W. (University of California at Davis, Department of Avian Science, Davis, CA, 95616). **Project number:** R01-ES00202. **Contract:** R01-ES-00202. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$49,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Organophosphate pesticides constitute an important environmental health problem because of their widespread use. Much is known about the toxic actions of these agents attributable to their inhibition of acetylcholinesterase (AChE) at neural and neuromuscular junctions. However, much less is known about the ways cells recover from organophosphate intoxication. In studies of the recovery of cultured muscle and nerve cells from paraoxon and diisoprophylfluorophosphate, evidence has been obtained that the rapid recovery process involves some type of feedback control of the rate of AChE recovery and an increase in total AChE activity and protein at the cells. In addition we have used various drugs to obtain evidence that AChE has been examined by electron microscopy. These studies will be continued by examining the role of protein degradation in the recovery process of the cells and the possible electrophysiological changes that accompany regulation of AChE levels. The levels of other cholinergic macromolecules, such as acetylcholine receptor and choline acetyltransferase will be examined to see if they are altered by factors that affect AChE. In addition, we propose to complete the isolation of the multiple forms of AChE of the chicken and study the localization and movement of the molecules.
Keywords: pesticides; organic phosphorus compounds; biological effects; toxicity; chickens; cell cultures; animal cells; cholinesterase; transferases; enzyme activity; inhibition; biological recovery; receptors; pathological changes; cell membranes.

34601 Quantitative Genetic Study of Environmental Mutagens. Lee, W.R. (Louisiana State Univ., Dept. of Zoology and Physiology, Baton Rouge, LA, 70803). **Project number:** R01-ES-00320.

Contract: R01-ES-00320. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

To evaluate the genetic hazard of chemicals in our environment and understand their mode of action, it is necessary to place chemical mutagenesis on a quantitative basis in an eukaryote organism that can be thoroughly and economically analyzed genetically. Ethyl methanesulfonate (EMS) was selected as the mutagen for developing a model test system because of its known mutagenic effectiveness and its simple chemical structure which makes it relatively easy to synthesize with radionuclides having high specific activity. The mutagenic action of EMS is considered due to its alkylation of DNA, a point of view supported by previous work on this project using Drosophila in a bioassay of blood plasma from hamsters that had been previously injected with EMS. To place the dosage of EMS on a quantitative basis, total alkylation of DNA in Drosophila melanogaster spermatozoa is measured on a per sperm cell basis and then further divided into alkylation at specific sites such as the 7 position guanine. This dosimetry will then permit the construction of dosage response curves with the dose in terms of alkylation and the response in terms of the extensive mutational spectrum developed with Drosophila. This project differs from previous work with alkylation in that we are studying both alkylation and the genetic consequence within the same germinal tissue of an eukaryote.
Keywords: genetic effects; chemical effluents; organic sulfur compounds; drosophila; spermatozoa; mutagenesis; mutation frequency.

34602 Benzene Toxicity and Metabolism. Snyder, R. (Thomas Jefferson University, 1020 Locust Street, Philadelphia, PA, 19107). **Project number:** R01-ES-00322. **Contract:** R01-ES-00322. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$70,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim is to study the biochemical events that lead to the functional and morphological changes characteristic of benzene toxicity and to determine how benzene toxicity might be prevented or alleviated. The metabolic pathway of C-14-benzene in vitro and in vivo will be studied and the metabolites produced will be quantitated and located in the animal, and the extent the metabolites are responsible for toxicity will be determined. The biochemical studies will be correlated with evaluations of bone marrow function both before and during the appearance of bone marrow disfunction. Erythrocyte and white cell counts, total counts and differential counting of white blood cells will be done as well as reticulocyte counts, Fe-59 uptakes into marrow and circulating RBC's and serum Fe determinations as parameters for monitoring benzene toxicity. At the earliest stage of toxicity, it is intended to look for interaction between benzene and/or its metabolites with nucleic acids. An attempt to prevent benzene toxicity by inhibiting its metabolism will be made and the role of nutrition in resistance to benzene toxicity will be studied.
Keywords: benzene; toxicity; metabolism; carbon 14 compounds; nutrition.

34603 Enzymatic Oxygen Fixation into Aromatic Hydrocarbons. Gibson, D.T. (University of Texas, Department of Microbiology, Austin, TX, 78712). **Project number:** R01-ES-00537. **Contract:** R01-ES-00537. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$67,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

Aromatic hydrocarbons constitute a major source of raw material for the production of fuels, industrial solvents, drugs, herbicides, pesticides and plasticizers. The parent hydrocarbons are toxic to most forms of life. In several cases it is known that oxygenated products formed enzymatically from the aromatic hydrocarbon are more harmful than the unsubstituted substrate. Little evidence is available that describes the enzymatic reactions involved in such transformations. The objectives of this research project are to elucidate the mechanisms of oxygen fixation into aromatic hydrocarbons and to define some parameters of biodegradability that relate to the effects of substituents on the benzene nucleus. Pseudomonas putida grows on toluene as sole source of carbon. The enzyme catalyzing the initial oxidation of toluene incorporates two atoms of molecular oxygen into the substrate with the formation of cis-2,3-dihydroxy-1-methylcyclohexa-4,6-diene. This reaction will be investigated in two ways: (1) the enzyme will be purified and the mechanisms of substrate-oxygen-enzyme interaction determined (techniques to be used include salt and solvent fractionation, column chromatography, electrophoresis, electron spin resonance, and spectrophotometry); and (2) the enzyme is known to oxidase azulene, a model substrate in which electron densities at different positions of the ring are known.
Keywords: hydrocarbons; toxicity; aromatics; pseudomonas; benzene; toluene; oxygen; chemical reactions; azulene; naphthalene; metabolism.

34604 Response of Alveolar Macrophages to Inhaled Particles. Brain, J.D. (Harvard University, 665 Huntington Avenue, Boston, MA, 02115). **Project number:** R01-ES-00583. **Contract:** R01-ES-00583. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$120,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective is to understand better how the lung responds to inhaled particles. Since clearance of particles and pathogens from the non-ciliated parenchyma of the lungs is the primary function of the alveolar macrophages and since their migratory pathways and behavior may be pivotal events in the pathogenesis of pulmonary disease, it is planned to focus attention on these cells. This investigation has three distinct purposes: (1) to investigate the origin and differentiation of alveolar macrophages using the techniques of histochemistry, autoradiography, and organ culture to trace the movement of macrophages into and/or through the interstitium and to document their differentiation; (2) to investigate the consequences of particle ingestion by alveolar macrophages and whether particle ingestion leads to activation of hydrolytic enzymes and to extracellular enzyme release, as will the migratory behavior of particle-containing macrophages; and (3) to investigate the importance of competitive phenomena following particle challenge using both in vivo and in vitro test systems. Since inhalation is the primary entry route for agents that cause environmental, occupational, and infectious diseases, it is of clear importance to clarify the roles of the macrophages.
Keywords: macrophages; lungs; pathogenesis; cell differentiation; biological pathways; aerosols; particles; infectivity.

34605 Perceived Intensity of Odorants and Irritants. Cain, W.S. (John B. Pierce Foundation of Connecticut, Inc., 290 Congress Avenue, New Haven, CT, 06519). **Project number:** R01-ES00592. **Contract:** R01-ES-00592. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$77,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The project concerns the perception of odor intensity. It seeks primarily to specify how odor intensity, and in particular the psychophysical function that relates perceived intensity to concentration, depends upon the physicochemical nature of odorous stimuli and upon various conditions of odor masking and adaptation. The odor stimuli will include odorous pollutants, irritants, and masking agents. Psychophysical procedures to be used are ratio scaling methods such as magnitude estimation (assignment of numbers to reflect ratio relations among perceived magnitudes), magnitude production, and cross-modality matching. Particular experiments aim: (1) to obtain psychophysical functions for various odorous substances and to relate the parameters (e.g., growth rate) of the functions to the physicochemical properties and perceived qualities of the substances; (2) to study observers who lack common chemical sensitivity in one nasal passage in order to isolate thereby the contribution of trigeminal stimulation to overall odor intensity; (3) to formulate a quantitative description of how various masking odors modify the psychophysical function, specifying in particular the masking ability of ozone; and (4) to determine how adaptation alters the psychophysical function, specifying the trading relation between intensity and duration of adapting stimuli.
Keywords: odor; biological adaptation; olfactory bulbs; physiology; man; air; gaseous wastes; water; inhalation; ingestion; membranes; toxicity; chemoreceptors; sensitivity.

34606 Distribution and Fate of Inhaled Sulfur Dioxide. Gunnison, A.F. (University of New York, 550 First Avenue, Room 559, New York, NY, 10016). **Project number:** R01-ES-00613. **Contract:** R01-ES-00613. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$96,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Inhaled sulfur dioxide as well as injected or ingested sulfite reacts with certain disulfides in mammalian plasma cleaving S-S bonds and producing S-sulfonate groups. The kinetics of the formation and clearance of plasma S-sulfonate in laboratory primate species will be studied and compared with similar studies on rabbits, mice, and rats. A major aim of the proposed research is to elucidate the mechanism of clearance of protein S-sulfonate from the plasma, especially with regard to the function of diffusible thiol groups. The importance of cysteine S-sulfonate in plasma S-sulfonate clearance and the potential of this system (cysteine + protein S-sulfonate reversible cysteine S-sulfonate) for functional sulfite transport to tissues outside of the blood stream will be investigated by various techniques including the use of S-35 tracer. Identification of plasma proteins affected by in vivo sulfitolysis will be undertaken with the aid of S-35 O3/sup 2-/. The ultimate objective is the detection of toxic effects due to structural alteration of proteins and possible

resultant functional changes. Sulfite oxidase, an enzyme which detoxifies sulfite by oxidation to sulfate, is especially rich in mammalian liver. This enzyme should play a major role in the determination of the availability of sulfite for reacting with disulfide bonds in plasma and other tissues.
Keywords: sulfur dioxide; inhalation; metabolism; rabbits; mice; rats; chemical bonds; sulfites; enzymes.

34607 Methylmercury Embryopathy. Mottet, N.K. (University of Washington, School of Medicine, Seattle, WA, 98195). **Project number:** R01-ES-00677. **Contract:** R01-ES-00677. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$212,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

There is a progressive increase in the general background level of mercury in our North American environment. Inorganic mercury in the environment can be converted to organic mercurials in the biological food chain and accumulate in food stuffs, principally as methylmercury. Man may directly consume methylmercury as an occupational hazard or may indirectly acquire chronic intoxication as the final predator in the biological chain. Methylmercury in man, unlike inorganic and some other organic mercurials, widely distributed in body tissues, produces a different pattern of clinical findings than inorganic or elemental mercury. The cerebrum and cerebellum are principally altered. Methylmercury freely passes through the placental barrier of man and some experimental animals. In addition to the neurolysis seen in the adult, the fetal brain injury is diffuse. A generalized hypoplasia of the brain and other viscera is seen. Excessive defective mitoses and chromosome breakage has been found in human lymphocytes cultured from patients with methylmercury poisoning. Beyond this fragmentary evidence little is known about the teratogenic effects of mercury on the primate. The investigation is designed to uncover deleterious effects on the fetus at the level of human subclinical exposure as well as at higher dosage levels.
Keywords: mercury; methylmercury; metabolism; brain; pathological changes; toxicity; man; animals.

34608 Enzymatic Degradation of Aromatic Compounds. Dagley, S. (University of Minnesota, 140 Gortner Laboratory, St. Paul, MN, 55101). **Project number:** R01-ES-00678. **Contract:** R01-ES-00678. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$57,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

All intermediates formed in the microbial degradation of catechols by meta-fission have been identified, and studies of the purified enzymes of this pathway will be continued. The evidence for two types of meta-pyrocatechase will be examined after screening soil organisms that contain the enzyme. Alkyl-substituted phenols were found to be metabolized through alkylgentisic acids by a sequence of reactions of probable general importance in the area of aromatic catabolism. These enzymes, some of which had not been previously reported, will also be purified and their modes of action studied. Methods of purification will involve column chromatography and preparative electrophoresis; and criteria of purity and data for molecular weight and subunit structure will be supplied by the analytical ultracentrifuge and gel electrophoresis. The enzymic degradation of halogen-substituted gentisates and phenylacetates will be studied with special attention to those enzymes that release halogens during the course of the reaction. The hydroylation of p-hydroxyphenylacetic acid, which appears to involve an N.I.H. shift will be investigated. Studies of the enzymes that degrade tropic acid and tropine will be completed. Soil organisms that grow with biphenylmethane and other compounds containing two free benzene rings have been isolated.
Keywords: aromatics; biodegradation; enzymes; soils; microorganisms; phenols; metabolism.

34609 Teratogenic Effects of Heavy Metals. Ferm, V.H. (Dartmouth College, Medical School, Hanover, NH, 03755). **Project number:** R01-ES-00697. **Contract:** R01-ES-00697. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$132,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The central concern of this research program is the effect of biologically non-essential heavy metals on mammalian embryonic development. Certain of these metals (lead, cadmium, arsenic, indium) already are known to exert teratogenic effects on the developing hamster embryo when administered via the maternal system early in gestation. It is planned to investigate further these effects by four different but complementary experimental approaches. First, in addition to supplementary studies on those heavy metals which have previously been shown to be teratogenic, the teratogenic potential of mercury compounds will be investigated, including some commonly used pesticides which contain this metal. As part of this approach, the interaction of several heavy metal combinations (lead-mercury, cadmium-mercury, cadmium-arsenic) on the develping embryo will be investigated. Secondly, an attempt will be made to detect by electron microscopy and related techniques small concentrations of teratogenic heavy metals within early placental and embryonic tissues. This approach will identify sites of localization as well as specific cytopathic effects of the heavy metals in these tissues. Thirdly, comparative studies on limb bud malformations induced by acetazolamide, an inhibitor of carbonic anhydrase, and certain heavy metals which may exert teratogenic action will be made.
Keywords: lead; cadmium; arsenic; indium; mercury; synergism; embryos; teratogenesis; toxicity; biological effects; metabolism; pesticides; pathological changes.

34610 Metabolism and Biochemical Actions of Cadmium. Cousins, R.J. (Rutgers--State Univ., Bartlett Hall, Lipman Drive, New Brunswick, NJ, 08903). **Project number:** R01-ES-00777. **Contract:** R01-ES-00777. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The relationship of graded, dietary cadmium intake levels to biochemical parameters associated with cadmium toxicity will be determined in rats and chicks. Cadmium uptake, calcium, copper and zinc concentration changes and enzyme activities will be investigated as a function of dose level in numerous tissues and will be correlated to the degree of toxicity. The mechanisms and factors influencing the synthesis of cadmium binding protein in liver and kidney will be investigated in detail. The mechanisms and factors involved in intestinal cadmium absorption will be studied in vivo. The influence of calcium and vitamin D at various dietary intake levels will be investigated. The functional significance of cadmium binding to intestinal mucosal cell proteins will be investigated as well. The effect of cadmium on calcium and bone metabolism will be extensively investigated. The intestinal absorption of calcium will be investigated with in situ duodenal loops. The influence of cadmium on the renal mitochondrial enzyme 25-hydroxycholecalciferol-1-hydroxylase and 1,25-dihydroxycholecalciferol synthesis will be extensively investigated.
Keywords: cadmium; metabolism; biochemical reaction kinetics; toxicity; rats; chickens; calcium; copper; zinc; synergism; vitamin d; ingestion; diet; enzymes; proteins; biosynthesis.

34611 Induction of Metallothionein by Cadmium, Copper, and Mercury. Bryan, S.E. (Louisiana State Univ., Dept. of Biological Sciences, New Orleans, LA, 70122). **Project number:** R01-ES-00802. **Contract:** R01-ES-00802. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$86,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Metals can produce varied effects on biochemical processes and it now appears that induction of (metal binding) proteins should be included among the diversity of responses multivalent metal ions elicit in biochemical systems. The induction of a great many proteins (enzymes) has been studied, yet the mechanisms by which this phenomenon is produced in mammalian systems remain obscure. The proposed study is designed to further elucidate the induction process initiated by cadmium, copper and mercury (known to bind to metallothionein) and to characterize the proteins induced in response to high levels of the respective metals. Mice will be challenged with chloride salts of copper, cadmium and mercury in drinking water; at specific time intervals following ingestion of metals, tissues will be excised and analyzed by centrifugation, gel filtration, electrophoresis, liquid scintillation, immunological and tissue culture techniques. Highly purified metal binding proteins will be characterized by spectrophotometry, amino acid composition, molecular weight analysis, metal analysis, electrophoretic properties and other parameters. In addition, the mechanism of induction will be explored by analysis of chromosomal material and tissue culture experiments. Hopefully, the study should give insight into molecular events which determine biological tolerance as opposed to toxicity and should contribute to our understanding of the regulation of specific gene expression.
Keywords: copper; cadmium; mercury; mice; ingestion; tissues; proteins; biochemical reaction kinetics; metabolism; tolerance; toxicity; chemical bonds.

34612 Selenium Toxicity: Role of Methionyl-tRNA Synthetases. Shrift, A. (State University of New York, Department of Biology, Binghamton, NY, 13901). **Project number:** R01-ES00807. **Contract:** R01-ES-00807. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$57,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

Because a selenium-accumulating plant, Neptunia amplexicaulis, excludes selenium from its proteins, it has been suggested that

altered aminoacyl-tRNA synthetases from accumulators are unable to utilize the selenium analogs of the normal substrates, methionine and cysteine. Therefore, to test this hypothesis, plant species (mainly from the genus Astragalus) known to accumulate selenium from seleniferous soils will be treated with 75-Se-labeled selenium compounds and examined to see if they also exclude selenium from their proteins. Methionyl-tRNA synthetases will be isolated and purified from accumulator species and from related species that not only are unable to accumulate the element but are inhibited by traces of selenium compounds. Methionine and selenium methionine will be tested to determine if methionyl-tRNA synthetases from accumulator species differ in their substrate specificities from those of nonaccumulator species. To characterize the synthetases from the two types of plants, K/sub m/, K/sub i/, and V/sub max/ values will be calculated from Michaelis-Menten kinetic data. Heat stabilities will be studied as well as the influence of substrate and analog on heat inactivation of the synthetases.
Keywords: plants; transfer rna; ligases; enzyme activity; biochemical reaction kinetics; comparative evaluations; selenium; biological accumulation; selenium 75; labelled compounds; selenium compounds; tracer techniques; temperature effects; metabolism; toxicity; methionine; cysteine.

34613 Toxicology of Organic Mercury for the Fetus and Newborn. Reynolds, W.A. (Univ. of Illinois, 1853 West Polk Street, Chicago, IL, 60612). **Project number:** R01-ES-00820. **Contract:** R01-ES-00820. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$82,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Increasing levels of organic mercury in the environment, and consequently in food, could be approaching hazardous levels for human beings in certain locations, especially during fetal life or infancy, since mercury apparently interferes with normal differentiation of the central nervous system. Body burdens of mercury will be estimated from mercury determinations performed on fluid and tissue samples derived from human fetuses, newborns, and mothers. Organic mercury will be measured by means of gas chromatography and total mercury will be measured by atomic absorption spectrophotometry during chronic and acute administration of methylmercury. The macaque pregnancy will be used as a model system in which to determine neurotoxic levels and the extent of tissue retention of mercury for the fetus and neonate. Possible pathological effects of mercury upon maturation of the cerebellum and cerebrum will receive close attention. The half-life of methylmercury-203 will be measured in the adult, the fetal and infant monkey. The extent of transmission of methylmercury-203 from mother to fetus via the placenta and from mother to infant monkey by means of suckling will be assayed. Finally, behavioral development of infant monkeys exposed to the methylmercury in utero or during lactation will be assessed.
Keywords: toxicity; mercury; body burden; ecological concentration; methylmercury; monkeys; juveniles; fetuses; behavior; central nervous system; air pollution.

34614 Regional Deposition of Inhaled Particles in Man. Lippmann, M. (University of New York, Medical Center, 550 First Avenue, New York, NY, 10016). **Project number:** R01-ES-00881. **Contract:** R01-ES-00881. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this study is to provide detailed information on regional particle deposition in the human respiratory tract, and to determine the effects of particle size, respiratory parameters, route of entry, and constitutional variables on the deposition efficiency at the various deposition sites. Ferric oxide microspheres tagged with gamma-emitting isotopes will be inhaled by human adult volunteer normals. Measurements of particle retention in the head and thorax will be made immediately after the exposure, and also 24 hours later, using external collimated scintillation detectors within a low-background chamber. The initial activity in the thorax includes both tracheo-bronchial (T-B) and alveolar deposits, while the 24-hour measurement includes only alveolar. Thus, the inhaled aerosol can be divided into the following components: exhaled, head, T-B and alveolar. The intra-bronchial deposition patterns will be studied using gamma-tagged aerosols deposited in hollow bronchial casts, where deposition can be measured as a function of branching level, and in excised whole lungs, which will be dissected for determining the patterns of deposition within the airways. The correspondence of the cast and excised lung data to the in-vivo situation will be tested by performing cast and excised lung inhalations on specimens taken from donkeys whose in-vivo deposition patterns have previously been tested with the same inhaled aerosols.
Keywords: man; aerosols; particles; deposition; respiratory system; lungs; inhalation; health hazards; dynamic function studies.

34615 Aqueous Solution Studies of Arsenates and Vanadates. Rieger, P.H. (Brown Univ., Dept. of Chemistry, Providence, RI, 02912). **Project number:** R01-ES-00894. **Contract:** R01-ES-00894. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$47,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Arsenates and vanadates are poisons which are thought to operate in some instances by mimicking phosphate in biochemical processes. Arsenate has been extensively used to study the sequence of reactions in the process of oxidative phosphorylation, both to gain further insight into the normal mechanisms and to understand the means by which arsenates uncouple the process. Mechanistic models which have been proposed usually involve arsenate esters and arsenatophosphates, but there has been no chemical study of such species under conditions approaching a biological environment. We propose to study the rates of hydrolysis of arsenate and vanadate esters, condensed arsenates and vanadates, and arsenatophosphates as well as the rates of oxygen exchange of arsenate and vanadate with water. We also plan to investigate the nature of phosphate-vanadate solutions to examine the possibility of vanadatophosphates. Because of the possible role of V(IV), we hope to characterize V(IV) species in neutral and basic solutions, and also to study V(IV,V) mixed valence species and V(IV)-phosphate species in solution. The results of these studies should be of fundamental importance to biochemists concerned with poisoning by arsenates and vanadates and with the mechanism of oxidative phosphorylation.
Keywords: aqueous solutions; arsenates; arsenic oxides; vanadates; vanadium oxides; biochemical reaction kinetics; toxicity; hydrolysis; phosphorylation.

34616 Air Pollutant: Lipid Membrane Interactions. Smith, L.L. (Univ. of Texas, Medical Branch, Galveston, TX, 77550). **Project number:** R01-ES-00944. **Contract:** R01-ES-00944. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$48,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

It is proposed to determine whether certain common air pollutants, such as excited singlet molecular oxygen, are involved in the oxidation of membrane-bound cholesterol in selected biological membranes and in model systems. Analysis of the cholesterol hydroperoxides initially formed in such systems upon exposure to the air pollutants can be used to determine whether excited singlet molecular oxygen or ground-state triplet oxygen is involved. The sterol hydroperoxides will be analyzed by means of thin-layer and gas chromatographic methods already developed and by gas chromatography-mass spectral methods to be developed during the study. The nature of the hydroperoxides formed will disclose the nature of the primary oxidant, certain cholesterol hydroperoxides being formed from excited singlet oxygen, and certain other hydroperoxides being formed from ground-state oxygen in radical chain reactions. A fundamental study of membrane-bound cholesterol oxidation by other common air pollutants, including ozone, nitrogen dioxide, peroxy-acetyl nitrate, etc., as well as excited singlet oxygen and ground-state oxygen (for control comparisons) will be made. The thermal decomposition and enzymic alteration products of the sterol hydroperoxides will also be analyzed in order to identify the initially formed hydroperoxides with more certainty. Means of controlling or moderating cellular membrane damage from such oxidations will be sought using the fundamental analytical results obtained. Specific human tissues and cell lines most sensitive to air pollutant-moderated oxidations will be determined, and specific cause-and-effect relationships between the primary oxidative events and recognized human disorders will be sought after.
Keywords: air pollution; lipids; cell membranes; lungs; toxicity; oxygen; cholesterol; biological models; ozone; nitrogen dioxide; acetates; nitrates; man; tissues; pathological changes; health hazards; metabolism; inhalation.

34617 Structural Models for Molybdo-Enzymes. Enemark, J.H. (University of Arizona, Department of Chemistry, Tucson, AZ, 85721). **Project number:** R01-ES-00966. **Contract:** R01-ES-00966. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$55,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Molybdenum is an essential metal in enzymes involved in purine metabolism, sulfur metabolism, the assimilation of inorganic nitrogen, and interconversions of inorganic nitrogen in the biosphere. Exposure to excess molybdenum has been linked with gout and atherosclerosis, and molybdenum deficiency interferes with normal sulfur metabolism. The molecular structures of the molybdoenzymes are unknown, however, there is evidence that all possess a common molybdenum cofactor. The nature of the molybdenum centers of the enzymes and of the cofactor are also unknown, but it is generally thought that one or more sulfur atoms are coordinated to the molybdenum atoms. The objectives of this research project

are to investigate structural models for molybdenum centers by an integrated series of chemical, physical and x-ray structural studies on well-defined molybdenum compounds. Special emphasis will be given to compounds which mimic the electron paramagnetic resonance (ESR) spectra of molybdo-enzymes, compounds which mimic the reactions of molybdo-enzymes, and compounds with sulfur-containing ligands.
Keywords: molybdenum; enzymes; purines; metabolism; nitrogen; biochemical reaction kinetics; chemical bonds; molecular structure; sulfur; nutrition; structural chemical analysis; pathological changes; man.

34618 Combined Impulse-Continuous Noise: Auditory Effect. Hamernik, R.P. (State University of New York, 750 E. Adams Street, Syracuse, NY, 13210). **Project number:** R01 ES00969. **Contract:** R01-ES-00969. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$52,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fusion(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Combinations of non-traumatic impulse and continuous noise can produce unusually severe changes in hearing sensitivity and cochlear integrity. The extent of this noise-induced trauma cannot be explained on the basis of addition of the acoustic power of the two noises. The purpose of the proposed research is to systematically study the effects of cochlear anatomy. Three impulses of variable intensity spanning a temporal range from 40 mu sec to 0.3 sec will be individually studied in combination with various intensities and band widths of a background continuous noise. Chinchilla will be used as the experimental animal. Noise-induced temporary and permanent threshold shifts will be measured at regular intervals after exposure using the auditory evoked response measure. At thirty days after exposure, the chinchilla will be sacrificed, their cochleas will be infused with Araldite, and flat preparations will be dissected. Analysis of the cochlear cell populations will be accomplished using phase microscopy and thin sectioning techniques. At interesting locations, the tissue will be analyzed with the electron microscope. The final evaluation of the particular noise exposure will depend on a correlation of the noise parameters with the audiological and histological changes. These data are a necessary prerequisite for the ultimate objective of this research project, namely, the establishment of a Damage Risk Criteria for impulse-continuous noise combinations.
Keywords: noise; biological effects; chronic exposure; laboratory animals; auditory organs; sensitivity; pathological changes; electron microscopy; histology; noise pollution; risk assessment; biological stress.

34619 Factors Influencing Deposition of Inhaled Particles. Brain, J.D. (Harvard University, 665 Huntington Avenue, Boston, MA, 02115). **Project number:** R01-ES-01016. **Contract:** R01-ES-01016. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$69,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective is to define more precisely how various factors affect the patterns of particle deposition which occur during inhalation. It is proposed to investigate how gravity and pleural pressure gradients influence alveolar deposition. By analyzing small samples of dried or frozen lungs, the plan is to measure the amount of alveolar deposition in different lung regions. It is also proposed to investigate how the various breathing patterns influence the distribution of particle deposition. A servo-pressure control system will be used to produce any desired breathing pattern at any specified lung volume. Finally, it is proposed to investigate species differences in regard to aerosol deposition and to attempt to apply principles of scaling to the experimental data with the goal of developing predictive powers. Since inhalation is the primary entry route for agents that cause environmental, occupational, and infectious disease, it is of clear importance to understand better how and where particles deposit in the lungs. This information will be of value in understanding and controlling environmental hazards.
Keywords: inhalation; deposition; aerosols; particles; lungs; dynamic function studies; metabolism; biochemical reaction kinetics.

34620 Possible New Antidotes for Mercury Poisoning. Jones, M.M. (Vanderbilt University, Box 1583, Station B, Nashville, TN, 37235). **Project number:** R01-ES-01018. **Contract:** R01-ES-01018. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$86,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

It is planned to develop an optimum chelate based therapy for mercury and methyl mercury poisoning, using a new animal model of chronic mercury poisoning which we have developed. The optimum therapy will be based upon the combined usage of unabsorbable polymeric chelating agents to absorb mercury involved in the enterohepatic circulation, and low molecular weight systemic chelating agents to enhance the urinary excretion of mercury. The polymeric chelating agent used will be the one which has been developed here which has the highest demonstrated capacity of mercury binding of any such material so far reported. Systemic agents to be used to enhance mercury excretion are those such as N-acetyl-L-penicillamine. The goal is the development of oral therapeutic agents of maximum efficacy and very low inherent toxicity.
Keywords: mercury; toxicity; bioadsorbents; decontamination; chelates; therapy; excretion.

34621 Kinetics of Uptake and Excretion of Vapors in Man. Thomas, V. (Miami University, P.O. Box 875, Biscayne Annex, Miami, FL, 33152). **Project number:** R01-ES-01029. **Contract:** R01-ES-01029. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$44,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective of the research is to define the kinetics of uptake, distribution, metabolism, and excretion of inhaled lipid soluble vapors in man, by a set of differential equations, using predictable constants. The physical, chemical, and biological constants needed will be determined by simple experiments. Solution of the equations will be facilitated by a program for large digital computer. To verify the pharmacokinetic model, the experimental conditions of suitable published studies in man will be simulated, and their results compared with the calculated data. Further verification will be done by animal experiments. The pharmacokinetic model for the rat will be elaborated, and the predicted concentrations of noxious compounds in the tissue compared with the concentrations in rats sacrificed at selected time intervals following exposure. The described pharmacokinetic model will be used to design the proper monitoring of industrial data; to predict the cumulation of inhaled compounds and their metabolites in the body; to explain the role of certain physiological factors (body fluid, pulmonary ventilation, tissue perfusion); and to formulate guidelines for the prediction of the uptake, distribution, metabolism, and excretion of new noxious compounds introduced in industry. Initial plans are to use toluene, trichloroethylene, carbon disulfide, and methylene chloride in the study.
Keywords: man; vapors; lipids; metabolism; inhalation; toluene; uptake; excretion; chemical reaction kinetics; hydrocarbons; health hazards.

34622 Damage to Nucleic Acids by Bisulfite (Sulfur Dioxide). Shapiro, R. (University of New York, Department of Chemistry, New York, NY, 10003). **Project number:** R01-ES-01033. **Contract:** R01-ES-01033. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$80,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Bisulfite ion (the aqueous form of the atmospheric pollutant, sulfur dioxide) has three reaction pathways with the major pyrimidine components of nucleic acids: (1) reversible saturation of uracil, (2) deamination of cytosine to uracil, and (3) transamination of cytosine to N-4-substituted cytosine derivatives (leading to protein-nucleic acid crosslinking). We propose that one or more of these reactions constitute the principal biochemical lesions inflicted by environmental sulfur dioxide, leading to the adverse effects on health associated with this pollutant. To test this hypothesis, these reactions are being investigated at four distinct levels: (1) mechanistic studies with nucleosides; (2) studies on the relation of reactivity to conformation at the polynucleoside level; (3) the effect of bisulfite modification of RNA on protein synthesis, using synthetic messengers, MS2 RNA, and the E. coli cell-free protein synthesizing systems; and (4) in vivo studies with bacteria, mammalian cells, and eventually mammals, to measure the extent of nucleic acid modification by bisulfite, and its consequences in terms of inhibitor of protein synthesis and killing of cells. We hope that this study will provide concrete data as to the adverse biochemical effects of varying degrees of exposure to sulfur dioxide, and that this will be useful in setting rational guidelines for the control of atmospheric levels of sulfur dioxide.
Keywords: nucleic acids; sulfur dioxide; pyrimidines; toxicity; pathological changes; animal cells; bacteria; air pollution.

34623 Photosensitivity: Environmental and Other Factors. Harber, L.C. (Columbia University, 630 West 168 Street, New York, NY, 10032). **Project number:** R01-ES01041. **Contract:** R01-ES-01041. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$175,000.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Adverse cutaneous photosensitivity reactions following exposure to environmental chemicals and light have been reported with increasing frequency during recent years. The broad objectives of the proposed project are to define more precisely the mechanisms of action of these adverse photoresponses as well as the influence of environmental factors and the biologic differences between individ-

uals which affect these reactions. Our approach to these objectives places particular emphasis on relatively unexplored aspects of this problem. Specifically, we are concerned with the role of temperature and humidity as they relate to photosensitivity reactions and the role of biologic factors of the host resulting in endogenously produced photosensitizers such as porphyrins. Although exogenous photosensitizing substances are well recognized causes of occupational dermatoses due to their primary irritant (phototoxic) or allergic (photoallergic) properties, little is known regarding the mechanisms of their photosensitizing properties on a molecular and submolecular biologic level. In addition, there presently exists no laboratory model for the study of the disabling photosensitivity in man known as persistent-light-reactors.
Keywords: ultraviolet radiation; visible radiation; solar radiation; photosensitivity; skin; man; biological effects; pollution; molecular biology; temperature effects; humidity.

34624 Effects of Lead on Procaryotic and Eucaryotic Cells. Tornabene, T.G. (Colorado State University, Department of Microbiology, Fort Collins, CO, 80521). **Project number:** R01-ES-01047. **Contract:** R01-ES-01047. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$32,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The research program has the objective of elucidating the primary responses of bacterial cells to lead in an attempt to define trace mechanisms of action. The bacterial study will be used as a model for studying the specific effects of lead on unaltered and unpropagated rabbit alveolar cells. Lead infected cells result in osmotically sensitive cells with greatly reduced membrane lipid contents. The proposed program concentrates on the effects of lead on lipid metabolism, cellular respiratory pigments, and the creation of cellular leakage. X-ray diffraction and electron probe studies will be conducted to determine the chemical composition of lead-containing aggregates observed in membranes of bacteria. This program will provide valuable information for establishing the physical-chemical modifications of cellular membranes and a reference source of information on the molecular basis of the action of lead.
Keywords: lead; rabbits; toxicity; metabolism; lipids; bacteria; biochemical reaction kinetics; animal cells.

34625 Lead and PCB's: Pharmacologic and Toxicologic Studies. Kappas, A. (Rockefeller University, 66th Street and York Avenue, New York, NY, 10021). **Project number:** R01-ES-01055. **Contract:** R01-ES-01055. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$211,000.
Related energy source: Coal(50); nuclear fission(25); hydroelectric(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The studies proposed examine the nature, mechanisms and consequences of the interactions of two major environmental pollutants, lead and polychlorinated biphenyls (PCBs), on the heme pathway, and on cytochrome P-450 and the mixed function oxidase system coupled to this heme-protein. Heme and P-450 play a central role in detoxification mechanisms for drugs, hormones, carcinogens and many chemically diverse substances derived from the environment. Lead and PCBs are ubiquitously distributed in the ecosystem of man; produce acute and chronic human diseases; and have potent interactions with the heme-P-450 systems. These interactions are of an inhibitory nature with respect to lead, and of a stimulatory nature with respect to the PCBs. Thus, lead and PCBs serve as excellent model substances for defining in chemical terms, the biological impact of many environmental pollutants which inhibit or induce the heme-P-450 complex. Lead and PCB-induced alterations in heme synthesis and in the activities of P-450 coupled enzymes can be expected to have major pharmacological and toxicological consequences, since the biological actions of drugs, hormones, carcinogens and other chemicals are determined to a significant degree by the rates at which they are metabolized. These effects of lead and PCBs on the heme-P-450 systems will be explored in detail, utilizing tissue culture techniques, whole animal preparations.
Keywords: lead; organic chlorine compounds; metabolism; toxicity; synergism; blood; biosynthesis.

34626 Dynamics of Lead Metabolism in Bone. Rosen, J.F. (Montefiore Hospital, 111 East 210th Street, Bronx, NY, 10467). **Project number:** R01-ES-01060. **Contract:** R01-ES-01060. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$129,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The central purpose of this research plan is to define further the dynamics of lead transport in children. To this end, the primary focus is to clarify factors that determine the movement of lead into and out of bone, where over 90% of endogenous lead is stored. This cardinal phase of the research plan will be carried out in bone organ culture, a convenient and precise way to study the effects of the ionic milieu and hormonal peptides that regulate lead's efflux from bone. Complementary in vitro experiments will examine: (1) the role of chick calcium-binding protein in the intestinal absorption of lead, and (2) the effects of ionized calcium (Ca++) and lanthanum (La) on the mechanisms of lead movement from red cell to plasma. Integration of data obtained from in vitro studies will be applied to construct different chelation regimens, for the treatment of lead-intoxicated rats, by adding to such therapy combinations of Ca++, calcitonin (CT), and parathyroid hormone (PTH). This comprehensive research plan, focusing on the skeletal metabolism of lead, presumably, will define more clearly the kinetics of lead transport. By so doing, the potential hazards of subtoxic doses of lead may be understood and more effective therapy may evolve for the treatment of childhood lead intoxication.
Keywords: lead; metabolism; bone tissues; biosynthesis; pathological changes; dynamic function studies; chickens; children; intestinal absorption; calcium ions; lanthanum ions; rats; skeleton; therapy.

34627 Effects of Lead on Fetal and Neonatal Development. Bowman, R.E. (University of Wisconsin, 1223 Capitol Court, Madison, WI, 53706). **Project number:** R01-ES-01062. **Contract:** R01-ES-01062. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$139,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objective of the proposed research is to determine the residual effects of low level lead exposure on the fetal and infant rhesus monkey. Pregnant rhesus monkeys will be fed low levels of lead throughout gestation and their infants evaluated biologically and behaviorally during infancy, adolescence, and early adulthood. Similar studies will also be conducted on infant monkeys that are exposed to low levels of lead during the initial year of life. These studies will help to clarify the effects of lead exposure during early life on the subsequent development of the infant. In addition, maximum tolerable levels of lead administered over a given period to fetal (via the mother) and infant monkeys will be established. The methods that will be employed in evaluating these animals will include behavioral studies that will emphasize social interaction and learning capabilities of these animals from birth to adulthood. The clinical studies conducted will be systematic hematological, radiological, and biochemical determinations throughout infancy, adolescence, and adulthood. After the completion of the clinical and behavioral studies histological and ultrastructural studies will be conducted on all of the major organs. In addition, total concentrations of lead in various tissues of the body will be determined.
Keywords: lead; fetuses; neonates; toxicity; biological effects; metabolism; macacus; reproduction; behavior; pathological changes; central nervous system; dynamic function studies.

34628 Metabolism of Environmental Contaminants by Fish. Lech, J.J. (Medical College of Wisconsin, 561 North 15th Street, Milwaukee, WI, 53233). **Project number:** R01-ES-01080. **Contract:** R01-ES-01080. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$34,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed research centers about the metabolism and disposition of xenobiotic chemicals in fish. The major goals are to determine the pathways of biotransformation of chlorinated benzenes, pyrethroid insecticides and petroleum hydrocarbons in fish and to determine the extent to which metabolism influences the toxicity and persistence of these chemicals. If biotransformation of these compounds in fish leads to less toxic compounds and the reactions proceed at significant rates, inhibition of their metabolism would be expected to increase toxicity as well as alter residue patterns of the parent compound and metabolites. On the other hand stimulation of metabolism by inducers such as polychlorinated biphenyls and polycyclic aromatic hydrocarbons may decrease toxicity and increase residues of metabolites. In general, the experimental approach involves determination of the acute toxicity (LC50) of the above compounds in trout, studying the metabolism of each compound and determining if the toxicity is altered by known inhibitors and inducers of microsomal drug metabolizing enzymes. Special attention will be given to the possibility of alteration of these metabolic processes by inducers and inhibitors which may be present in the aqueous environment.
Keywords: fishes; metabolism; organic chlorine compounds; insecticides; petroleum; hydrocarbons; aromatics; toxicity; water pollution.

34629 Environmental Mutagenesis and DNA Repair. Smith, P.D. (Emory University, Department of Biology, Atlanta, GA, 30322). **Project number:** R01-ES01101. **Contract:** R01-ES-01101. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$112,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Early observations that x irradiation and nitrogen mustard were mutagenic first raised the concern of geneticists to the potential dangers of physical and chemical agents in the environment and sparked intensive inquiries into the nature of the mutagenesis process. Recent studies of this phenomenon have relied heavily on microbial systems but have been very successful in detailing both the molecular nature of alterations to the genetic material and the enzymatic nature of the genetic control of DNA repair mechanisms. These latter observations have, in large measure, depended upon the use of genetically-altered mutagen-sensitive strains and recent observations with eukaryotes suggest that mutagen-sensitive strains will be similarly useful in advancing our knowledge of these processes in higher organisms. This proposal describes studies aimed at developing and testing new genetic strains of the complex multicellular eukaryote, Drosophila melanogaster, which will be useful tools in the evaluation of environmental chemicals for potential mutagenic activity. The experiments have been designed to assay the entire Drosophila genome in order to isolate mutant strains which exhibit sensitivity or resistance to particular chemical agents, especially mutagens.
Keywords: drosophila; mutations; pollution; mutagens; mutagen screening; dna; biological repair; mutagenesis.

34630 Size/Chemical Measurements of Atmospheric Particles. Dahneke, B.E. (Univ. of Rochester, Dept. of Radiation Biology and Biophysics, Rochester, NY, 14642). **Project number:** R01-ES-01107. **Contract:** R01-ES-01107. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$105,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant measurements technology.

The object of this research is to measure the detailed size-chemical nature of atmospheric particulates. These data are desired in order to evaluate the toxicity of atmospheric particulates which depends on both their inhalability (aerodynamic size) and their chemical composition. The data will be obtained in an aerosol beam device which (1) measures the aerodynamic size or mass of a particle by measuring its time of flight between two focused light beams in a vacuum chamber and (2) measures, by surface ionization mass spectrometry, the abundance of various charge to mass species present in individual particles. The measurements will therefore provide information about the chemical composition of the size subranges of atmospheric particulates. The data of particular interest concern toxic species such as 1,2-benzopyrene, asbestos, and UO2 among others. If these data can be obtained in sufficient detail, it should be possible to identify the major sources of toxic atmospheric particulates. The instrument will be calibrated and the data will be collected and searched with the view of finding unique features of toxic and other aerosols which may serve to specifically identify their sources.
Keywords: air pollution; aerosols; particles; particle size; earth atmosphere; chemical composition; benzopyrene; asbestos; uranium dioxide; toxicity.

34631 Cadmium Toxicology. Klaassen, C.D. (Univ. of Kansas, Rainbow Blvd. at 39th Street, Kansas City, KS, 66103). **Project number:** R01-ES-01142. **Contract:** R01-ES-01142. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$47,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Cadmium is an environmental pollutant which has been shown to be toxic to a number of tissues in mammalian systems. These studies will make clear what dose is necessary to produce injury to the various tissues, which tissue is most sensitive to cadmium, and if there is a marked difference in the toxic sign between animals that receive one high single dose and those that receive multiple low doses over a long time. Information will be gained on the importance of metallothionein on the toxicity of cadmium. The following questions will be investigated: does metallothionein alter the distribution of cadmium; do metallothionein and cadmium levels in the tissues continue to rise with prolonged administration at different doses, or is a plateau achieved; what is the mechanism by which cadmium is excreted into the bile; can it be enhanced by treatment with microsomal enzyme inducers; will interruption of the enterohepatic circulation increase the elimination of cadmium from the body. If we can answer these very basic questions, then we should be able to treat cadmium poisoning on a more informed basis.
Keywords: cadmium; toxicity; decontamination; tissues; organic sulfur compounds; response modifying factors; enzymes; metabolism.

34632 Carcinogenic Intermediates of Vinyl Chloride and Analogs. Van Duuren, B.I. (New York University, 550 First Avenue, New York, NY, 10016). **Project number:** R01-ES01150. **Contract:** R01-ES-01150. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$68,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This proposal is concerned with the study of the metabolism of the carcinogens vinyl chloride (VC) and trichloroethylene (TCE). The primary objectives are to isolate and characterize the activated carcinogenic intermediates of these two compounds, to determine the carcinogenic activity of such intermediates, and to study their covalent binding to tissue constituents. It is suggested that epoxide intermediates of both compounds are the activated carcinogens. These epoxide intermediates are alpha-chloro ethers; compounds of the latter type are known to be potent carcinogens. Studies on the metabolism of VC and TCE will be conducted on rat liver homogenates and intracellular fractions and components derived from it. The malignant transformation of primary rat embryo cells in vitro by the parent compounds, their epoxides, and their rearrangement products will be studied. The carcinogenic activity of the activated intermediates will be determined by rat feeding experiments and by cocarcinogenesis experiments on mouse skin. These studies will lead to new insights concerning occupational and environmental carcinogens and their mechanism of action in animals and man.
Keywords: pvc; vinyl monomers; chlorinated aliphatic hydrocarbons; metabolism; in vitro; liver; tissues; homogenates; metabolites; epoxides; carcinogenesis; rats; mice; embryonic cells; reaction intermediates; pathological changes; neoplasms.

34633 Regulation of Neural Distribution of Heavy Metals. O'Tuama, L.A. (University of North Carolina, School of Medicine, 319 Biological Sciences Research Center, Chapel Hill, NC, 27514). **Project number:** R01 ES01151. **Contract:** R01-ES-01151. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$86,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The goal of the study is to assess the interaction of heavy metals with the developing neural barrier transport systems. The objective will be achieved by studying: (1) the uptake of the metals by barrier sites (choroid plexus, meninges, and paraventricular tissue); and (2) the effects of the metal on the barrier systems for translocation of neurally active solutes (calcium, hexoses, and aminoacids). To define patterns of barrier tissue distribution that correlate with neurotoxicity, we will study two neurotoxic metals, Pb(NO3)2 and Hg(Cl2) and a non-neurotoxic agent, Cd(Cl2). Flux across the combined neural barrier membranes will be measured by the single injection indicator dilution technique of Oldendorf, modified to allow timed jugular venous sampling. A technique will also be developed to monitor discretely flow across the isolated choroid plexus in vivo. All experiments will be performed in developing albino rabbits and the design will allow study of the effects of poisoning introduced at different developmental stages, and will contrast effects of acute high dose and chronic low level exposure. Isotope levels (203Pb, 203Hg, 109Cd, 45Ca, 14C-O-methylglucose, and 14C-L-tryptophan) will be determined by liquid scintillation or gamma spectroscopy and metal levels will be determined by atomic absorption spectroscopy.
Keywords: lead nitrates; mercury chlorides; cadmium chlorides; injection; rabbits; tissue distribution; nervous system; brain; biological effects; toxicity; cell membranes; membrane transport; age dependence; ontogenesis; lead 203; mercury 203; cadmium 109; calcium 45; carbon 14 compounds; tracer techniques; pathological changes; scintillation counting; gamma spectroscopy; absorption spectroscopy; acute exposure; chronic exposure.

34634 Multiple Loci Screen for Mutations in Mammalian Cells. Siciliano, M.J. (University of Texas, System Cancer Center, 6723 Bertner Avenue, Houston, TX, 77030). **Project number:** R01 ES01287. **Contract:** R01-ES-01287. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$99,000.
Related energy source: nuclear fusion(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The mutational process in mammalian somatic cells are being studied with special emphasis on the role of alterations in regulatory control factors as a source of cell variation. For this a newly developed Chinese hamster ovary (CHO) cell system is being used that is capable of distinguishing between regulational and structural gene mutational events and a human choriocarcinoma cell line (JEG) regulationally variant for a selectable enzyme. The exposure of CHO cells to ultraviolet radiation, nonselective isolation of single cell clones and the examination of the clones for alterations in the electrophoretic mobility and expression of the products of over 40 enzyme loci proved an effective method of detecting mutations in mammalian cells. Mutants were identified with respect to alterations in specific proteins and fell into four classes which included structural gene as well as possible control factor modifications. Unlike results from selective systems, structural gene electrophoretic mutants revealed CHO cells to be functionally and chromosomally quasi-diploid and dose response studies indicated that the frequency of mutants/survivor peaked instead of being linear with dose. Use of a selective system (6-thioguanine resistance) followed by screening

survivors through the enzyme battery after electrophoresis resulted in double mutants. This double mutant technique will now be used to measure the frequency of electrophoretic mutants at two different uv dose levels to determine not only the effectiveness of enrichment for variants, but also the kinetics of drug resistant and electrophoretic mutants in the same cells. Effects of chemical mutagens on the system will be begun. Somatic cell hybridization analysis will be begun to study the interaction and segregation of the control as well as structural gene mutants. Through electrophoretic, chromosomal, and somatic cell hybridization analysis we have determined adenosine deaminose (ADA) to be under negative regulational control in the human JEG cells. The genetics of that control in human-mouse hybrid clones will be analyzed and a system will be devised (through the use of ara-adenosine) to select for ADA turn-on in these cells. This system will then be evaluated as a screen for detecting agents which alter regulatory states in human cells.
Keywords: ultraviolet radiation; irradiation; cell cultures; somatic cells; tumor cells; hamsters; man; genetic radiation effects; gene mutations; radioinduction; mutagens; mutagen screening; genetics; dose-response relationships; mutation frequency; risk assessment; hybridization.

34635 Auditory Effects of Long Exposure to Low Levels of Noise. Mills, J.H. (Medical University of South Carolina, 80 Barre Street, Charleston, SC, 29401). **Project number:** R01 ES01301. **Contract:** R01-ES-01301. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$95,000.
Related energy source: Coal(20); oil and gas(20); nuclear fission(20); solar(20); geothermal(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objective is to specify the quantitative and qualitative relations between physical characteristics of noise and the temporary hearing losses produced by the noise. Knowledge of these relations for human observers will permit the specification of levels of noise that will not injure the inner ear, will not produce a temporary hearing loss, and will not delay the decay of an existing hearing loss. In addition, these relations will provide a scientific basis for the development of noise standards and criteria. Human observers will be exposed to low levels of continuous and intermittent noises for periods of up to 48 to 60 hrs. Auditory sensitivity for pure tones as well as other tests of auditory function will be measured before an exposure, during quiet periods interspersed within an exposure, and after an exposure. Results will be evaluated with respect to previous human and sub-human data, a predictive model (the equivalent power model), and current noise standards and criteria. Collectively, the proposed experiments will provide a parallel to earlier and current animal experiments and aid in elucidating the mechanisms of hearing and hearing loss.
Keywords: noise; biological effects; man; auditory organs; physiology; sensitivity; safety standards; noise pollution; pathological changes; neurology; biological stress; chronic exposure.

34636 Monitoring Mutagens with Mammalian Chromosomes. Hsu, T.C. (Univ. of Texas, 6723 Bertner Avenue, Houston, TX, 77025). **Project number:** R01-ES-01304. **Contract:** R01-ES-01304. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$122,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

There is an urgent need for devising and standardizing procedures for monitoring the effects of environmental mutagens on the genetic systems of higher animals. For practical purposes, these procedures should be relatively inexpensive, not laborious, easily quantitated, and the test objects should be related to the genetic system of man and other mammals. Chromosomes of cells in culture fulfill all these criteria and should be one of the most suitable testing materials. Since most mutagens induce chromosome damage (hence they are also clastogens), chromosome damage should serve as a conservative indicator of gene damage. However, investigators in the past used various test objects (many were poor materials) and test systems (many haphazardly designed), so their data are incomplete and are not strictly comparable. This project is designed to systematically test several cytologically advantageous materials and to determine the most efficient, economical and information-yielding protocol for future screening of environmental mutagens. Our test materials include, in addition to diploid human fibroblasts, cells of the Chinese hamster (for its fast growth rate and good chromosomes), the Indian muntjac (for its very low diploid number, 2n = 6), two species of the deer mice (differing drastically in the amount of constitutive heterochromatin and repetitive DNA content), and the laboratory mouse.
Keywords: mutagen screening; optimization; hamsters; chromosomal aberrations; mice; biological indicators.

34637 Lead Pharmacokinetics and Toxicity. Fung, H.L. (State University of New York at Buffalo, Amherst, NY, 14260). **Project number:** R01-ES-01317. **Contract:** R01-ES-01317. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$59,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective of this proposal is to carry out a systematic investigation of the factors which affect lead pharmacokinetics in experimental animals. Parameters which alter lead absorption, distribution and elimination will be studied as potential avenues for lead poisoning prevention and treatment. Inhibition of lead absorption is studied focusing on the processes which govern lead absorption in immature animals. These processes are (1) dissolution, (2) transit, and (3) permeability of lead from paint chips in the gastrointestinal tract. Interference of each of these processes can potentially alter the absorption characteristics of lead. Dissolution of lead from paint chips can be inhibited by precipitating anions, antacids and ion-exchange resins. Transit of lead can be promoted by metoclopramide and slowed by buffered carbohydrate solutions. Permeability of lead across the gastrointestinal barrier can be affected by the presence of competing metal ions. These approaches will be tested in the proposed research, using both in vitro and in vivo models. Formulation differences in lead paints (e.g., oil based vs latex) may have dramatic influence on the rate of release of lead from paints. The in vivo absorption and in vitro dissolution of various commericial lead paints will be compared. The intrinsic factors governing lead clearance from blood and lead entry into brain are not well defined in the literature. The fraction of free (diffusible) lead in the plasma may play a central role in these processes. Distributive changes among components of blood may give rise to concomitant changes in brain lead levels. In this proposal, the erythrocyte and plasma protein binding characteristics in different animal species are compared. The inter-relationship between erythrocyte lead binding, plasma free lead, brain lead and lead clearance from the body will be examined. The effect of metal ions such as calcium, zinc and magnesium on brain lead entry and egress will be investigated.
Keywords: lead; metabolism; toxicity; paints; gastrointestinal tract; therapy.

34638 Trace Element Deposition in Ambient Aerosol Inhalation. Winchester, J.W. (Florida State University, Department of Oceanography, Tallahassee, FL, 32306). **Project number:** R01-ES-01326. **Contract:** R01-ES-01326. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$67,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The response to inhalation of ambient aerosol particles from indoor and selected outdoor environments will be investigated using high sensitivity elemental analysis by proton induced x-ray emission, PIXE. The response may include both deposition of particles in the respiratory tract and growth in particle size due to exposure to high relative humidity during breathing. Both responses may depend on particle size and on chemical composition of the particles and may be different for different component particles in a mixed aerosol. The different components may be distinguished by their different elemental composition, and the respiratory response of each may be determined in a single experiment. Samples will be taken by 5 stage cascade impactor with fine particle filter and will provide resolution of particles <0.25 to >4 mu-m equivalent aerodynamic diameter. Each size range is analyzed for its elemental constituents by PIXE, including S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, Pb, Zr, Cd, and additional heavy metals if present in the aerosol. The nanogram sensitivity of the PIXE technique permits fine particle size resolution at a sampling rate of 1 liter/minute and requires of human subjects only 10 minutes or less of breathing time per sample. Experiments are carried out using ambient aerosol from different actual environments and do not require the use of special tracer.
Keywords: biological effects; aerosols; air pollution; particles; inhalation; trace amounts; deposition; sulfur; chlorine; potassium; calcium; titanium; vanadium; chromium; manganese; iron; nickel; copper; zinc; bromine; lead; zirconium; cadmium; metals.

34639 Environmental Pollutants and Toxicology of the Liver. Peterson, R.E. (Univ. of Wisconsin, School of Pharmacy, Madison, WI, 53706). **Project number:** R01-ES-01332. **Contract:** R01-ES-01332. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$46,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to study the effects of certain environmental pollutants and hepatotoxins with the retrograde intrabiliary injection (RII) technique and gain some insight into how these agents produce effects on the liver. Some studies have already been initiated using CCl_4 as a model compound to produce liver damage. We have found that CCl_4 liver damage produces a dicrotic notch in the recollection curve for the retrogradely injected compounds. Several approaches are proposed to investigate this finding based on the proposition that this effect of CCl_4 is on duct and ductular sites in

the biliary tree. Ability to detect functional damage at such sites is a new finding for CCl4. For obvious reasons, we will broaden the study to include other hepatotoxins and environmental pollutants. CO in initial trials, by virtue of its effect to depress bile flow, produces changes in the shape of the recollection curves for the compounds given by retrograde intrabiliary injection. Attempts will be made to differentiate effects of hypoxia from those of CO. Because dichloromethane type compounds are converted by metabolism to CO, possible intrahepatic release of CO and effects of this release will be evaluated. A study of selected compounds which produce liver damage will be made. Allylisopropylacetamide will be studied for hepatic porphyric effects.
Keywords: liver; toxicity; air pollution; toxins; carbon tetrachloride; carbon monoxide; biological effects; pathological changes.

34640 Lead Neurotoxicity During Development. Woolley, D.E. (University of California at Davis, Animal Physiology Department, Davis, CA, 95616). **Project number:** R01-ES-01503. **Contract:** R01-ES-01503. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: Coal(50); oil and gas(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed research will examine the neurotoxic effects of low-level lead exposure during early postnatal development in rats. Emphasis will be placed on a functional analysis of a specific brain system damaged by lead poisoning. The hippocampus, a neural system known to be affected by lead poisoning and thought to be important in plumbism's neurological sequelae, was selected for study. Functional development of the hippocampus will be studied directly by electrophysiological techniques and indirectly by behavioral measures. Neurohistological methods will be used to examine the effect of lead on hippocampal morphological development and these data will be related to the results of functional testing. The neuropharmacological responsiveness of hippocampal neurotransmitter systems, as well as hippocampal seizure thresholds, will be compared in lead poisoned and control rats. The hypothesis that one mechanism of lead neurotoxicity may be displacement of zinc by lead at neural sites will be tested by determination of lead and zinc concentrations in the hippocampus and several other brain regions. An attempt will be made to modify the severity of the neurotoxic consequences of lead exposure by manipulation of dietary zinc intake.
Keywords: lead; toxicity; neurology; central nervous system; diet; nutrients; neonates; rats.

34641 Toxicity of Pure PCBs for Rhesus Monkeys. McNulty, W.P. (Medical Research Foundation of Oregon, Oregon Regional Primate Research Center, 505 NW 185th Avenue, Beaverton, OR, 97005). **Project number:** R01-ES-01522. **Contract:** R01-ES-01522. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$150,000. **Related energy source:** Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Commercial mixtures (Aroclors) of polychlorinated biphenyls (PCBs) are more toxic to rhesus monkeys (Macaca mulatta) than to rats. However, in preliminary experiments, two individual pure PCBs were much less, and one was more, toxic to monkeys than Aroclor 1242. The oral toxicity of two tetrachlorobiphenyls and two hexachlorobiphenyls for rhesus monkeys will be assessed by use of criteria of clinical appearance and squamous gland metaplasia. One member of each pair of equally chlorinated compounds will have chlorine substitution in the ortho position, and the other will have only meta and para substitutions. Test feedings will stop when toxicity is apparent, and recovery on normal diet will be followed for a year. Samples of body fat, blood, and excreta will be periodically analyzed for the levels of the PCBS and the appearance of metabolites during both experimental feeding and recovery. Metabolites found in monkeys made sick by a given PCB will be definitively identified if possible, and their toxicity will be evaluated whenever enough compound can be synthesized for feeding experiments.
Keywords: organic chlorine compounds; aromatics; toxicity; macacus; rats; pathological changes.

34642 Protection Against Hepatotoxicity by Zinc. Chuapic, M. (University of Arizona, Health Sciences Center, Tucson, AZ, 85724). **Project number:** R01-ES-01570. **Contract:** R01-ES-01570. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Previous work documented that Zn++ forms a stable binuclear complex with NADPH thus inhibiting NADPH oxidation dependent reactions in liver microsomes such as metabolism of xenobiotics by mixed function oxidases (MFO), formation of secondary carcinogens, and formation of lipid peroxides. The goal of this proposal is to test that the in vitro effects of zinc as above also takes place in vivo in zinc supplemented animals. It is proposed that elevation of zinc in biological fluids and various liver compartments, mainly in microsomes will protect the liver against hepatotoxins and secondary hepatocarcinogens by inhibiting their metabolism by MFO. In isolated hepatocytes or in rats fed diets with various zinc content or parenterally supplemented with zinc, the liver injury induced by acute or chronic CCl4, aflatoxin B, will be studied by a complex methodology involving histology, electron microscopy, pharmacological and biochemical methods. The aim is to present the evidence that supplementation of zinc protects liver against xenobiotics and secondary carcinogens. The conditions under which this occurs will be established.
Keywords: zinc; toxicity; metabolism; liver; carcinogenesis; decontamination; immunology; biochemistry; microorganisms; carcinogens; nutrition; dynamic function studies.

34643 Effects of Lead Exposure on the Developing Rat Brain. Louis-Ferdinand, R.T. (Wayne State University, 1400 Chrysler Avenue, Detroit, MI, 48202). **Project number:** R01-ES-01638. **Contract:** R01-ES-01638. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$71,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This proposal describes an approach which will be utilized to determine the effect of low level lead exposure on selected biochemical and functional parameters associated with blood-brain barrier development. Brain and blood lead levels will be determined to relate lead effects on each parameter to tissue lead levels. Neonatal rats will be given lead acetate (7.5 mg/kg, i.p.) and utilized for in vivo amino acid and EDTA brain uptake studies or in vitro determinations of brain Y glutamyltranspeptidase and butyrylcholinesterase activities. Age comparison studies of lead susceptibility will be conducted to compare lead effects and tissue lead levels produced in two age groups which possess different lead sensitivities. The effect of lower lead doses on these parameters will be measured in different brain regions to estimate the lead dose and tissue levels at which no discernible effects are produced. The results of this investigation will answer essential questions concerning the relationship between lead dose, blood and brain lead levels produced and their effects on biochemical and functional indices of blood-brain barrier development. These results will facilitate the development of a relationship between enzyme and functional disturbances produced in these studies and lead toxicity in children.
Keywords: lead; toxicity; rats; brain; central nervous system; behavior; pathological changes; dynamic function studies; enzymes; sensitivity; children.

34644 Enzyme-Mediated Generation of Halogenated Pollutants. Siuda, J.F. (University of Pittsburgh, 726 Salk Hall, Pittsburgh, PA, 15261). **Project number:** R01-ES01644. **Contract:** R01-ES-01644. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$41,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

Enzyme-mediated generation of organohalogens may serve as an alternate source of halogenated pollutants. Haloperoxidases will be incubated with chloride or bromide ions and various organic substrates. The substrates will include B-keto acids and phenols which are known natural products and/or which are present in the biosphere. These reactions will attempt to determine if haloforms, halophenols and phenolic coupling products (biphenyls, dibenzodioxins, dibenzofurans, etc.) are formed by physiological functions. As an approach to simulating environmental conditions, the effect of pH on the type and quantity of reaction products will be investigated. Comparison of isolated products will be made with known structures of halogenated pollutants. The experimental results may aid in determining how certain halogenated compounds are produced and metabolized in the environment by microbiological processes. Haloperoxidase-catalyzed reactions may be useful in predicting baseline concentrations of halogenated substances in the environment.
Keywords: aromatics; halogenated aliphatic hydrocarbons; halogenated aromatic hydrocarbons; anions; keto acids; phenols; biodegradation; biosynthesis; microorganisms; ecosystems; peroxidases; enzyme activity; catalytic effects; ph value; biosphere; bench-scale experiments.

34645 Effects of Methylmercury on Fetal Brain. Choi, B.H. (University of Rochester, 601 Elmwood Avenue, Rochester, NY, 14642). **Project number:** R01-ES-01722. **Contract:** R01-ES-01722. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$112,000. **Related energy source:** Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This research proposes to study the effects of methylmercury on the growth and development of fetal brain. A genetically defined inbred strain of mouse, and organotypic and dissociated cultures of mouse fetal brain and human fetal brain (obtained from hysteroto-

mies) will be used. Pregnant animals will be given predetermined doses of methylmercury at specific stages of pregnancy. Offspring sacrificed at specified times will be studied with various morphologic techniques including electronmicroscopy, immunocytochemistry, Golgi techniques, radioautography and classical light microscopic stains. Both primary and secondary cultures of human and mouse fetal cerebrum and cerebellum will be exposed to various concentrations of methylmercury and the short and long term effects on sequential development of brain in vitro will be analyzed. The overall objectives of this proposal are to assess in detail the changes in development of fetal brain brought about by maternal intoxication of methylmercury, particularly the changes in the pattern of cell proliferation, neuronal migration, cortical differentiation and organization of cerebrum and cerebellum; to ascertain as fully as possible the mechanisms whereby these changes are brought about; and to correlate the findings with alterations observed in some of the developmental disorders of the nervous system encountered in man.
Keywords: methylmercury; biological effects; metabolism; brain; growth; fetuses; man; mice; central nervous system; behavior.

34646 Cardiotoxicity of Chronic Lead Exposure. Williams, B.J. (University of Texas, Medical Branch, Department of Pharmacology and Toxicology, Galveston, TX, 77550). **Project number:** R01-ES-01767. **Contract:** R01-ES-01767. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$45,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The detrimental effects on long term exposure to low concentrations of lead are not well understood. A recent observation from this laboratory indicates that increased cardiac risk may occur as a latent sequela to lead exposure during early post-natal development in rats. The proposed study is designed to further examine the nature of this phenomenon by determining the relationship of exposure time and lead concentration to effect, and the specificity of the cardiac response. Suckling rats will receive lead via mother's milk for a part or the whole of the nursing period (21 days). Concentrations of lead in blood and heart will be determined by atomic absorption spectrophotometry after various lengths of treatment. Animals will be placed on normal diet for 3 months prior to cardiac testing. The effect of norepinephrine and other drugs on cardia rhythm will be examined in vivo and in the isolated perfused heart. Biochemical analyses of autonomic neurotransmitter production and metabolism in the hearts of lead-exposed animals will be performed to evaluate the integrity of the cardiac autonomic system. Data from this study should allow us to define the nature of lead cardiotoxicity, and predict the risks involved in low level lead exposure.
Keywords: cardiovascular diseases; chronic exposure; lead; toxicity; epidemiology; rats; ecological concentration; blood; heart; drugs; biological effects; neurology; cardiovascular system.

34647 New System for Screening Environmental Mutagens. Finnerty, V.M. (Emory University, Biology Department, Atlanta, GA, 30322). **Project number:** R01 ES01804. **Contract:** R01-ES-01804. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

A test system utilizing Drosophila melanogaster is presented which may be developed into an extraordinarily sensitive and useful tool for evaluating environmental chemicals for their ability to induce a variety of chromosomal lesions. The system is especially well suited for the assessment of chromosomal lesions as measured via the induction of duplications.
Keywords: mutagens; mutagen screening; drosophila; chromosomal aberrations.

34648 Effects of PCBs on Fetal and Neonatal Development. Bowman, R.E. (University of Wisconsin, 22 North Charter Street, Madison, WI, 53706). **Project number:** R01-ES-01847. **Contract:** R01-ES-01847. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$131,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The present research program will receive the offspring of adult female monkeys which have been exposed in other research projects of 0.5 to 5 ppM of polychlorinated biphenyls (PCBs) in their daily diet prior to and throughout pregnancy and for four months of nursing of the offspring, but will not be involved in exposing any subjects to PCBs. The present project will then maintain these offspring on normal diets and will periodically monitor them for clinical health and body burdens of PCBs. These offspring will be subjected to a broad battery of behavioral tests to assess behavioral toxicology possibly resulting from the fetal and neonatal exposure to PCBs. Offspring will be available from monkeys fed either Aroclor 1248 or Aroclor 1016, or PCB residues derived from contaminated Great Lakes fish, allowing a comparison of the relative toxicities of these three PCB mixtures. From graphs of quantitative behavioral measures plotted against PCB body burdens, it is planned to determine whether there appears to exist a threshold of PCB dosage or of PCB body burdens below which toxic effects are not seen. If so, then the data should permit quantitative estimates of this threshold limit body burden. The data will permit a comparison of threshold limits derived both from clinical health assessments and from behavioral tests. Comparison of adult exposed and fetal-neonatal exposed monkeys will assess whether the developing organism is more vulnerable than the adult to toxic damage from PCBs. Emphasis will be on the detection of irreversible effects of PCB exposures through testing of the animals over several years following exposure.
Keywords: organic chlorine compounds; aromatics; fetuses; neonates; toxicity; monkeys; biological pathways; behavior; adults; comparative evaluations; chronic exposure; nutrition; diet; pathological changes.

34649 Childhood Lead, Pyrimidines and Metabolic Debris. Angle, C.R. (University of Nebraska, 42nd and Dewey Avenues, Omaha, NB, 68105). **Project number:** R01-ES-01857. **Contract:** R01-ES-01857. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Epidemiological studies.

Recent studies in children confirm observations on lead workers that the red cell of both man and the rat contains a phosphorylase specific for pyrimidines, pyrimidine 5'-nucleotidase (EC 3.1.3.5; P5N). P5N dephosphorylates pyrimidine nucleotides, preventing accumulation in the red blood cell. It is inhibited by lead (10 to 40 mu-g%). It is proposed to examine the epidemiologic significance of P5N in preschool children identified and followed in the Omaha Childhood Lead Poison Program. In addition to assays of red cell P5N, the children will be surveyed for the presence of red cell cytidine and uridine phosphates, nucleotides which accumulate in deficiencies of P5N. The accumulation of cytidine phosphate as metabolic debris may cause feedback inhibition of ribosomal degradation resulting in alteration of mRNA and, consequently, globin synthesis. This will be investigated by the correlation of P5N activity and of the intraerythrocytic accumulation of pyrimidines with measures of alpha and beta chain globin synthesis.
Keywords: lead; epidemiology; metabolism; biochemistry; blood; toxicity; children; pyrimidines; biochemical reaction kinetics.

34650 Is the Lung In Utero Sensitive to Chemical Toxins. Kilburn, K.H. (Mt. Sinai School of Medicine, 100th Street at 5th Avenue, New York, NY, 10029). **Project number:** R01-ES-01865. **Contract:** R01-ES-01865. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$122,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The interrelated objectives of this proposal are to determine if the embryo lung is more sensitive than the adult or newborn to toxic chemicals and to determine if certain pulmonary diseases begin with in utero injury by toxic chemicals. It is proposed to test representatives of five groups of chemicals known to affect the lung, many to which man is occupationally exposed, for effects on the developing mouse or rat lung in utero. Chemicals will be given intraperitoneally in pregnant dams and after proper doses are found, effects on organogenesis of the lung, vessels and other organs appraised by systematic morphological studies and measurements. Agents to be analyzed for effects include vinyl chloride, paraquat, copper deficiency (nutritional chelating agents and cadmium), bromobenzene and polychlorinated biphenyls and amphophilic drugs such as AY9944 and solvents. By studying litter mate animals at birth, at weaning, at puberty, at adult and old adult, both immediate and latent effects should be detected. Methods include gross anatomy, histology, electron microscopy and some biochemical probes. It is hoped that such studies will lead to early, more sensitive and more reliable ways to detect potential for lung injury and disease by chemicals.
Keywords: lungs; embryos; teratogenesis; toxins; physiology; respiratory system diseases; etiology; rats; mice; plastics; copper; nutrition; organic chlorine compounds; aromatics; benzene; drugs; organic solvents; pathological changes.

34651 Heavy Metals in Early Mammalian Embryogenesis. Abramczuk, J. (Wistar Institute, 36th and Spruce Streets, Philadelphia, PA, 19104). **Project number:** R01-ES-01866. **Contract:** R01-ES-01866. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$80,000.
Related energy source: Coal(40); oil and gas(20); oil shale(20); nuclear fission(20) **R and D categories:** Health effects assessments.

Little is known about the effects of heavy metal ions on the early development of mammalian embryos. The overall objective of the proposed research is to examine the effects of 24 different heavy

metals, applied either in vivo or in vitro, on the development of early mouse embryos. The following subjects will be studied: (1) the development in vitro of mouse 1-cell and 2-cell embryos in the presence of various concentrations of particular metal ions (fractions of blastocysts developed from cultured embryos will be estimated and karyological analysis of embryos performed); (2) postimplantation development of blastocysts obtained from 1- and 2-cell embryos grown in vitro in the presence of a studied heavy metal, and then transferred to foster mothers (development of blastocysts exposed for 12 to 24 hours to a given metal. Numbers of implantation and resorption sites, or normal and abnormal fetuses, and the size and survival of litters will be assayed); (3) the effects of intravaginal deposition of heavy metal salts on the preimplantation and postimplantation development of mouse embryos; and (4) the effects of heavy metals provided in the diet of mothers shortly before ferilization and during preimplantation development of embryos on preimplantation and postimplantation development of embryos. Results of the proposed project should lead to: (1) a better understanding of the mechanisms regulating development of preimplantation embryos; (2) a potential application in human birth control; and (3) disclosure and control of potential mutagenic, teratogenic and embryotoxic environmental contaminants.

Keywords: embryos; teratogenesis; metals; cadmium; lead; mercury; toxicity; mutagens; mutagenesis; fetuses; biological models; mice.

34652 Health Effect of Environmental Asbestos Fiber Length. Willeke, K. (University of Cincinnati, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** R01-ES-01870. **Contract:** R01-ES-01870. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$57,000.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Health effects assessments.

The permissible exposure to airborne concentration of asbestos fibers is expressed in terms of number of fibers longer than 5 micrometers per unit volume of air sampled. While there is general conviction that the fibrogenic effect of asbestos is physically size dependent, definitive studies have not been performed because of the lack of suitable techniques for size-classifying asbestos samples. Grinding of fibers not only changes the length, but also diameter and crystallinity. In the present proposal, a new opposing-jet impaction technique, first designed for the size-classification of spherically-shaped particles, developed by the principal investigators, will be further developed for the classification by length of asbestos fibers. In this technique, the fibers are aligned parallel to the streamlines in the airjet of the first impaction stage and perpendicular to the streamlines in the airjet of the second stage. By opposing the asbestos-laden airjet by a clean airjet of the same magnitude, the fibers are classified into two effluent streams depending on their length, diameter and alignment in the flow-field. Length-classified fibers of glass and of different asbestos types will be administered to animals intratracheally to study relative early fibrogenic effects on the respiratory tract and by gavage to study relative effects on biochemical parameters in cells of the gastrointestinal tract.

Keywords: asbestos; health hazards; air pollution; gastrointestinal tract; fibers; particle size.

34653 Blood Lead, Body Lead Compartments and Lead Exposure. O'Flaherty, E.J. (University of Cincinnati, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** R01-ES-01872. **Contract:** R01-ES-01872. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$52,000.

Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The lead content of most tissues is directly proportional to lead exposure. However, experimental studies suggest that kidney lead deposition accelerates as exposure increases while both epidemiological and experimental studies demonstrate that blood and urine lead concentrations show decreasing incremental rises with increasing exposure. Together with limited evidence for the development of lead tolerance, these observations suggest that internal redistribution and sequestration of lead responsive to lead exposure are mechanisms whose purpose is to reduce lead toxicity. The experiments described are designed to reproduce the nonlinearity of blood and kidney lead in an animal model and to use the model to: (1) study tissue distributions as functions of duration and magnitude of exposure; (2) study subcellular distributions in critical tissues as functions of duration and magnitude of exposure; (3) correlate these data with the results of tolerance studies to determine whether redistribution and sequestration are mechanisms of tolerance development, and (4) correlate the distribution data with response measures to determine whether the effect of lead is associated with an active fraction or fractions of the total body burden.

Keywords: blood; lead; body burden; toxicity; deposition; urine; tolerance; bioadsorbents; animal cells.

34654 New Screening Methods for Toxic Substances. Dougherty, R.C. (Florida State University, Department of Chemistry, Tallahassee, FL, 32306). **Project number:** R01-ES-01878. **Contract:** R01-ES-01878. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$65,000.

Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant characterization and analysis.

This project will continue the development of general procedures for toxic residue detection which are designed to detect any unknown member of broad chemical classes of toxic substances when the presence of that compound is not suspected. The methodology involves the application of negative chemical ionization (NCI) mass spectrometry after subjecting environmental substrates to minimal and specific cleanup procedures for each class of toxic substances. The fact that NCI mass spectra are virtually transparent for biomolecule and very sensitive to the presence to toxic substances will be used to detect the molecules in question. NCI mass spectra of partially cleaned up environmental substrates will be matched by computer to a library of NCI spectra of toxic substances which will be developed during this project. The toxic substances in the spectra library will include those samples available from the EPA repository of toxic substances and those available from the National Cancer Institute repository of carcinogens. Specific cleanup procedures will be developed which do not involve adsorption chromatography for polychlorinated organics, nitrosamines and nitrosamides, phosphates and phosphothicates, carbamates, and polycyclic fungal toxins. Procedures for aqueous and lipid rich substrates will be developed. The sensitivity for all compounds in the NCi mass spectral library will be determined under standard operating conditions. The amount of recovery of selected examples of toxic substances in the classes examined will be determined. A new specific detector for N-nitroso compounds will be developed and its sensitivity and freedom from artifacts will be tested. The detector will be based on photoionization detection of nitric oxide generated by thermolysis or photolysis of the N-nitroso compounds. A confirmation protocol for samples tentatively identified in the NCI screening procedure will be developed. This protocol will involve gas chromatography mass spectrometry and simple gas chromatography for confirmation and quantitation of identified unknowns.

Keywords: toxic materials; mass spectra; environment; chemical analysis; organic chlorine compounds; aromatics; organic nitrogen compounds; organic phosphorus compounds; fungi; carbamates.

34655 Zinc and Cadmium Interference with Lead Exposure Tests. Thawley, D. (University of Missouri, Department of Veterinary Microbiology, Columbia, MO, 65201). **Project number:** R01-ES-01889. **Contract:** R01-ES-01889. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.

Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This is a proposal to determine the effects of zinc and cadmium exposure on amino-levulinic acid dehydrase (ALAD) activity, amino-levulinic acid (ALAU) excretion and free erythrocyte porphyrin (FEP) concentration in lead intoxicated rats. Lead will be administered orally while zinc and cadmium will be administered either orally or subcutaneously at levels appropriate to exposure in a heavy metal contaminated environment. Data will be analyzed to determine whether either lead--zinc or lead--cadmium interactions occur involving any of the above lead exposure screening parameters. Blood lead, zinc and cadmium concentrations, and basic hematological readings will also be made. The basic objective for this proposal is to clarify the effects of the interactions between lead and zinc, and lead and cadmium on 3 screening parameters for lead exposure. Since environments contaminated with lead are commonly contaminated with zinc and cadmium, an urgency exists for this work to be carried out to ensure the screening tests currently employed for testing lead exposure are not recording false negative results in lead intoxicated individuals exposed simultaneously to high levels of zinc or cadmium.

Keywords: zinc; cadmium; lead; aminolevulinic acid; toxicity; synergism; metabolism; mutagen screening; interfering elements; bioassay; reliability; rats.

34656 Cytopathologic Effects of Polychlorinated Biphenyls. Bell, M. (University of Cincinnati, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** R01-ES-01890. **Contract:** R01-ES-01890. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$47,000.

Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The cytopathologic effects of exposure to polychlorinated biphenyl compounds (PCBs) have varied considerably with the dosages and mixtures of isomers administered, with duration of exposure, and with the species that have exhibited toxic effects. The liver has been the organ studied most carefully for histo- and

cytopathologic changes because hepatomegaly has often resulted from PCB toxicity, because the agranular endoplasmic reticulum (the site of drug metabolizing enzymes in hepatocytes) proliferates in response to PCB exposure, and because hepatic tumors have been produced in rodents after long-term exposure. Available evidence indicated that PCBs often affect the histologic and cytologic organization of other tissues, especially epithelia and their derivatives, that have moderate to rapid rates of cell renewal. No studies thus far have attempted to determine whether PCBs directly affect cell division, cell differentiation, or both of these processes. In the proposed experiments, the effects of exposure to Aroclor 1254, a widely used askarel of PCBs and a persistent environmental pollutant, will be compared in two sites--cutaneous sebaceous glands and gastric glands of the stomach--whose cytology is known to be altered after exposure to PCBs. The effects on rates of cell division in these sites will be determined by radioautography, and those on cell differentiation with cytochemical and morphometric techniques. Data thus obtained will be correlated with ultrastructural observations of these sites gained from transmission and scanning electron microscopy.
Keywords: organic chlorine compounds; aromatics; pathological changes; toxicity; rats; metabolism; chronic exposure; skin; gastrointestinal tract; stomach.

34657 Alkylating Carcinogen Mutagenesis in Mammalian Cells. Burki, H.J. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** R01-ES-01916. **Contract:** R01-ES-01916. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$53,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

It is proposed to develop a model system for studying the mutagenesis of alkylating carcinogens in asynchronous and synchronous mammalian cells in vitro. Using asynchronous cells of differenet species and tissue origin, the production of mutations by ethylnitrosourea (ENU) and related environmental carcinogens will be measured. The effects of cellular repair processes on the induction of mutations will be determined by measuring the loss of carcinogen-produced damage and relating it to mutagenesis. In addition, the induced frequency of certain specific mutations during the cell cycle will be measured to test if specific mutagenic changes are associated with specific cell-cycle times. ENU is used because of its advantageous chemical characteristics, and because of its special carcinogenc properties. Exposing homogeneous populations of selectively synchronized mammalian cells to this agent offers a novel way to test for alkylating-induced mutations in mammalian cells. These experiments may give us a practical understanding of chemical mutagenesis from alkylating agents which will be useful for estimating total risks, as well as risks relative to other environmental carcinogens to the human population.
Keywords: alkylating agents; carcinogens; mutagenesis; animal cells; mutagen screening; optimization; in vitro; mutation frequency; nitroso compounds; organic nitrogen compounds; dna; risk assessment.

34658 Study of Metal-Binding Peptides. Yoshida, A.Y. (City of Hope Medical Center, 1500 E. Duarte Road, Duarte, CA, 91010). **Project number:** R01-ES-01928. **Contract:** R01-ES-01928. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$58,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the project are to: (1) elucidate the relationships between peptide structure and metal-binding activity of synthetic oligopeptides which contain three cysteine residues; and (2) examine the detoxification effects of the metal-binding peptides against Cd and Hg in animals. A naturally existing protein designated as thionein obtained from various mammals has strong metal-binding activity, and the protein has been implicated in detoxification of harmful metal ions. Thionein consists of about 60 amino acid residues, and among them 20 are cysteine. One molecule of thionein binds to about 7 metal ions, indicating that three -SH groups are involved in mercaptide formation. Several oligopeptides were synthesized (6 to 13 amino acid residues) which contained three cysteine residues, and it was found that the synthetic peptides also had strong metal-binding activity. In the proposed project, various peptides which contain three cysteine residues will be synthesized by the solid-phase method and liquid-phase method. The peptide will be purified by ion-exchange chromatography and reverse-phase chromatography. Binding activity of the peptides towards Cd, Hg and Zn will be determined. The peptides with strong affinity to Cd and Hg will be used for detoxification of animals which have been treated with these harmful metals.
Keywords: peptides; chemical bonds; metals; binding energy; proteins; cadmium; mercury; bioadsorbents; decontamination; chemical properties; toxicity; zinc.

34659 Behavioral Indicators of Lead Neurotoxicity. Valciukas, J.A. (Mount Sinai School of Medicine, 5th Avenue and 100th Street, New York, NY, 10029). **Project number:** R01-ES-01933. **Contract:** R01-ES-01933. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$10,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Health effects assessments.

Lead is a widely used environmental toxic agent and there is a great need for practical, sensitive methods for detecting its early biological effects in man. It is currently agreed that neurobehavioral changes might be the earliest indicators of subclinical lead intoxication. However, it is not yet clear which neurobehavioral dimensions are most likely to be effected by lead. The present study proposes to examine behavioral indicators of lead neurotoxicity, some of which (such as performance tests) have proven to be sensitive in the assessment of the earliest functional central nervous system changes produced by lead. It is also proposed that the speed and quantitative characteristics of eye movements (as detected by electro-oculographic methods) might be an important addition to the battery of neurobehavioral tests. The speed and characteristics of saccades are known to be influenced by neurotoxic agents, particularly when they act selectively, as lead does, on the cerebullum. Elevated blood lead levels and zinc protoporphyrin (ZPP) have been shown to be correlated with lowered performance test scores. It is also expected that these two biological indicators of exposure will be correlated with a decrease in the speed of oculomotor behavior. Performance tests (including the electrophysiological evaluation of visuo-oculomotor performance) might prove to be simple and objective methods for the early evaluation of central nervous system functional changes produced by this environmental toxic agent.
Keywords: lead; toxicity; biological indicators; brain; neurology; central nervous system; zinc compounds; biological localization; pathological changes.

34660 Study of Mutagenesis by Chemical Carcinogens. Cavalieri, L.F. (Sloan-Kettering Institute for Cancer Research, 410 East 68th Street, New York, NY, 10021). **Project number:** R01-ES-01936. **Contract:** R01-ES-01936. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$79,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This proposal is concerned with mutagenesis and carcinogenesis induced by aromatic polycyclic hydrocarbons which are environmental pollutants. The experiments described will show whether, and how, DNA adducts formed from the proximate carcinogens produce mutations. The study offers a new approach: the use of mammalian virus SV40, with its DNA modified in vitro by treatment with the proximate hydrocarbon carcinogen. The modified and characterized SV40 DNA vector will then be studied in infected cells, from which can be learned the molecular nature (base change, insertion, deletion) and location of mutations caused by the hydrocarbon adducts. The studies will also help to elucidate the role of DNA repair in mutagenesis. Both pre- and post-replicative repair will be studied and it will be determined whether the repair process itself is error-prone. A close correlation between mutagenesis and carcinogenesis will be made possible by examining the extent of mutagenesis of SV40 in the same cells in which transformation by the hydrocarbons will be studied. This last approach will also provide a basis for the screening of potential carcinogens.
Keywords: mutagenesis; chemical effluents; carcinogenesis; polycyclic aromatic hydrocarbons; metabolism; genetic effects; biological models; mutagen screening; dna; biological repair; viruses; infectivity; toxicity.

34661 Microwave Effects on Excitable Membrane Systems. Cleary, S.F. (Virginia Commonwealth University, Medical College of Virginia, Box 877, Richmond, VA, 23298). **Project number:** R01-ES01938. **Contract:** R01-ES-01938. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$38,000.
Related energy source: nuclear fusion(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

An investigation of the effect of electric fields at microwave frequencies on the induction of action potentials in excitable membrane systems is proposed. The objective of the research is to differentiate between effects due to the impressed microwave electric field as contrasted to other microwave-specific thermal and nonthermal effects. A waveguide irradiation technique will be used to expose the algae Chara australis and other excitable cell systems to low intensity microwave radiation in the frequency range of 2 to 4 GHz in a thermostated irradiation chamber. Initially continuous wave microwaves will be employed, followed by an investigation of pulse modulated fields. The cell systems will be of sufficient size to permit the measurement of action potentials with electrodes exterior to the waveguide, thus minimizing interactions between the microwave field and the detection system. Prior to microwave exposure the mean threshold electric field strength for the induction of the action potential will be determined by the use of a variable amplitude pulsed current stimulator. Thresholds will be redetermined during

and after exposure of the cell system to microwave radiation of known field strength. Variations in the excitation threshold will be interpreted in terms of the summation of the field strengths of the impressed stimulus and the microwave field. The independent variables to be investigated will be microwave field strength, microwave frequency pulse duration and amplitude, latency for recovery of preexposure threshold, and temperaturc.
Keywords: electric fields; microwave radiation; hz range; biological effects; algae; cell membranes; electric potential; pathological changes; threshold energy; pulsed irradiation; latency period; biological recovery; temperature measurement.

34662 Factor Affecting Irritant Potency of Gases and Aerosols. Amdur, M.O. (Harvard University, 665 Huntington Avenue, Boston, MA, 02115). **Project number:** R01-ES-1939-01. **Contract:** R01-ES-1939-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$76,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The work proposed is part of a long-term program of study of the irritant potency of compounds of interest as contaminants of urban and industrial environments. The unifying thread of the program has been, and will continue to be, the correlation of physical or chemical factors of the exposure environment with observed biological response. Priority is given to two general areas: the effect of particle size on the irritant potency of aerosols and the possible potentiation of irritant gases by aerosols. The biological assay method used is the measurement of the mechanics of respiration of unanesthetized guinea pigs before, during and after exposure to the material or materials being studied. For a certain group of irritants, including sulfur dioxide and sulfuric acid, the increase in flow-resistance is the most sensitive criterion of response and can be related to the concentration of irritant present. Specific areas of investigation will include biological and chemical studies of the conversion of sulfur dioxide to sulfuric acid by oxidizing aerosols and studies of the joint toxic action of sulfur dioxide and sulfuric acid for a range of particle sizes of sulfuric acid. Plans are also being made to study nitrogen alone and in combination with aerosols and in combination with sulfur dioxide.
Keywords: aerosols; particles; gases; guinea pigs; toxicity; sulfur dioxide; respiration; sulfuric acid; nitrogen dioxide; synergism; biological effects; lungs; pathological changes.

34663 Mutation and Selection in Drosophila Populations. Simmons, M.J. (University of Minnesota, Genetics and Cell Biology Dept., St. Paul, MN, 55108). **Project number:** R01-ES01960. **Contract:** R01-ES-01960. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this project is to characterize the effects of randomly induced mutations on fitness in populations of Drosophila melanogaster. Mutations will be induced on the x-chromosome with ethyl methanesulfonate (EMS) and x rays. Their effects will be ascertained in single and multiple generation experiments. In the former, the influences of the mutants on survival will be measured; in the latter, attention will be focused on total fitness effects. Of course, total fitness includes survival, but it involves other components, such as fertility, as well. One goal is to determine the connection between the survival and total fitness effects of new mutants. Another is to compare the effects of chemical and radiation-induced mutations. A third is to explore the possibility that the total fitness effects vary from one generation to another, and if so, randomly or otherwise. In a separate series of experiments using EMS-induced and spontaneous mutants, data will be collected to determine if fitnesses are transitive; these experiments will be of the multiple generation type. In much of this work the method will involve competition between mutagenized and unmutagenized x-chromosomes carried in hemizygous males. By monitoring the relative frequencies of the two over time, it is possible to estimate the intensity with which mutants are selected out of the population. Taken together with known mutation rates, these estimates should enhance our understanding of how mutation and selection affect the level of genetic variability in Drosophila populations.
Keywords: x radiation; irradiation; males; drosophila; genetic radiation effects; x chromosome; mutations; radioinduction; mutation frequency; spontaneous mutations; ems; mutagenesis; comparative evaluations; population dynamics; survival time; genetic variability.

34664 Rapid Tests for Environmental Carcinogens. Furlong, N.B. (University of Texas, System Cancer Center, 6723 Bertner Avenue, Houston, TX, 77030). **Project number:** R01-ES-01967. **Contract:** R01-ES-01967. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$46,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

A new family of assays for detecting potential chemical carcinogens is described. These assays measure the extent to which a substance alters the specificity of base selection during DNA replication in vitro. The basis of this measure is the incorporation into DNA of an analogue substrate relative to a natural substrate in a DNA polymerase reaction. The reaction utilizes a mammalian DNA polymerase, DNA templates from mammalian cells and analogue/natural competitive substrate pairs under conditions which normally select against analogue incorporation. Substances are tested for their ability to enhance the relative incorporation of the analogue substrate. Enhancement is taken as evidence that selection specificity has been altered, i.e., error-prone synthesis has been induced. Substances which do not require metabolic activation are tested for their primary site of action by pretreating the polymerase, by pretreating the template or by direct addition to the reaction. In addition, substances that require metabolic activation to interact with DNA are tested for the extent to which these interactions promote error-prone replication by using DNA templates extracted from tissues exposed to such substances. For example, using the incorporation of araATP relative to dATP in the presence of various heavy metal salts, correlation has been found between the increased ratios of analogue incorporation and the carcinogenicity of these metallic cations. Other analogue substances, corresponding to each of the four normal substances, are proposed for testing. The effects on each of these test systems of treating either the DNA polymerase or the DNA template with these direct-acting carcinogens will be determined and, in addition, the sensitivity of the assays in detecting altered template activity for DNA extracted from cells exposed to two carcinogens that require metabolic activation will be established. These results will provide the basis for selecting and standardizing assays appropriate for use in screening potential environmental carcinogens.
Keywords: carcinogens; mutagen screening; optimization; bioassay; dna replication; animal cells; standards; metabolism; chemical effluents.

34665 NO2, Collagen and Elastin: Experimental Emphysema. Kleinerman, J.I. (Mt. Sinai School of Medicine, 1 Gustave L. Levy Place, New York, NY, 10029). **Project number:** R01-ES-02110. **Contract:** R01-ES-02110. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$90,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of the proposed research is to analyze the quantity, character and dynamics of lung elastin and collagen following acute and chronic exposure to NO2. Biochemical, isotopic, histologic and ultrastructural methods will be applied. Alterations in lung collagen and elastin are to be correlated with elastase and collagenase contents of alveolar macrophages before and in the course of NO2 exposures to evaluate the importance of the macrophage as an intermediary of injury. Lung tissue prolyl and lysyl hydroxylase activities, which reflect synthesis in the scleroproteins will be studied as corroborative evidence of dynamic alteration in connective tissues. The effects of D penicillamine on the biochemical and structural aspects of connective tissue repair after NO2 exposure will be studied. The in vivo role of the new synthetic protease (elastase) inhibitor- ananyl, prolyl alanyl chloromethylketone (AAPACK) (or Ala-Ala-Pro-Val-Ck) on the activity of macrophage elastases during the course of NO2 exposure will be determined and correlated with the biochemical and ultrastructural changes produced in the collagen and elastin of the lung. The morphometric determination of fiber size, distribution and total fiber length of elastin will be determined before and during NO2 exposure. Similar studies for collagen and reticulin will be developed. The characteristics of the elastin meshwork will be evaluated by scanning electron microscopy.
Keywords: nitrogen dioxide; lungs; toxicity; pathological changes; collagen; elasticity; reticulocytes; emphysema; epidemiology.

34666 Asbestos and Cancer. Warnock, M.L. (University of California School of Medicine, Dept. of Pathology, San Francisco, CA; 94143). **Project number:** R01-ES02117. **Contract:** R01-ES-02117. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$43,000.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Our previous studies have failed to demonstrate a relation between numbers of pulmonary asbestos bodies and the presence of carcinoma of the lung or gastrointestinal tract in workers with very low asbestos exposure. Asbestos bodies, however, represent only a part, and perhaps only a small part, of the total lung asbestos burden, which is composed of coated bodies as well as uncoated fibers. It remains possible that a relation exists between numbers of uncoated asbestos fibers and the presence of bronchogenic carcinoma. This study will attempt to quantify and type the uncoated asbestos fibers as well as asbestos bodies at various sites in the lung. A new preparative method has already been developed and used for exam-

ining and identifying the nature of the cores of asbestos bodies by electron diffraction. The same method will be used to identify further these same bodies by electron microprobe analysis. An additional preparative method has been devised for recovering uncoated asbestos fibers. Relations between numbers of coated and uncoated asbestos fibers, as well as their relative locations within the lung, will be tabulated, and an attempt will be made to correlate numbers or types of fibers with the presence or absence of carcinomas. It has been previously shown that numbers of asbestos bodies are related to occupation. An attempt will be made to establish whether a similar situation exists for uncoated fibers or whether they are derived from the environment.
Keywords: asbestos; inhalation; biological effects; carcinogenesis; lungs; carcinomas; electron diffraction; electron microprobe analysis; coatings.

34667 Nervous System Porphyrins and Lead and PCB Effects. Whetsell, W. (Univ. of Tennessee, Memphis, TN, 38163). **Project number:** R01-ES-02421. **Contract:** R01-ES-02421. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The research is designed to (1) further investigate the nature of the porphyrin-heme biosynthetic pathway in organotypic cultures of nervous system; and (2) study the effects, in this tissue culture model, of two environmental toxic agents, lead and chlorinated hydrocarbons. The investigator will localize and characterize the porphyrin biosynthetic pathway(s) in living nervous tissues using fluorescence microscopic and spectrofluorometric methods. In mature cultures treated with lead, light and electron microscopic techniques will be applied to study cellular components which are affected by lead, i.e., neuronal elements versus supporting elements; spectrofluorometric techniques are being used to measure differences in porphyrin production of lead-treated cultures compared to non-lead-treated cultures. In immature cultures, effects of lead on normal growth and development and on porphyrin metabolic pathways will be evaluated. The efficacy of lead-chelating agents and heme in preventing or reversing effects of lead will also be studied. In mature cultures treated with chlorinated hydrocarbons (polychlorinated biphenyls-PCBs), biochemical and morphological effects will be studied in relationship to nervous system porphyrin-heme pathways.
Keywords: nervous system; tissue cultures; heme; biosynthesis; lead compounds; aromatics; organic chlorine compounds; biological effects.

34668 Metabolic Activity of Brain Capillaries. Goldstein, G.W. (Univ. of Michigan, Ann Arbor, MI, 48109). **Project number:** R01-ES-02380. **Contract:** R01-ES-02380. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to study the metabolic basis of acute encephalopathy produced in young rat pups by feeding their mother lead carbonate. The young rats develop severe cerebellar edema which has the same pathological features found in human cases of lead poisoning. There is histological and chemical evidence that the primary disturbance in acute lead encephalopathy may be an increased permeability of brain capillaries to plasma. We have adapted a procedure for the isolation of capillaries from brain for use in rats. We have shown that the isolated capillaries retain enzymatic and metabolic activity and now plan to define the metabolic reaction occurring in the capillaries of rats with lead encephalopathy. In addition to preparation of the animal model and the isolated brain capillaries, methods will include measurement of the permeability of the capillary preparation to protein and lead, monitoring of cellular integrity as indicated by glucose uptake, glucose metabolism, and oxygen consumption, and assay of those enzymes which may serve as biochemical markers for the different cellular and subcellular fractions of brain and of those known to be inhibited by low concentrations of lead.
Keywords: lead compounds; biological effects; brain; capillaries; permeability; rats; neonates; metabolism.

34669 Metabolic Effects of Lead Poisoning in Childhood. Piomelli, S. (Columbia Univ., New York, NY, 10032). **Project number:** R01-ES-02343. **Contract:** R01-ES-02343. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Epidemiological studies.

The purposed research will investigate the clinical significance of hematological evidence of lead toxicity in asymptomatic children with moderately elevated body burden of lead. These stuies will investigate whether, at equal blood Pb levels, more pronounced metabolic effects reflect a greater body burden of lead and greater evidence of neurological toxicity. These studies will evaluate the different content and the molecular species of protoporphyrin present in red cells fractionated according to age to provide an insight to the temporal sequence of lead exposure at time of testing to be used in diagnosis and treatment. These studies will also evaluate the effect of Fe deficiency on porphyrin elevation. An epidemiological study will be performed in children, as well as in adults, to substantiate the evidence for a dose-effect relationship between body burden of Pb and metabolic interference. These studies will be performed in individuals with blood Pb in the range presently considered normal, to demonstrate evidence of metabolic effects even in this range.
Keywords: children; metabolism; lead; toxicity; body burden; nervous system; protoporphyrins; iron; porphyrins; nutritional deficiency.

34670 Isolating Carcinogen Sensitive Mammalian Cell Mutants. Stamato, T.D. (Wistar Inst. of Anatomy and Biology, Philadelphia, PA, 19104). **Project number:** R01-ES-02274. **Contract:** R01-ES-02274. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop methods for isolating mammalian cells in tissue culture which are sensitive to a variety of lethal agents, the purpose being to apply the techniques of biochemical genetics to study of the mechanisms of DNA repair, mutagenesis, and carcinogenesis in mammalian cells in culture.
Keywords: cell cultures; mutagen screening; animal cells; sensitivity; separation processes; mutants.

34671 Inhalation Carcinogenesis By Formaldehyde and HCL. Sellakmuar, A.R. (New York Univ., New York, NY, 10016). **Project number:** R01-ES-02270. **Contract:** R01-ES-02270. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It has been observed that low levels of bis(chloromethyl)ether may be formed by the gas phase reaction of formaldehyde and hydrogen chloride. The research is designed to: (1) determine the carcinogenic effects of these combined exposures; (2) determine possible carcinogenic effects of these chemicals when given separately; (3) determine the promoting or cocarcinogenic effects of hydrogen chloride on formaldehyde; and (4) determine the level of alkylating activity of BCME and other alkylating agents present in the combined atmosphere of formaldehyde and hydrogen chloride. The study involves 700 Sprague Dawley rats, divided into seven groups. Animals will be exposed by inhalation in the following manner: 6 hour/day, 5 days/week to (1) formaldehyde and hydrogen chloride at the 10 ppM level, mixed and pre-mixed; (2) formaldehyde or hydrogen chloride given separately at 10 ppM; (3) formaldehyde and hydrogen chloride on alternate days at 20 ppM each; and (4) air sham-exposed and untreated controls.
Keywords: formaldehyde; inhalation; hydrochloric acid; carcinogenesis; ethers; organic chlorine compounds; rats; biological effects; trace amounts.

34672 Sequelae to Childhood Lead Exposures: a Twin Study. Marmer, M. (Cornell Univ., Ithaca, NY, 14853). **Project number:** R01-ES-02267. **Contract:** R01-ES-02267. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Epidemiological studies.

The purposes of this research are to determine if there are long-term consequences of increased lead absorption in children and to evaluate the current criteria for treatment of lead overexposed children. The research will utilize a twin methodology to control for exposures to environmental risk factors other than lead and for genetic and cultural factors which might confound outcome measures such as intelligence quotients. Members of twin pairs with a history of increased lead absorption will be compared with less-exposed twin siblings on neuropsychological measures and school performance. The population of twins will be obtained from the records of the New York City Bureau of Lead Poisoning Control. Premorbid conditions will be determined from birth records, hospital/doctors records, and from parental interview.
Keywords: children; lead; metabolism; biological effects; genetic effects; uptake; response modifying factors.

34673 Inhalation Carcinogenesis by Direct-Acting Compounds. Dulak, N.K. (New York Univ., New York, NY, 10016). **Project number:** R01-ES-02249. **Contract:** R01-ES-02249. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A series of direct-acting alkylating and acylating compounds will be studied to determine whether their carcinogenic potency in the respiratory tract is related to their chemical reactivity. Relatively short but intense inhalation exposures of Sprague-Dawley rats will be carried out, with the concentrations of the compounds adjusted to

reflect their relative chemical reactivities. In a series of parallel in vitro studies, the same chemicals will be examined for their ability to effect transformation and mutagenesis in mammalian cell systems. **Keywords:** inhalation; carcinogenesis; biochemical reaction kinetics; mutagenesis; alkylating agents; acylation; rats; in vitro.

34674 Development of Eukaryotic Ames Type Mutagen Monitor. Milan, R.A. (Washington State Univ., Pullman, WA, 99164). **Project number:** R01-ES-02224. **Contract:** R01-ES-02224. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to develop a series of waxy pollen mutants in barley which will be highly sensitive to low levels of mutagens in the environment and will identify the type of mutation, i.e., frameshift or base substitution, induced. These mutants will be in a widely adapted plant capable of in situ mutagen monitoring in and around factories, laboratories, and reactors, on farms and in mobile air pollution monitoring laboratories. The waxy pollen system was chosen because it can record mutation events at the waxy locus occurring as low as one in 10/sup -6/ pollen grains. Waxy mutant alleles will be induced by base substitution (bs), framshift (fs), and deletion producing mutagens. They will be selected and mapped from recombination and depletion mapping data. Frequencies of reverse mutations in putative fs and bs mutants following treatments with a series of bs and fs mutagens will establish the desired mutagen testers. These testers will be analyzed for mutagen sensitivity and monitoring capability under simulated monitor conditions and in mobile air pollution monitoring laboratories. **Keywords:** mutagen screening; barley; pollen; evaluation.

34675 Toxic Substances Response Data Statistical Procedures. Van Ryzin, J.R. (Rand Corp., 1700 Main St., Santa Monica, CA, 90406). **Project number:** R01-ES-02222. **Contract:** R01-ES-02222. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

Statistical tests for discriminating a one-hit from a multi-hit model and a multi-hit from a multi-stage model will be examined. In addition to this, anticipated generalizations of models will be made including a model allowing a multi-stage process in which each stage is multi-hit and a model allowing for threshold variability based on animal biological tolerances. Other problems considered will be an examination of the sensitivity of the multi-hit model to model assumptions, the design of experiments for placing animals at appropriate dose levels for the multi-hit model, the effect of smoothing data by using isotenic methods on the goodness-of-fit to the models, and optimal design of experiments for discriminating between models. One very promising area to investigate is the modeling of dose-response curves to incorporate pharmacokinetic modeling. Such models can dramatically increase or decrease the risk estimates depending on the activating or de-activating mechanism at work. Thus, the proposal addresses a number of important areas for risk assessment models and the corresponding low-dose extrapolation. **Keywords:** statistical models; dose-response relationships; risk assessment; toxic materials; experiment planning.

34676 Bioactivation and Covalent Binding of Toxic Haloalkenes. Guengereich, F.P. (Vanderbilt Univ., Nashville, TN, 37232). **Project number:** R01-ES-02205. **Contract:** R01-ES-02205. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the research are enumerated: (1) determination of the alkylating agents involved in the covalent binding of vinyl chloride, vinylidene chloride, trichloroethylene, vinyl bromide, and acrylonitrile to protein and nucleic acids; (2) elucidation of the role of epoxide hydratase in the metabolism of vinyl halides in vivo and in vitro; (3) immunohistochemical localization of epoxide hydratase in liver and lung; (4) examination of vinyl halide metabolism in the lung in vitro; (5) determination of the mechanism of cytochrome P-450 heme destruction that occurs during haloalkene metabolism; and (6) examination of DNA-chromatin protein cross-linking by metabolites of haloalkenes.
Keywords: chlorinated aliphatic hydrocarbons; covalence; biochemical reaction kinetics; proteins; nucleic acids; metabolism.

34677 Effect of Toxic Metals on Drug and Hemoprotein Metabolism. Maines, M.D. (Univ. of Illinois, Chicago, IL, 60680). **Project number:** R01-ES-02180. **Contract:** R01-ES-02180. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the proposed research are designed to expand knowledge of metal ion toxicity and biological function. Specific points to be investigated include: (1) to study the role of metal ions in the depressed capacity of the newborn to metabolize drugs and to explore means by which neonatal jaundice can be checked by inhibiting heme oxygenase; (2) to further characterize the enzymes involved in heme degradation and to investigate the role of metal ions on the activity of biliverdin reductase; (3) to study the effect of repeated exposure to metal ions on the response of the hepatic microsomal mixed function oxidase activity and heme metabolism pathway to the effect of a second exposure to metals and selected xenobiotics (also the effect of a second exposure to metals and xenobiotics and the effect of exposure to important environmental contaminants, namely toxic heavy metals on hepatic glutathione levels); and (4) to elucidate the mechanism by which cytochrome P-450 is degraded in response to metal ion exposure and the role of ligandin in heme metabolism.
Keywords: elements; toxicity; biological functions; drugs; metabolism; dose-response relationships; heme; neonates.

34678 Mechanisms of PB Toxicity in Developing Fetal Tissues. Rifkind, A.B. (Cornell Univ., Ithaca, NY, 10021). **Project number:** R01-ES-02165. **Contract:** R01-ES-02165. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to investigate the role of covalent binding and mixed function oxidase activity in producing PCB toxicity, using a chick embryo model system. The Km and Vmax will be compared for covalent binding of PCB's to liver microsomes in vitro, with PCB production in vivo of hepatotoxicity as determined histologically, induction of mixed function oxidase activity and covalent binding. The effects of PCB cogeners differing in degrees of chlorination and isomeric form will be compared to delineate structural requirements for PCB production of toxicity, covalent binding and mixed function oxidase induction. The effects of inducers and inhibitors of mixed function oxidase on PCB covalent binding and hepatotoxicity will be examined. Changes in hepatotoxicity and covalent binding of the PCB's and in hepatic mixed function oxidase activity during embryonic development will be evaluated and compared. We expect thereby to learn whether covalent binding is associated with hepatotoxicity for some PCB's or PCB's in general, whether the extent of covalent binding and hepatotoxicity are affected by hepatic mixed function oxidase activity and whether PCB binding and susceptibility to PCB toxicity change during embryonic development.
Keywords: aromatics; organic chlorine compounds; biological models; chickens; embryos; toxicity; covalence; microsomes; liver.

34679 Cyclopenta(c,d)pyrene: a Suspected Environmental Carcinogen. Cavalieri, E.L. (Univ. of Nebraska, Omaha, NE). **Project number:** R01-ES-02145. **Contract:** R01-ES-02145. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This proposal is concerned with synthesis, carcinogenicity, mutagenicity, metabolism, and binding studies of CPP. 3,4-Dihydroxycyclopenta(cd)pyrene (DCPP), a constituent of coal tar pitch, will also be an integral part of this study. A simple and efficient synthesis of CPP is proposed, and will also be applicable to preparation of a 14C analog. DCPP and some of the major potential metabolites will be synthesized from CPP. The carcinogenic effect of CPP will be proven definitively by repeated application and initation--promotion in mouse skin. The carcinogenicity of DCPP will also be tested. The biological effect of the two hydrocarbons will be compared to that of the potential carcinogenic metabolites of CPP, CPP-3,4-oxide, and of the environmental carcinogen benzo(a)pyrene (BP).
Keywords: condensed aromatics; hydrocarbons; carcinogenesis; synthesis; metabolism.

34680 Environmental Agents in Atherogenesis. Penn, A.L. (New York Univ., New York, NY, 10016). **Project number:** R01-ES-02143. **Contract:** R01-ES-02143. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A systematic study of dose and time of treatment on plague induction and intimal cell proliferation in chicken aorta will be made for 7,12-dimethylbenzanthracene (DMBA) which was a potent atherogen in our preliminary study. In addition, benzo(a)pyrene, the most commonly studied PAH, dibenz(a,h)anthracene, and dibenz(a,c)anthracene will be tested for comparative atherogenicity in the chicken. Evidence will be sought, through the use of 3H-labeled PAH's, that these compounds are taken up directly in the aorta. The binding of the aqueous-insoluble PAH's to serum lipoproteins will be investigated as a possible mechanism of solubilization and transport of the PAH's to the arterial wall. The atherogenic

potential of injected cigarette tar and of inhaled CO and CS2 will be tested in a series of pilot experiments.
Keywords: benzopyrene; benzanthracene; carcinogenesis; chickens; aorta; dose-response relationships.

34681 Effects of Microwaves on Uroendocrine Functions. Lu, S.T. (Univ. of Rochester, Rochester, NY, 14642). **Project number:** R01-ES-02313. **Contract:** R01-ES-02313. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to delineate physiologic regulations (neuroendocrine function) and tissue injuries (serum enzymes) in microwave exposed rats free of non-specific stresses. The quantitative relation among power densities, body temperatures and neuroendocrine functions or tissue injuries will be assessed. Specific attention will be paid to the interrelationships of hypothalamic/-hypophysical/thyroid/adrenal/somatotrophic axes in the animal subjected to microwave energy exposure. The interaction of previous exposure on responses or injuries of rats to subsequent exposure will be investigated. Recovery or manifestation of acute neuroendocrine perturbance and tissue injuries by microwave exposure will be attempted. Rats will be acclimated to experimental procedures. A 3-hour equilibrium period will be given before each microwave exposure. The project will extend from single to repeated (60 times, 4 hours daily) exposure to 2450 MHz (CW) microwaves in the far-field at 0.1 to 40 mW/sq cm or the equivalent specific absorption rate. Absorption rate will be determined for inter-species and interlaboratory comparison. The exposure techniques (single- vs. multi-body) will be compared.
Keywords: microwave radiation; rats; biological radiation effects; endocrine glands; radiation injuries.

34682 Pharmacokinetics of the Neurotoxin 2,5-Hexanedione. Bischoff, K.B. (Univ. of Delaware, Newark, DE). **Project number:** R01-ES-02138. **Contract:** R01-ES-02138. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Labeled 2,5-hexanedione (administered ip) will be used in tissue distribution studies as a basis for developmant of a pharmacokinetic model. Of special interest will be concentration levels in and around nerves and spinal cord, which should help in clarifying the ultimate cytotoxicity. Specifically, questions pertaining to a dying back phenomenon being responsible for the observed pathologies should be clarified. Extension of the pharmacokinetic model to include lung uptake from inhalational exposure will also be studied.
Keywords: acetylacetone; biochemical reaction kinetics; tissue distribution; nervous system; toxicity.

34683 Chemical Pathology of Haloethylene Injury. Reynolds, E.S. (Univ. of Texas, Galveston, TX, 77550). **Project number:** R01-ES-02102. **Contract:** R01-ES-02102. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The goal is to elucidate the molecular mechanisms by which the haloethylenes, such as vinyl chloride, 1,1-dichloroethylene, and trichloroethylene, cause acute liver injury and aberrations in genetic material. Acute hepatic injury will be characterized by a multifaceted chemical, enzymatic and morphologic approach. Cytogenetic studies will be carried out directly on the bone marrow and where possible on isolated hepatocytes from haloethylene exposed animals. Urine, bile and blood of haloethylene exposed animals, as well as haloethylene metabolites isolated from these fluids, will be assayed for mutagenicity by a variety of indicators. Haloethylene biotransformation will be monitored in whole animals, in isolated hepatocytes, and in cell fractions, and metabolites includng covalently bound macromolecules will be isolated and identified. Relationships will be sought between injury and specific metabolic products. Patterns of metabolite production indicative of injurious metabolic pathways will be sought in animals in order to develop non-invasive methods to screen for haloethylene injury in man.
Keywords: chlorinated aliphatic hydrocarbons; biological effects; liver; injuries; metabolism; mutagenesis.

34684 Etiologic Co-Factors in Asbestos Carcinogenesis. Braud, K.G. (Univ. of Minnesota, Minneapolis, MN, 55455). **Project number:** R01-ES-02101. **Contract:** R01-ES-02101. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to explore factors and events involved in asbestosis cancer. Inoculation of fibrous glass pledgets containing asbestos fibers into the pleural spaces of mice will be carried out according to the method of Stanton. The carcinogenic process will be followed and analyzed employing a methodology previously developed for the study of foreign body tumorigenesis. Specifically, the following questions regarding asbestos carcinogenesis will be investigated: cell type of tumor origin; frequency of preneoplastic foci; morphological and cultural characteristics of preneoplastic cells; their mono- or pluriclonal origination and expansion; preneoplastic kinetics and maturation stages at the tissue and cellular levels; timing and nature of physical interaction between asbestos fibers and cells at various defined stages of the carcinogenic process; and the role of tissue fibrosis and phagocytic macrophage activity.
Keywords: asbestos; carcinogenesis; mice; lungs; neoplasms; tumor cells; morphology.

34685 Modification of Methylmercury Toxicity by Selenium. Chang, L.W. (Univ. of Arkansas, Little Rock, AR, 72201). **Project number:** R01-ES-02097. **Contract:** R01-ES-02097. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The protective effect of selenium against methylmercury toxicity on the nervous system is investigated. Adult male Sprague-Dawley rats will be exposed to methylmercury choridc via intubation at dose level of 2.0 mg/kg body weight (2.0 ppM). One group of mercury-treated animals will also be administered with 0.2 or 0.4 ppM sodium selenite. The blood level of glutathione peroxidase of the animals will be monitered in correlation to the toxic condition of the animals. The animals will be sacrificed in different periods of the experiment according to the development of neurological symptoms of methylmercury poisoning. Before sacrifice, 14C-glycine and 14C-orotic acid will be administered to the animals. The activities of protein synthesis and RNA synthesis in the nerve cells of the cerebellum and dorsal root ganglia in the control, MeHg-treated, MeHg/Se-treated, and Se-treated animals will be compared by means of biochemical method (scintillation analysis). Tissue samples from the cerebellum and dorsal root ganglia of these animals will also be obtained for light and electron microscopic analysis. By means of such biochemical and morphological correlated studies, the bases of the selenium protection aganist methylmercury toxicity may be elucidated.
Keywords: selenium compounds; methylmercury; toxicity; rats; carbon 14; radioimmunoassay; response modifying factors.

34686 Microsomal Oxidative Dehalogenation of Chloroethanes. Thompson, J.A. (Univ. of Colorado, Boulder, CO, 80309). **Project number:** R01-ES-02069. **Contract:** R01-ES-02069. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

An objective of the research is to study microsomal oxidative dechlorination of polychloroethanes. Metabolic products formed in vitro will be identified using gas chromatography/mass spectrometry and effects of induction, inhibition, age, sex, and genetics on metabolite formation will be measured. This data, together with that obtained using deuterium labeled substrates, will help to elucidate the reaction mechanisms involved. Another objective is to extend the usefulness of a recently developed in vitro screening test for environmental substances which impare the energy metabolism of human neutrophils and platelets. A microsomal metabolizing system will be added so that the cells are exposed to chemicals and their biotransformation products. This approach more closely mimics the in vivo situation and has proven successful in other toxicity screening tests.
Keywords: organic polymers; chlorinated aliphatic hydrocarbons; oxidation; microsomes; metabolism; biochemical reaction kinetics.

34687 Environmental Polycyclics: Metabolism and Activation. Lavoie, E.J. (American Health Foundation, Valhalla, NY, 10595). **Project number:** R01-ES-02030. **Contract:** RO1-ES-02030. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to elucidate the proximate and ultimate carcinogens formed metabolically from the environmental polyaromatic hydrocarbons, 2- and 3-methylfluoranthene, benzo(b)fluoranthene, benzo(j)fluoranthene, dibenzo(a,h)pyrene, dibenzo(a,i)pyrene, and dibenzo(c,g)carbazole. All of these environmental agents are carcinogenic on mouse skin or in the hamster respiratory system. The methods for the isolation and structural elucidation of the proximate carcinogens employ a combination of high pressure liquid chromatography and mutagenesis assay in S. typhimurium with suspect isolates being subsequently assayed on mouse skin. Structural elucidation of the isolated proximate carcinogens will be confirmed by unequivocal synthesis. Ultimate carcinogens will be synthesized from the proximate forms and assayed in newborn mice. Studies on the effect of representative environmental

modifiers on the metabolic formation of the identified proximate carcinogen will then be performed.
Keywords: polycyclic aromatic hydrocarbons; metabolism; toxicity; carcinogens; mice; hamsters; skin; lungs; mutagen screening; salmonella.

34688 Mutagenicity and Metabolism of Cyclopenta(c,d)pyrene. Eisenstadt, E. (Harvard Univ., Boston, MA, 02115). **Project number:** R01-ES-02021. **Contract:** R01-ES-02021. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The basic objective of this research program is to develop specific information about the molecular basis for the potent mutagenicity of cyclopenta(c,d)pyrene (CPP), a polycyclic aromatic hydrocarobn (PAH). CPP is a novel PAH whose structure was recently determined and whose mutagenic activity was recently characterized. Grantee will also identify the products of metabolism of CPP by mammalian tissue homogenates and determine the formation and identity of deoxyribonucleoside adducts resulting from reactions between isolated DNA and reactive CPP metabolities (and chemical analogs of these metabolities). An attempt will also be made to measure the formation and repair of CPP-deoxyribonucleoside adducts in bacterial cells.
Keywords: polycyclic aromatic hydrocarbons; mutagenesis; metabolism; metabolites.

34689 Environmental Dusts and Macrophage Function. Hamilton, J.A. (Sloan-Kettering Institute for Cancer Research, New York, NY). **Project number:** R01-ES-02014. **Contract:** R01-ES-02014. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to test noxious dusts and fibers, which are commonly found in the environment, for their ability to induce putative inflammatory mediators from mouse peritoneal macrophages. These molecules are the enzymes, plasminogen activator and collagenase, and prostaglandins. Several environmentally important materials will be used with particular emphasis on asbestos. These fibers will be manipulated and physical measurements made to determine what structural and chemical characteristics are important for activity in our in vivo and in vitro test systems. Study cellular control mechanisms for the synthesis of the mediators and hopefully to find drugs which could alleviate the deleterious effects of such fibers and dusts.
Keywords: dusts; macrophages; particles; inflammation; enzymes; prostaglandins; asbestos; aerosols; fibers; toxicity; biological functions; air pollution.

34690 Chronic Perinatal Lead Exposure and Brain Function. Hoffer, B.D. (Univ. of Colorado, Denver, CO, 80262). **Project number:** R01-ES-02011. **Contract:** R01-ES-02011. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to examine the effects of acute and chronic lead administration, as well as other metals, on a number of defined synaptic inputs, and transmitters to identified neurons in hippocampus, cerebral cortex, cerebellum and caudate. The effect of fetal and neonatal lead exposure on maturation of these same brain regions, studied using histological, histochemical, and electrophysiological techniques, will be examined. All experments will be carried out in brain pieces transplanted to the anterior chamber of the eye, permitting an isolated and selective activation of the various inputs to mature brain as well as an analysis of intrinsic vs extrinsic or indirect factors in any lead-induced developmental abnormalities.
Keywords: lead compounds; biological effects; brain; growth; neonates; fetuses.

34691 Ozone Chemistry and Chemical Carcinogenesis. Murray, R.W. (Univ. of Missouri, St. Louis, MO, 63121). **Project number:** R01-ES-01984. **Contract:** R01-ES-01984. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this work is to further study the environmental health aspects of the reactions of ozone with organic compounds. Specific objectives include a study of the chemistry of the ozonolysis intermediates, carbonyl oxides, as this chemistry may relate to the functioning of monooxygenase enzymes and the conversion of precarcinogens to ultimate carcinogens.
Keywords: ozone; carcinogenesis; health hazards; chemical reactions; organic compounds; carbonyl radicals; reaction intermediates; naphthalene; polycyclic aromatic hydrocarbons; atmospheric chemistry.

34692 Hematopoietic Toxicology of Environmental Pollutants. Gurney, C.W. (Univ. of Chicago, 950 E. 59th St., Chicago, IL, 60637). **Project number:** R01-ES-01969. **Contract:** R01-ES-01969. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop a biological model for demonstration and quantitation in vivo of hematopoietic toxicity produced by pollutants, therapeutic compounds, and other chemicals. The great hematopoietic reserve in normal mice will first be eliminated by a combination of splenectomy and the production of standardized damage of the hematopoietic system with 89-Sr, a bone-seeking, beta-emitting isotope. In this model, which will be more sensitive to hematopoietic toxins than normal animals, the fall in hematocrit, reticulocyte count, white cell count, platelet count, and marrow concentration of colony-forming units (stem cells) will then be determined and the hematopoietic response to a standardized challenge with erythropoietin or hypoxia will then be measured as functions of the dosage of hematopoietic toxins administered. The duration of the persistence of defects produced by toxic substances will also be determined.
Keywords: biological models; mice; pollution; toxicity; hematopoietic system.

34693 Chemically Induced Non-Disjunction in Mutant Mice. De Boer, P. (State Agricultural Univ., Wageningen, Netherlands). **Project number:** R01-ES-01921. **Contract:** R01-ES-01921. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of the research is to test a number of chromosome systems in the mouse which either have high spontaneous non-disjunction rates or otherwise are expected to do so, the hypothesis being that systems which exhibit high spontaneous non-disjunction are sensitive for induced non-disjunction too. Non-disjunction will be first induced by spindle poison (among which are those with social-medical importance) which aids in ranking the chromosome systems proposed for sensitivity. All systems are characterized by marker chromosomes, which can be recognized during the first and second meiotic division. The spindle poisons can be applied during prometaphase, metaphase and anaphase of the first meiotic division. A second period to focus attention on is the period of chromosome synapsis during zygotene. Both male and female mice can be used for this. The results are obtained after cytological scoring of secondary meiocytes. Once a sensitive system is established, known and suspected chemical mutagens can be tested for their non-disjunction inducing capacity.
Keywords: mice; mutants; chromosomes; mutagen screening; mutagenesis.

34694 Intermediate Metabolites Involved in Benzene Toxicity. Nerland, D.E. (Univ. of Louisville, Louisville, KY, 40232). **Project number:** R01-ES-001901. **Contract:** R01-ES-01901. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The long-term objectives of this project are two-fold: to add to present knowledge of the mechanism of benzene induced hematopoietic toxicity and to develop improved methodology and analytical techniques for studying benzene metabolism. The technique of combined gas chromatography-mass spectrometry (GC-MS) using deuterium labeled molecules and studies utilizing intermediate metabolities of benzene will be employed to attain these objectives.
Keywords: metabolites; benzene; toxicity; metabolism; gas chromatography; mass spectroscopy; deuterium compounds; hematopoietic system; biological effects.

34695 Absorption of Inhaled Sub-Micron Trace Metals. Menzel, D.B. (Duke Univ., Durham, NC, 27710). **Project number:** R01-ES-01859. **Contract:** R01-ES-01859. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Using the isolated, ventilated and perfused rat lung the removal of intratracheally instilled trace metals will be studied. The nature of the removal process will be investigated by kinetic analysis. The applicability of the IVPL data in vivo removal will be tested by the use of intratracheal instillations in relatively intact rats. An ultra-fine particle (0.1 to 0.2 mu) aerosol exposure system will be developed and utilized to study the pulmonary deposition and removal kinetics of trace metals. The results obtained from the three different experimental procedures will be correlated to potential models of the molecular mechanisms by which pulmonary absorption occurs. Possible lung membrane damage resulting from the deposition upon inhalation of these trace metals as ultra-fine aerosols

will be investigated by studying the effects on the carrier mediated absorption of phenol red. Subtle effects of metal cation transport by the lung on its normal physiological role in the regulation of blood perfusion will be tested by measurements of the release of vasoactive substances by the lung following heavy metal exposure.
Keywords: metals; lungs; trace amounts; rats; particle size; aerosols; metabolism; membranes; cations; dyes; biochemical reaction kinetics.

34696 Air Pollutants on Lung Airway Cells in Novel Culture. Crocker, T.T. (Univ. of Califorinia, Irvine, CA, 92717). **Project number:** R01-ES-01835. **Contract:** R01-ES-01835. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine the extent to which specific cell types (respiratory epithelium, alveolar macrophages, type II cells), isolated from animal tissues and cultured under conditions which simulate respiratory surfaces in vivo, experience toxicity, inhibition or stimulation of macromolecular synthesis, or neoplastic transformation when exposed to airborne pollutant gases at concentrations found in urban atmospheres; (2) provide evidence concerning the cocarcinogenic activity of the common pollutant gases NO2, SO2, and ozone as they may affect neoplastic transformation of mammalian cells by airborne pollutants; and (3) relate the findings to presently-known effects of airborne pollutants in vivo.
Keywords: air pollution; nitrogen dioxide; sulfur dioxide; ozone; biological effects; cell cultures; in vivo; toxicity; carcinogenesis; mammals; lungs.

34697 Metalloprotein Nitrosyl Formation and Reactivity. Doyle, M.P. (Hope Coll., Holland, MI, 49423). **Project number:** R01-ES-01673. **Contract:** R01-ES-01673. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The long-term goal of the research is to provide the chemical and biochemical basis for determination of the toxicity of nitric oxide, NO, and derivative nitrosyl compounds. The project relates environmental sources of the nitrosyl group to potentially damaging biological transformations through the formation and reactions of metalloprotein nitrosyl complexes. Investigations with iron hemoproteins will detail the extent of nitrosyl complex formation in reactions with common nitrosyl compounds, determine the potential for nitrosyl exchange between iron hemoproteins, and describe the occurrence of nitrosylation reactions of biologically significant substrates by these metalloprotein nitrosyl complexes.
Keywords: nitrogen oxides; toxicity; nitroso compounds; proteins; biochemistry; biochemical reaction kinetics; biological pathways.

34800 Effect of Nitrogen Dioxide on Pulmonary Monocytes. Acton, J.D. (James Madison University, Department of Biology, Harrisonburg, VA). **Project number:** 1R01-ES-02136-02. **Contract:** 1R01-ES-02136-02. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$37,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The research program is designed to study the nature of the lesions which nitrogen dioxide induces in the pulmonary cell populations involved in the immune response. The effect of NO2 and the viral and nonviral-induced production of interferon by lung monocytes will be compared. The cytotoxic activity of these preparations will be evaluated. Following exposure to NO2, the capacity of pulmonary cells lavaged from rabbits to produce interferon will be studied. The virus model will involve the use of Newcastle disease virus as the inducing agent and vesicular stomatitis as the challenge virus; poly I.poly C will be used as a nonviral inducer. The effect of NO2 on the mycobacterium bovis (BCG)-induced cell-mediated immune response in the lung will be determined. The effect of NO2 on the quantity and function of cells recruited into the lung following BCG vaccination will be examined. In particular, the generation of migration inhibitory factor (MIF), macrophage agglutinating factor (MAgF), cytotoxic activity, and immune interferon will be studied. The effect of NO2 on alveolar macrophage membrane receptors involved in the immune response will be determined. Experiments will be performed in vitro to study the effect of NO2/sup -/ on alveolar macrophage receptors for macrophage agglutinating factor, migration inhibitory factor, interferon, lymphocytes, immunoglobulin and complement.
Keywords: nitrogen dioxide; lungs; immunology; dynamic function studies; biological effects; rabbits; bacteria; infectivity; viruses; respiratory system diseases.

34801 Effects of Atmospheric Pollutants on Behavior. Geller, I. (Southwest Foundation for Research and Education, P.O. Box 28147, San Antonio, TX, 78284). **Project number:** 1R01-ES-01246-03. **Contract:** 1R01-ES-01246-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$84,000.
Related energy source: Coal(25); oil and gas(50); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The goals of this research are to apply operant technology for the evaluation of atmospheric pollutants on behavior of laboratory animals. A determination will be made of the minimal doses and exposure times required to produce alterations of behavior. Substances to be evaluated include carbon monoxide, nitrogen dioxide, ketones, sulfur dioxide, and acrolein.
Keywords: behavior; air pollution; carbon monoxide; nitrogen dioxide; ketones; sulfur dioxide; acrolein; biological effects; biological models.

34802 Lead Absorption, Excretion and Metabolism. Conrad, M. (University of Alabama, University Station, Birmingham, AL, 35294). **Project number:** 1R01-ES-01306-01. **Contract:** 1R01-ES-01306-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$71,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Previous reports from a variety of sources have associated a number of factors with the absorption, excretion, and total body burden of lead. An animal model system has been developed which permits studies of the absorption, excretion, and body distribution of lead. This will be utilized to confirm or deny older reports and then to investigate the mechanism by which these factors influence the absorption or excretion of lead. Substances shown to exert an intraluminal effect which enhance or diminish the absorption of lead will be investigated to characterize the physiochemical changes which occur with lead in the lumen of the small intestine. Factors identified as producing either a mucosal or corporeal effect will be investigated and an effort will be made to identify common sites in the pathway for the absorption and excretion of lead and the competitive of facilitating substance. The effects of total body burden of lead upon the subsequent absorption of dietary lead will be studied to ascertain if there is an inhibitory feedback mechanism. If the latter can be identified, the importance of lead in various body pools in contributing to this effect will be studied and a search will be undertaken for other substances which exert a similar inhibitory effect. It is postulated that these studies will provide a rational understanding of factors associated with acute and chronic lead intoxication and basic information related to the pathways regulating the absorption and excretion of lead.
Keywords: lead; intestinal absorption; skin absorption; excretion; metabolism; body burden; toxicity.

34803 Accumulation of Guanine Due to Heavy Metals. Farkas, W.R. (University of Tennessee, Memorial Research Center and Hospital, 1924 Alcoa Highway, Knoxville, TN, 37920). **Project number:** 1R01-ES-01323. **Contract:** 1R01-ES-01323. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$56,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Renal toxicity and gouty arthritis are two of the multiple results of lead poisoning. In addition, lead causes degradation of nucleic acids and a study of the effects of lead on the enzymes of purine metabolism has been started in order to correlate the clinical observations with biochemical events. These preliminary studies showed that the enzyme, guanine aminohydrolase (guanase), was inhibited by Pb2+ at 10/sup -7/M. The role of guanase is to convert guanine to xanthine. Since guanine is very insoluble, lead poisoning might lead to accumulation of guanine precipitates in vivo. Indeed, elevated levels of guanine have been found in lead-poisoned rabbits. These preliminary studies have shown that Hg2+ and Ag+, but not Cd2+ or any other metal tested, was inhibitory to guanase. This proposal, therefore, is to study the effects of these heavy metal pollutants at low levels (sub clinical) and at high levels characteristic of acute poisoning in vitro on the enzyme and in vivo on the metabolism of guanine. The study would also include administration of 14C guanine to poisoned and normal animals to determine in which organs free guanine accumulates. Another goal of this proposal will be to examine the deposits (accumulated in the joints) of patients with saturnine and normal gout in order to determine if guanine is present in the precipitates. Lead and mercury are volatile components of coal, and lead is an atmospheric contaminant due to its continued use in gasoline. Mercury is also a water contaminant. Therefore, this study would give an indication of the extent to which these pollutants give rise to renal and metabolic problems related to the accumulation of the highly insoluble metabolite guanine.
Keywords: rheumatic diseases; lead; toxicity; metabolism; guanine; mercury; kidneys; diseases; silver; rabbits; enzymes; pathological changes.

34804 Effect of Atmospheric Pollutants on Pulmonary Defenses. Goldstein, E. (University of California, Department of Internal Medicine, Davis, CA, 95616). **Project number:** 1R01-ES-01327-03.

Contract: 1R01-ES-01327-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Because atmospheres containing submicron-sized sulfate or nitrate particles and sulfur dioxide or nitrogen dioxide are considered potentially hazardous to health, studies are proposed which will assess the impact of these pollutants in combinations on pulmonary defense systems. Exposure of rodents to ambient or near-ambient concentrations of sulfate particles + sulfur dioxide, and nitrate particles + nitrogen dioxide will be evaluated to determine if these pollutants act additively or synergistically to inhibit mucociliary transport (32P-labelled Staphylococcus aureus), phagocytic ingestion (histologic localization of bacteria), and killing of phagocytized bacteria (measurements of bacterial viability).
Keywords: air pollution; lungs; infectivity; immunology; sulfates; nitrates; sulfur dioxide; nitrogen dioxide; health hazards; microorganisms; phosphorus 32; synergism; aerosols; particles; respiratory system diseases.

34805 Prolonged Exposure to Four Levels of Air Pollutants. Feir, D.J. (St. Louis University, Biology Department, St. Louis, MO, 63103). **Project number:** 1R01-ES-01361-03. **Contract:** 1R01-ES-01361-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to determine the following effects of exposure of an insect species to 4 consistent levels of a complex mixture of air pollutants: (1) the effects on growth rate, reproduction, survivorship, and life span over 12 successive generations; (2) the effects of air pollutants on animals exposed only at certain stages of the life cycle; (3) possible synergistic actions of air pollutants and stress factors; and (4) the pathway or mechanism of action of the pollutants. Only two possible pathways will be investigated during the time of this study: effects on hormones controlling growth and development in insects, and effects on metabolic rates. The pollutants will be SO2, NO, NO2, CH4, CO, and (NH4)2SO4. The levels of the gases in the mixture will be approximately those found in a typical urban environment, those found under high or episodic conditions, and those found under emergency conditions. The levels of pollutants are maintained by a programmed monitoring system with feedback control.
Keywords: air pollution; health hazards; chronic exposure; synergism; genetic effects; biological pathways; biochemical reaction kinetics; metabolism; sulfur dioxide; nitrogen oxides; nitrogen dioxide; methane; carbon monoxide; ammonium sulfates; enzymes; toxicity.

34806 Studies of Oxidant-Induced Pulmonary Lesions. Montgomery, M.R. (Veterans Administration Hospital, 54th Street and 48th South, Minneapolis, MN, 55417). **Project number:** 1R01-ES01365-03. **Contract:** 1R01-ES-01365-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$27,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is designed to investigate: (1) the possibility of a common chemical mechanism responsible for the pulmonary lesions resulting from exposure of animals to oxygen, ozone, or paraquat; (2) the role of pulmonary fatty acid desaturation in the development of these lesions; and (3) the identification of factors useful in design of rational therapy for the chronic lesion associated with acute exposure to these and other strong oxidants.
Keywords: oxygen; ozone; herbicides; oxidizers; acute exposure; inhalation; animals; biological effects; lungs; pathological changes; carboxylic acids; respiratory system diseases; therapy; toxicity; biochemistry.

34807 Metabolism and Toxicity of Organometallic Agents. Hanzlik, R.P. (University of Kansas, Department of Medicinal Chemistry, Lawrence, KS, 66045). **Project number:** 1R01-ES-01375-03. **Contract:** 1R01-ES-01375-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Organometallic derivatives of transition metals are finding increasing use in numerous applications, particularly as additives in fuels and petroleum products, yet the biological properties of this class of compounds are virtually unknown. A systematic investigation is proposed of the toxicity, pharmacological properties, and metabolism of a set of organometallic compounds of chromium, manganese, and iron. The compounds to be studied are analogs of simple organic compounds whose toxicity, pharmacology, and metabolism are very well known (e.g., benzene, toluene, styrene, amphetamine, ephedrine, diphenhydramine). The analogy is simply based upon replacement of a phenyl group by an aromatic organometallic equivalent such as (C5H5)FeC5H4/sup -/, (CO)3CrC6H5/sup -/, or (CO)3MnC5H4/sup -/. Both acute and prolonged toxicity will be evaluated using histological as well as biochemical techniques. Pharmacological studies as well as metabolism studies will be performed in vivo as well as in vitro, and any metabolites with an intact organometallic moiety will be isolated and fully characterized.
Keywords: organometallic compounds; metabolism; toxicity; chromium; manganese; iron; benzene; toluene; styrene; organic compounds.

34808 Metallothionein in Metabolism and Toxicity of Cadmium. Shaikh, Z.A. (University of Rochester, 601 Elmwood Avenue, Rochester, NY, 14642). **Project number:** 1R01-ES-01448-03. **Contract:** 1R01-ES-01448-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$41,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This project deals with the metabolism of a toxic element, cadmium, in an animal model. The absorption, tissue distribution and excretion of an orally administered isotope of cadmium will be followed in rats. The biological half-life of cadmium in the rat in general, and in the critical organs--liver and kidney in particular--will be determined. Retention of cadmium in the critical organs is brought about by metallothionein. The mechanism by which cadmium stimulates protein synthesis in these organs will be investigated. Cadmium is bound to metallothionein not only in liver and kidney, but also in other tissues like pancreas, spleen and placenta. The proteins from these organs will be isolated and purified and their properties will be compared with the hepatic protein. A radioimmunoassay procedure will be developed to measure metallothionein in tissues and biological fluids. It is postulated that intestinal absorption of cadmium and the passage of the element from the mother to fetus and newborn may be restricted by the presence of metallothionein and other metal-binding proteins in intestinal mucosa, placenta and mammary gland. The validity of this concept will be tested in animals experimentally exposed to cadmium. Involvement of cadmium in renal tubular dysfunction and hypertension has been suggested. The role of metallothionein in etiology of these diseases will be evaluated.
Keywords: cadmium; metabolism; toxicity; tissue distribution; rats; liver; kidneys; retention; radioimmunoassay; diseases; etiology.

34809 Epidemiologic Study of CORD in Cohorts. Detels, R. (University of California, Los Angeles, CA, 90024). **Project number:** 1R01-ES-01473-03. **Contract:** 1R01-ES-01473-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$427,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Epidemiological studies.

This is a proposal to perform longitudinal studies on three already established population-based cohorts in areas exposed to (1) moderate levels of photochemicaloxidant pollutants, (2) combined reductant, oxidant and hydrocarbon pollutants, and (3) minimal levles of chemical pollutants, and on a cohort to be established in an area chronically exposed to high levels of oxidant-type pollutants. The objectives of the proposal are to: (1) observe the natural history of chronic obstructive respiratory disease (CORD) and functional respiratory impairment; (2) identify environmental factors including chronic exposure to specific air pollutants which play a role in the evolution, exacerbation and rate of progression of CORD and/or functional impairment; (3) identify as yet unsuspected demographic, familial and constitutional characteristics of individuals who go on to develop irreversible CORD and/or functional impairment; (4) identify those parameters of expiratory flow and the flow-volume curve derived from spirometry, the alveolar plateau, closing volume fraction, and residual volume derived by the single-breath nitrogen test (SBNT), airway resistance, functional residual capacity, and specific conductants derived from body plethysmography, including x-ray and reported symptoms which can best predict impending CORD and/or functional impairment at a still reversible stage in susceptible individuals; and (5) provide information on the variability (a) of individual performance and subgroup performance for each of these tests of lung function and (b) associated with seasonal factors or other factors present at the time of testing.
Keywords: respiratory system diseases; epidemiology; photochemical oxidants; lungs; dynamic function studies; respiratory system; sensitivity; biological variability; genetic variability; chemical effluents; metabolism.

34810 Intranasal Homeostasis Viruses and Pollutant Gases. Bang, F.B. (Johns Hopkins University, 615 North Wolfe Street, Baltimore, MD, 21205). **Project number:** 1R01-ES-01477-03. **Contract:** 1R01-ES-01477-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(75); oil and gas(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Respiratory disease is the major cause of human death. SO2 is a universal air pollutant, the nasal mucosa is the first site of impact of

airborne viruses and toxins, and epithelial sloughing is a primary response to both. The most important single mechanism for maintaining nasal mucociliary clearance during exposure to daily fluctuating doses of toxins and viruses is mucociliary homeostasis. New techniques will be used to monitor nasal homeostatic mechanisms sequentially in individual living chickens during exposure to combined effects of acute and chronic viral infections and graded levels of SO2. Immunopathology and nasal histopathology will be followed during all phases of the interactions between viruses and pollutant gas. An added study will evaluate effects of continuous low level exposure to SO2 during the first three weeks of life on cell dynamics, on nasal and sinus transport rates, and on development of organized lymphoid cell systems in nasal and paranasal tissues and in the thymus and bursa.
Keywords: viruses; sensitivity; gases; air pollution; respiratory system diseases; toxins; sulfur dioxide; etiology; health hazards; immunology; biological effects; toxicity.

34811 Inhaled Aerosols: Behavior, Effects, and Clearance. Frank, R. (Washington University, 679 6000 Street, Seattle, WA, 98195). **Project number:** 1R01ES-01478-03. **Contract:** 1R01-ES-01478-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$268,000. **Related energy source:** Coal(25); oil and gas(25); oil shale(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

An interdisciplinary effort is proposed to study the interaction between inhaled aerosols and the respiratory system. Project I seeks to determine the influence of the hygroscopic growth of aerosols on deposition, whether supersaturation of aerosols occurs and its implications for deposition, and the influence of altered respiratory mechanics on deposition. Project 2 examines the importance of the pH and molecular composition of sulfate/sulfite aerosols in causing pulmonary functional changes in guinea pigs, and whether the NH3 excreted into alveoli modifies the chemistry and effect of acid aerosols. Project 3 extends the observations of Project 2 to health subjects and to adolescent asthmatic patients with exposures during rest and exercise. Project 4 examines the role of the alveolar wall in determining whether insoluble particles that deposit locally are cleared along the muco-ciliary system or enter the tissue compartment.
Keywords: aerosols; hygroscopicity; deposition; respiratory system; physiology; aerosols; sulfates; sulfites; inhalation; guinea pigs; biological effects; respiratory system; pathological changes; ph value; ammonia; molecular structure; aerosols; sulfates; sulfites; inhalation; man; patients; adolescents; asthma; biological effects; respiratory system; pathological changes; aerosols; inhalation; deposition; respiratory system; lung clearance; lungs; respiratory tract cells.

34812 Nephrotoxic Effects of Environmental Hydrocarbons. Zimmerman, S.W. (University of Wisconsin, 1300 University Avenue, Madison, WI, 53706). **Project number:** 1R01-ES-01480-03. **Contract:** 1R01-ES-01480-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This research has a goal of defining the relationship between chronic progressive renal disease and exposure to environmental hydrocarbon solvents. Clinical studies have established a relationship between human glomerulonephritis and hydrocarbon solvent exposure, in addition to the well known acute renal tubular toxicity of many of these agents. This study will attempt to produce an animal model of hydrocarbon-induced glomerulonephritis in rats by chronic intraperitoneal administration of common petroleum distillates and hydrocarbon solvents. Gasoline, carbon tetrachloride, toluene, trichloroethylene, and a degreasing solvent, stanisol, will be studied regarding their glomerulotoxic and nephrotoxic potential. The mechanism of induced injury will be studied by examining tissue with light, immunofluorescence and electron microscopy. N,N-diacetylbenzidine has been shown to produce a proliferative glomerulonephritis in rats. Study of the pathogenesis of this glomerulonephritis which is morphologically similar to a form of human glomerulonephritis mediated by immune mechanisms is proposed. The role of the immune system in potentiating this toxin-induced glomerulonephritis will be studied by light, immunofluorescence and electron microscopy of renal tissue, as well as by a search for serum anti-kidney antibodies.
Keywords: hydrocarbons; chronic exposure; kidneys; solvents; toxicity; urogenital system diseases; nephritis; etiology; rats; immunology.

34813 Cadmium: Neurobehavioral and Trace Metal Studies. Cooper, G.P. (University of Cincinnati, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** 1R01-ES-01494-03. **Contract:** 1R01-ES-01494-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$85,000.
Related energy source: Coal(75); oil and gas(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The studies are designed as a coordinated effort to define the behavioral and neurophysiological effects of acute and chronic cadmium administration, the sensitivity of the rat to cadmium at major developmental stages, and the potential interrelations between essential trace metal balance and cadmium toxicity. In the studies of chronic Cd exposure, the methods will be to: (1) assess the effects on selected behavioral and neurophysiological parameters such as spontaneous locomotor activity, motor coordination, aggressiveness, learning, peripheral nerve conduction velocity, visual evoked response, and skeletal muscle contractile force; (2) determine the relative effects of Cd exposure during the pre-gestational, gestational, neonatal, and adult periods; and (3) determine the concentration of Cd, Fe, Zn, and Cu in selected tissues to ascertain whether changes in trace metal balance may be associated with the occurrence of signs of neurotoxicity. In the acute exposures and in vitro work, the objectives are to: (1) elucidate the mechanism of action of Cd as a synaptic blocking agent; and (2) determine the effects of localized brain injections of Cd and whether particular brain loci are more sensitive than others.
Keywords: cadmium; toxicity; neurology; behavior; biological models; iron; zinc; copper; biological accumulation; quantitative chemical analysis.

34814 Detecting Mutations Induced by Environmental Pollutants. Lark, K.G. (Utah University, Department of Biology, Salt Lake City, UT, 84112). **Project number:** 1R01-ES01498-03. **Contract:** 1R01-ES-01498-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to develop a system which can be used to study the ability of environmental pollutants to induce somatic mutations at different loci in animal and plant cells. The methods used to develop this system will be applicable to development of a similar system in other animal or plant cell lines. A series of conditional lethal mutants will be prepared. In the heterozygous form these will appear as pseudo dominant with incomplete penetrance. Inactivation of such mutant loci will result in reversion of the heterozygote to wild type. Such reversions will detect point, deletion, and frameshift mutations. As a result, the mutant strains will provide a sensitive system for the detection of environmentally induced mutations. In such strains somatic crossing-over also should be readily detected, thus allowing a test for agents which increase cross-over rate. The project will approach: (a) induction of mutants and their selection in heterozygotes; (b) conversion of heterozygotes to mutant homozygotes; (c) marker rescue incorporation of mutant loci from these homozygotes into a non-mutagenized background, to produce clean heterozygotes; and (d) tests for reversion of the heterozygotes. Initially, a model system (HGPRTase) will be used to test predicted characteristics of heterozygotes containing dominant alleles with partial penetrance.
Keywords: pollution; hydrocarbons; genetic effects; animal cells; plant cells; somatic mutations; mutagenesis; mutagen screening; crossing-over.

34815 Metallothionein: Structure-Function Relationships. Petering, D.H. (University of Wisconsin, Department of Chemistry, Madison, WI, 53201). **Project number:** 1R01-ES-01504-03. **Contract:** 1R01-ES-01504-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$71,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The role of the cadmium binding protein, metallothionein, in the pathology of environmental cadmium exposure is a question of prime importance. Although some properties of the protein are known, in depth studies have not been done to define the metal-ligand structure and dynamics of this protein, their possible role in cadmium movements and deposition in cells, and the actual, quantitative relationship of cadmium binding in the metallothionein to cellular and organismic toxicity from the metal. The present research sets forth a series of experiments which will address these areas of needed inquiry: (1) a variety of physico-chemical techniques including laser Raman and 13-C nmr spectroscopy, amperometric titrimetry, and functional group modification will be used to examine the structure of the metal binding sites in metallothionein; (2) kinetic studies will determine rates of metal exchange between metallothionein and metal complexes and ligands; (3) quantitative analysis of cadmium distribution between metallothionein and other cellular constituents will be undertaken under controlled conditions of exposure of rats to toxic and essential metals which produce definite toxic effects; (4) antibodies to metallothionein and thionein will be developed which will be used for the sensitive immunodetection of these proteins in rat tissues; (5) model kinetic studies of metal exchange between metallothionein and rat liver mitochondria will be used to investigate the distribution of cadmium among cellular components; and (6) a line of Ehrlich ascites cells resistant to cadmium will be

developed so that biochemical aspects of cadmium toxicity and resistance to cadmium may be examined in vitro.
Keywords: cadmium; metabolism; proteins; pathological changes; biochemical reaction kinetics; animal cells; rats; toxicity; antibodies; immunology; ascites tumor cells; ehrlich ascites tumor.

34816 Bacterial Degradation of PCB: Consequences and Effects. Saylor, G.S. (University of Tennessee, Department of Microbiology, Knoxville, TN, 37916). **Project number:** 1R01-ES01521-03. **Contract:** 1R01-ES-01521-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

This investigation is designed to determine the interaction between polychlorinated biphenyls (PCB) and naturally occurring microbial communities. The direct objectives of the proposed investigation are fourfold: (1) to determine the environmental rate of PCB degradation in aquatic habitats; (2) to assess the potential for bioamplification of PCB residues in aquatic food chains; (3) to determine the mutagenic potential of PCB and its metabolites in aquatic environments; and (4) to elucidate the effect of PCB contamination and potential metabolites on the structure and function of aquatic heterotrophic bacterial communities. Gas chromatography and radioisotope assays will be employed to assess microbial PCB degradation and bioaccumulation. Auxotrophic bacterial mutants will be used as test organisms in screening experimentally degraded samples for the presence of microbially produced mutagenic PCB metabolites. The impact of PCB contamination on the microbial ecology of selected freshwater habitats will be determined by comparing heterotrophic respiration rates radioisotopic substrate decomposition rates, heterotrophic uptake kinetics, and generic composition of natural microbial populations in control and PCB dosed environments.
Keywords: aquatic ecosystems; water pollution; aromatics; organic chlorine compounds; biological accumulation; ecological concentration; biodegradation; food chains; mutagenesis; metabolites; bacteria; biological effects; population dynamics; gas chromatography; tracer techniques; mutagen screening; microorganisms; ecology.

34817 Environmental Mutagens: Their Mechanisms of Action. Sofer, W.H. (Johns Hopkins University, Charles and 34th Streets, Baltimore, MD, 21218). **Project number:** 1R01-ES-01527-03. **Contract:** 1R01-ES-01527-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$62,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The *Adh-gene-enzyme system* may be used to study the mechanism of action of chemical mutagens in a higher organism. This system is unique for this purpose because (1) chemical methods have been developed to detect forward mutations, (2) chemical procedures have been developed to detect reverse mutations, and (3) the product of the gene, alcohol dehydrogenase (ADH) has been purified and chemically characterized, and will soon be sequenced. This project involves 4 separate steps: (1) generate Adh-negative mutants with five interesting chemical mutagens; (2) characterize these mutants with regard to whether they yield ADH-like cross-reacting material (CRM); and (3) for those mutants that are CRM-negative, carry out reversion analysis and examine their polytene chromosomes.
Keywords: mutagenesis; mutagens; biochemical reaction kinetics; dna; risk assessment; chemical effluents; dehydrogenases; biological models.

34818 Effects of Hydrocarbons on Defense Mechanisms. Tripp, M.R. (University of Delaware, Department of Biological Sciences, Newark, DE, 19711). **Project number:** 1R01-ES-01531-03. **Contract:** 1R01-ES-01531-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$59,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Environmental chemicals, particularly hydrocarbons, cause disease themselves and may make organisms more susceptible to infectious disease as well. It is proposed to study 3 animal species as models and show how hydrocarbons adversely affect defense mechanisms. The hard clam (Mercenaria mercenaria), blue crab (Callinectes sapidus), and mummichog (Fundulus heteroclitus) will be exposed chronically to nonlethal concentrations of phenol, naphthalenes, and water soluble petroleum extracts. In the clam, effects on epithelial surfaces will be examined histologically (including ultrastrucutre), phagocytosis by hemocytes and intracellular digestion will be measured as will changes in hemolymph protein. In the crab, damage to gills will be assessed by light and electron microscopy, and hemocyte function and hemolymph protein will be assayed by electrophoresis. These two species lack the ability to form immunoglobulins, thus offering unique opportunities to study the effect of chemicals on nonspecific defense mechanisms. Treated fish will be assayed for their ability to reject scale transplants and to form immunoglobulins. Other physiological parameters to be measured include blood cortisol concentrations, hematocrit, blood cell and protein composition.
Keywords: hydrocarbons; chemical effluents; biochemical reaction kinetics; infectivity; molluscs; crustaceans; physiology; metabolism; diseases; pathological changes.

34819 Respiratory Anaphylaxis to Industrial Chemicals. Karol, M.H. (Pittsburgh University, Graduate School of Public Health, 622 Parran Hall, Pittsburgh, PA, 15261). **Project number:** 1R01-ES-01532-03. **Contract:** 1R01-ES-01532-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$43,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The guinea pig will be developed as an animal model of pulmonary hypersensitivity to small airborne industrial chemicals. To define the conditions providing maximum sensitization, small chemicals (haptens) will be covalently linked to carrier protein molecules, and the resulting hapten-protein conjugates used as antigens. Hapten-specific respiratory hypersensitivity occurring either immediately or several hours following exposure (delayed onset) to the allergen will be assessed by analysis of pulmonary functions. For these determinations, the hapten will be coupled to a heterologous carrier. The influence of the following factors upon induction of hapten-specific pulmonary hypersensitivity will be determined: (1) dose of allergen; (2) number and length of daily exposures; and (3) interval between exposures. Using the conditions producing optimum hapten-specific hypersensitivity, various industrial chemicals will be aerosolized. Determination and comparison of the allergenic capabilities of the chemicals using dose-response and threshold concentration studies should allow prediction of safe levels for industrial workers. Histopathological examination of the sensitized respiratory tissue and skin test sites will provide indications of cell-mediated immunity. Serological evaluations will be routinely performed. Local and circulating hapten-specific antibodies will be assayed by the following techniques: radioimmunoelectrophoresis, enzyme-linked immunosorbent assay, passive cutaneous anaphylaxis, and passive leukocyte sensitization. In this way a possible relationship between an in vitro immunological assay and the state of pulmonary hypersensitivity as ascertained by bronchial provocation should become apparent.
Keywords: immunology; respiratory system; guinea pigs; dynamic function studies; biological models; inhalation; lungs; aerosols; particles.

34820 Nature of Lead and Mercury Binding Nuclear Proteins. Cherian, G.M. (Western Ontario University, Health Sciences Center, London, Ontario, Canada). **Project number:** 1R01-ES-01535-03. **Contract:** 1R01-ES-01535-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$19,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objectives of this study are to determine the nature of proteins forming intracellular complexes with potentially toxic metals, particularly lead and mercury. Both of these metals are known to bind intracellularly with acid nuclei proteins. It is not known whether these proteins are synthesized specifically for binding with these metals. Experiments are planned to determine the role of de novo synthesis on the availability of the proteins. Rats exposed to excessive amounts of lead and mercury will be treated with metabolic inhibitors of protein synthesis and acidic nuclear protein-metal complexes will be isolated and compared quantitatively with intoxicated rats not treated with metabolic inhibitors. If it is found that treatment by inhibitors of protein synthesis (e.g., cycloheximide and/or actinomycin D) inhibits lead protein formation, the toxic effects of the same amounts of metal will be compared in treated and untreated rats. If protein-metal complexing is desirable, as suspected from studies to date, possible induction of lead and/or mercury binding acidic nuclear proteins will be studied by prior exposure to less toxic essential metals, zinc and/or copper.
Keywords: lead; mercury; proteins; metabolism; rats; toxicity; biosynthesis; zinc; copper.

34821 Nature of Radiation Induced Genetic Damage. Novitski, E. (University of Oregon, Department of Biology, Eugene, OR, 97403). **Project number:** 1R01-ES-01536-03. **Contract:** 1R01-ES-01536-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$65,000.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The relation between radiation-induced mutations and chromosome breaks is not understood at the present time; a new hypothesis of the whole animal from only one of the first two cleavage products appears to resolve some of the problems. The research will focus on the study of the production of mosaics in Drosophila melanogaster as a function both of x-ray dose and chemical treat-

ment, and the computer analysis of genetic data on chromosome loss and dominant lethal production in view of this hypothesis.
Keywords: genetic radiation effects; radioinduction; mutations; chromosomes; drosophila; strand breaks; x radiation; radiation doses; biological models.

34822 Metabolism, Induction, and Toxicity of PCBs. Kaminsky, L.S. (New York State Department of Health, New Scotland Avenue, Albany, NY, 12201). **Project number:** 1R01-ES01544-03. **Contract:** 1R01-ES-01544-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$59,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); nuclear fusion(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The polychlorinated biphenyls (PCBs) are found universally as toxic environmental pollutants. The objectives of the proposed research program are to determine the mechanisms of hepatic microsomal metabolism of selected individual PCBs and to relate this metabolism to the toxicity of the corresponding PCB. The role of the number and position of chlorine substituents on the PCBs in controlling metabolite patterns and toxicity will be determined and used to predict the toxicity of untested PCBs. The inductive effects of PCBs on hepatic microsomal mixed function oxidases and the consequences of such induction for hepatic drug and xenobiotic metabolism will also be investigated. Mechanisms of PCB metabolism will be investigated by: (1) the determination of binding constants for PCB-hepatic cytochrome P-450 interactions in rat and monkey microsomes using difference spectral techniques; (2) isolation, using high pressure liquid chromatography, and identification, using mass spectrometry and NMR, of the metabolic products of the in vitro metabolism of selected PCBs by hepatic microsomes; (3) molecular orbital calculations of PCBs and theoretical reactive intermediate metabolites (e.g., arene oxides) using extended Huckel and CNDO/2 calculations; (4) the study of the covalent binding of C-14-labeled PCB metabolites to microsomal macromolecules; and (5) the investigation of the effect of epoxide hydrase and glutathione S-epoxide transferase on the in vitro metabolism of PCBs by microsomal and solubilized rat enzyme systems. The acute and chronic inductive effects of PCBs will be probed in rats using quantitative assays of hepatic microsomal enzyme levels and determinations of drug metabolism activities.
Keywords: aromatics; organic chlorine compounds; metabolism; toxicity; rats; monkeys; liver; microsomes; oxidases; lyases; transferases; enzyme activity; metabolites; biological pathways; biological functions; pathological changes; cytochromes; binding energy; in vitro; molecular structure; carbon 14 compounds; biological effects.

34823 Metabolism, Genome Repair, and Environmental Mutagens. Waldren, C.A. (Colorado University, 4200 E. 9th Avenue, Denver, CO, 80220). **Project number:** 1R01-ES01555-03. **Contract:** 1R01-ES-01555-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$52,000.
Related energy source: Coal(20); oil and gas(20); nuclear fission(20); nuclear fusion(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

It is clear that certain environmental agents with little known toxicity of their own can greatly enhance the lethal and mutagenic action of other physical and chemical agents. An example of this is the effect of caffeine and related compounds on the lethal action of uv and x irradiation and on the action of certain alkylating agents. Inhibition of purine biosynthesis has also been shown to cause serious damage, mainly embryotoxicity and teratogenicity. The interrelationship of these phenomena will be studied by examining the metabolism of caffeine in Chinese hamster ovary cells (CHO-K1/pro-) and mutant cells defective in purine, pyrimidine, and amino acid metabolism grown in culture. Methods will include assessment of caffeine metabolism by high pressure liquid chromatography, the effect of caffeine on nucleotide biosynthesis, and the analysis of genetic repair processes in selected mutants under various experimental conditions.
Keywords: cell cultures; animal cells; caffeine; metabolism; biological effects; nucleotides; biosynthesis; mutations; biological repair; dna; mutagens; mutagenesis; synergism.

34824 Active Site of Delta-Aminoelevulinic Acid Dehydratase. Lerman, C.L. (Haverford College, Department of Chemistry, Haverford, PA, 19041). **Project number:** 1R01-ES01572-02. **Contract:** 1R01-ES-01572-02. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The project will attempt to elucidate the identity, three-dimensional relationships, and chemical properties of the groups which are responsible for the catalysis of conversion of delta-aminolevulinic acid to porphobilinogen by the enzyme delta-aminolevulinic acid dehydratase from bovine liver. The tools to be used are probes in the form of substrate analogs. Work will include inhibition by stereoisomers of substrate analogs and affinity labeling to identify active site residues.
Keywords: aminolevulinic acid; porphyrins; biosynthesis; lyases; catalysis; enzyme activity; molecular biology; biochemistry; liver.

34825 Heavy Metal-Induced Damage to the Nervous Tissue. Prasad, K.N. (University of Colorado, 4200 East 9th Avenue, Denver, CO, 80262). **Project number:** 1R01-ES-01576-03. **Contract:** 1R01-ES-01576-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$88,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this proposal is to investigate the molecular mechanisms by which heavy metals damage nervous tissue. The specific aim of this project is to study the effect of methyl mercury on the nervous tissue, using mouse neuroblastoma and rat glioma cells in culture as experimental models. The following studies will be performed: (1) establish the dose-response relationships for methyl mercury effects upon growth rate and differentiation; (2) establish the dose-response relationships for methyl mercury effects upon neurotranmitter metabolism; and (3) establish dose-response relationships for methyl mercury effects upon cyclic nucleotide metabolism. Data may be useful in estimating the relative sensitivity of dividing nerve and glial cells to methyl mercury using the above criteria.
Keywords: central nervous system; pathological changes; methylmercury; mice; rats; nucleotides; metabolism; nerve cells; sensitivity.

34826 Toxicity of Prenatal Carbon Monoxide Exposure. Annan, Z. (Johns Hopkins University, 615 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** 1R01-ES-01589-03. **Contract:** 1R01-ES-01589-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$73,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Carbon monoxide (CO) has long been recognized as an environmental hazard and standards for acute exposure have been established. Little attention has been focused, however, upon the effects that chronic exposures to this gas might have although such exposure is relatively common. Cigarette smoking is the major source of carboxyhemoglobin (HbCO) and smokers on the average maintain HbCO levels of 5%. The fetus of a smoking mother carries similar burdens of CO in blood. The proposed research is designed to assess the effects of chronic prenatal CO exposures on the development of the neonatal organism, to determine the permanence of such changes through longitudinal studies, and to determine threshold values below which such effects do not occur. The principal levels of analysis include spontaneous behavioral assessments as well as responses to centrally acting drugs, brain and organ development through protein and DNA analyses, and neurochemical studies designed to measure perturbations in monoamine systems resulting from prenatal hypoxia.
Keywords: toxicity; carbon monoxide; embryos; metabolism; chronic exposure; tobacco smokes; teratogenesis; brain; organs.

34827 Effects of Mercurial Poisons on Na+,K+-ATPase. Askari, A.A. (Medical College of Ohio, P.O. Box 6190, Toledo, OH, 43614). **Project number:** 1R01-ES-01599-03. **Contract:** 1R01-ES-01599-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$49,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Na+,K+-ATPase, an enzyme of the plasma membrane, is involved in the regulation of the internal ionic environment of most mammalian cells. Previous work has suggested that the inhibition of this enzyme by methylmercury may be related to the neurological abnormalities and the embryotoxic effects produced by this environmental poison. Our recent work shows that the interaction of methylmercury and other short-chain alkylmercury compounds with Na+,K+-ATPase leads to a unique mode of modification of this enzyme. While the overall Na+,K+-dependent ATPase activity of the mercurial-modified enzyme is inhibited, none of the partial reactions of the enzyme seem to be affected. In view of this, the goals of this project are: (1) to study in detail the mechanism of modifying effects of these mercurials on the isolated Na+,K+-ATPase; (2) to determine the functional consequences of the mercurial-induced modification of the enzyme; and (3) to determine if the toxic effects of methylmercury in the intact animal are related to this unique type of modification of the enzyme. The purified dog kidney enzyme will be used to study the effects of mercurials on the kinetics of the partial reactions of the enzyme, and to identify the site of the reaction of the mercurials within the enzyme complex. Intact human red cells, and phospholipid vesicles containing the purified enzyme will be used to study the effects of mercurials on the Na+,K+-translocations that are mediated by the enzyme. Methylmercury-poisoned pregnant mice will be used to determine if the brain

enzyme obtained from the mother and the fetus are affected in the same way that the purified enzyme is modified by methylmercury in vitro.
Keywords: animal cells; enzymes; methylmercury; organic mercury compounds; metabolism; toxicity; atp-ase; biochemical reaction kinetics; dogs; man; mice.

34828 Teratogenicity of Chlorinated Hydrocarbon Solvents. Manson, J.M. (Cincinnati University, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** 1R01-ES-01601-03. **Contract:** 1R01-ES-01601-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$74,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Increasingly greater numbers of women of child-bearing age are entering the work force where they are exposed to agents of unknown teratogenic potential. Chlorinated hydrocarbon solvents are widely used in industry, and preliminary studies have indicated they could have a detrimental effect on the developing fetus. These preliminary studies were not performed with reference to pregnant women workers in that inhalation exposure occurred only from days 6 to 15 of gestation in rats, and teratogenic analyses were conducted on term fetuses alone. It is proposed to examine the teratogenicity and/or embryotoxicity, transplacental carcinogenicity and behavioral effects of methyl chloroform, methylene chloride, trichloroethylene and tetrachloroethylene with reference to working populations of women. Adult female rats will be pretreated with ethanol or phenobarbitol, exposed to high and low concentrations of solvents by inhalation for two weeks prior to gestation. After breeding, the dams will be exposed from days 0 to 16 of gestation, which approximates the first two trimesters of human development. Fetuses will be at term for embryotoxic and/or teratogenic effects, postnatally for behavioral alterations, and at 18 months for carcinogenic lesions.
Keywords: organic chlorine compounds; teratogenesis; toxicity; solvents; biological models; fetuses; rats; inhalation; behavior; ethanol; phenobarbital; synergism; embryos; carcinogenesis; pathological changes.

34829 Frog Mutagenesis Test System. McKinnell, R.G. (University of Minnesota, 250 Bio Science Center, St. Paul, MN, 55108). **Project number:** 1R01-ES-01605-03. **Contract:** 1R01-ES-01605-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$81,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

A 3-year project is proposed to develop and characterize a mutagenic test system in the frog, Rana pipiens, and to compare the results obtained with those from other mutagenic test systems. In its simplest terms the test system will consist of administration of mutagenic chemical to male frog, recovery of the treated animal's sperm, fertilization of eggs with the sperm, and analysis of the developing embryos for mutagenic changes. A dose response relationship for both chromosome aberrations and abnormal morphology of developing embryos for the known mutagen, triethylenemelamine (TEM), will be established. Somatic vs. gametic chromosomal changes will be compared within the same animal, and the genetic nature of induced changes will be confirmed by amphibian nuclear transplantation (cloning). The usefulness for mutagenesis screening of androgenetic haploid embryos will be studied. The effects on frogs of different routes of administration of test chemicals will be tested. The mutagenic potential of varying classes of known chemical mutagens will be studied.
Keywords: mutagenesis; frogs; bioassay; mutagen screening; performance testing; comparative evaluations; chromosomal aberrations; embryos; biological pathways; biological models; chemical effluents; carcinogens.

34830 Environmental Contaminants: Effect on Tumor Immunity. Kerkvliet, N.I. (Oregon State University, 107 Druden Hall, Corvallis, OR, 97331). **Project number:** 1R01-ES01612. **Contract:** 1R01-ES-01612. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed study will determine the effect selected environmental contaminants have on the immune response of mice to a growing tumor and the effects of contaminant-induced immune alteration on the incidence and growth rate of tumors in intoxicated animals. Several parameters of immunity will be assessed at various times after tumor inoculation. Assays will include lymphocyte-mediated cytotoxicity, serum blocking activity, lymphokine production, and lymphocyte blastogenesis. In addition, contaminant-exposed animals will be monitored for changes in in vivo tumor growth rate parameters (regression, progression, metastases formation). Contaminants (lead, cadmium, arsenic, PCBs) will be administered in the drinking water or in food for 15 weeks prior to tumor inoculation and immune testing. Subclinical doses of the contaminants will be included. Two tumor systems, the B16 melanoma and MSV-induced sarcoma, will be utilized to compare the differences in immune function between a progressive and a regressive tumor in the presence of environmental contaminants.
Keywords: lead; cadmium; arsenic; aromatics; organic chlorine compounds; ingestion; mice; biological effects; toxicity; immune reactions; implants; melanomas; sarcomas; growth; pathological changes.

34900 Biologic Effects of Environmental Radiation. Urbach, F. (Temple University, School of Medicine, 3400 N. Broad Street, Philadelphia, PA, 19140). **Project number:** P01-ES-00269. **Contract:** P01-ES-00269. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$316,000.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The studies proposed are directed to approach experimentally most of the present day problems in photobiology known to be of importance to man. Particularly, they are directed at the investigation and prevention of interactions of sunlight with otherwise useful chemicals with resultant sometimes unexpected, and sometimes drastic ecologic and biologically harmful effects. Approaches to be used utilize techniques of optical physics, particularly design of novel light sources and light measurement devices, photochemical studies of polycyclic aromatic hydrocarbons, various phototoxic compounds and effects of antioxidants with emphasis of the effect of photoproducts on augmentation of photocarcinogenesis, studies of the effects of ultraviolet radiation and visible light on human epidermal cells in vitro (including effects on DNA, RNA and protein synthesis, urocanic acid metabolism and DNA repair), investigations of models for measurement of uv effects (photophysiology) and experiments in clinical photobiology including restudying skin erythema action spectra, phototherapy of icteric neonates and use of phototoxic agents in cutaneous phototherapy. A core program supporting these studies is also prepared.
Keywords: biological effects; ultraviolet radiation; polycyclic aromatic hydrocarbons; photochemistry; carcinogenesis; visible radiation; human populations; man; animal cells; dna; rna; proteins; biological repair; biosynthesis; biological models.

34901 Pulmonary Effects of Environmental Oxidant Pollutants. Dungworth, D.L. (University of California at Davis, Dept. of Veterinary Pathology, Davis, CA, 95616). **Project number:** P01-ES-00628. **Contract:** P01-ES-00628. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$440,000.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

A variety of animal species, principally rats and monkeys, will be chronically exposed to ozone at concentrations in the high ambient range. A multidisciplinary group will make integrated biochemical, bacteriological, physiological, and pathological evaluations of effects. By plotting the relative levels of sensitivity of the various parameters studied and the effects observed, a basis will be provided for making predictions of possible long-term consequences of photochemical smog on man. A primary goal is to test critical hypotheses concerning biochemical and cellular mechanisms responsible for the deleterious effects of the pollutants. Major pathogenetic and modifying factors of interest are: the role of lipid peroxidation in initiating damage; the phenomenon of adaptation; the sites of impairment in pulmonary alveolar macrophages; and the sequence and nature of lesions resulting in the development of chronic obstructive pulmonary disease (bronchitis/emphysema) and interstitial fibrosis. An additional goal is to explore further the potentrial prophylactic value for human populations of dietary antioxidants and trace element selenium.
Keywords: rats; monkeys; chronic exposure; exposure chambers; inhalation; ozone; biological effects; lungs; pathological changes; biochemistry; cytology; lipids; oxidation; biological adaptation; macrophages; respiratory system diseases; etiology; antioxidants; selenium; diet; air pollution.

34902 Silicate, Pulmonary Secretions and Lung Disease. Lynn, W.S. (Duke University, P.O. Box 3711, Durham, NC, 27710). **Project number:** P01-ES-01581. **Contract:** P01-ES-01581. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$214,000.
Related energy source: Coal(25); oil and gas(25); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is two-fold: (1) characterization of those materials, cellular and acellular, secretory and foreign, which accumulate in airways of man in response to environmental pollutants, primarily crystalline silicates; and (2) using experimental animals, delineation of the inflammatory and destructive sequelae which result in lungs from inhalation of the identifiable environmental crystals and their adsorbed organic pollutants. The method used for obtaining such material from patients known to be exposed to dusts is bronchoal-

veolar lavage. Methods to be used in this study include morphologic, cytologic, crystalographic elemental, and biochemical analyses.
Keywords: silicates; air pollution; health hazards; metabolism; particles; aerosols; animal cells; lungs; patients; pathological changes; organic compounds; inhalation.

34903 Health Effects of Fossil Fuels Utilization. Wogan, G.N. (Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139). **Project number:** P01ES01640. **Contract:** P01-ES-01640. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$525,000.
Related energy source: Coal(25); oil and gas(25); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective of the proposed research program is to develop a series of data bases on which assessment of potential health consequences, especially total burden of environmental carcinogens and mutagens resulting from combustion of fossil fuels can be made more objectively and with greater precision than is currently possible. The general approach is intended to define conditions of combustion for several fuel types, including readily vaporized fuel, coal, heavy oil and shale oil, which generate minimal amounts of compounds of carcinogenic and/or mutagenic properties. Several approaches will be utilized, involving the collaboration of combustion engineers, analytical chemists, and biologists.
Keywords: fossil fuels; combustion products; health hazards; carcinogens; mutagens; data base management.

34950 Multinuclear NMR Investigations of Metallothionein. Otvos, J.D. (Yale Univ., School of Medicine, 333 Cedar Street, New Haven, CT, 06510). **Project number:** R23-ES-01674. **Contract:** R23-ES-01674. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$34,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The interaction of cadmium with metallothionein, a low molecular weight cysteine-rich cadmium binding protein, will be investigated by 113Cd, 13C, and 1H nuclear magnetic resonance (NMR). This multinuclear NMR study should provide the detailed structural information needed to define the chemical nature of the cadmium binding sites. Since metallothionein is suspected to play an important, though poorly characterized, physiological role in metal detoxification, metabolism and/or transport, such structural information may be expected to lead to understanding of the nature of cadmium toxicity and the mechanisms by which cadmium is handled by various organisms, including man, in the biosphere. The experimental approach will be to completely define the structural state of native rabbit liver metallothionein in terms of its natural abundance 113Cd, 13C, and 1H NMR parameters. Native metal ions will then be removed and substituted with enriched 113Cd(II) under conditions which maintain the native protein structure and cysteine oxidation state as monitered by 13C and 1H NMR. The extreme sensitivity of the 113Cd chemical shift to the nature and geometry of the surrounding ligands should allow a determination to be made of metal binding stoichiometry, extent of sulfur ligation, and symmetries of the individual binding sites. Dynamic information such as metal and ligand exchange rates will also be accessible. The structural information obtained on the rabbit liver protein will then be used to explore questions relating to its function. In particular, metallothioneins from different tissue (kidney), different species (horse, human), and of different chromatographic form will be characterized by multinuclear NMR to determine whether there is a structural basis for their previously observed variations in native metal ion content.
Keywords: cadmium; proteins; biochemical reaction kinetics; cysteine; chemical bonds; toxicity; molecular structure; nuclear magnetic resonance; metabolism; liver.

34951 Longitudinal Study of Air Pollution on Mortality. Finch, S.J. (State University of New York, Research Foundation, Stony Brook, NY, 11794). **Project number:** R23-ES-01686. **Contract:** R23-ES-01686. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$40,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Epidemiological studies.

A longitudinal epidemiological study of census tracts with high residential stability assesses whether the recent decreases in air pollution have been followed by decreases in mortality rates. To date, 40 stable census tracts have been identified in Buffalo, and pollution levels have been estimated for a period of years. Both the decrease in pollution level and the change in mortality rate will be estimated for each census tract. The research will examine whether larger decreases in air pollution are followed by larger decreases in mortality rates. The effects will be isolated by cause of death, age, sex, and race. The results will be verified by corresponding analyses on stable tracts in different cities.
Keywords: mortality; air pollution; epidemiology; human populations; new york; health hazards; respiratory system diseases.

34952 Neonatal Gastrointestinal Absorption of Lead, Cadmium, and Mercury. Walsh, C.T. (Boston University, 881 Commonwealth Avenue, Boston, MA, 02115). **Project number:** R23-ES-01708. **Contract:** R23-ES-01708. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$22,000.
Related energy source: Coal(20); oil and gas(30); oil shale(30); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is designed to determine whether the neonate is at greater risk than the adult from ingestion of potentially toxic heavy metals because of more rapid and/or extensive absorption from the gastrointestinal tract. The absorption kinetics of inorganic salts of lead-203, cadmium-109 and mercury-203 in the neonate will be compared to those in newly weaned and adult animals. Rats will be used as the primary animal model; important observations made in rats will be tested in a second species, the guinea pig, to provide an indication of the validity of generalizing the findings to man. The absorption of tracer amounts of lead, cadmium and mercury will be directly determined using the in vivo segment technique which permits measurement of rates of uptake into the intestinal mucosa, retention in the gut wall and systemic absorption. Where appropriate, the overall extent of absorption of these metals after gastric intubation will be estimated indirectly by a method entailing determination of radioactivity remaining in the gastrointestinal tract. The effect of aspects of neonatal diet and gut physiology on absorption of these metals will be determined in the following two types of experiments: (1) the role of a largely milk diet in the neonate will be assessed by comparing the absorption of the metals in weaned control rats with an experimental group of the same age receiving only milk for one week; and (2) the role of pinocytosis by the neonatal gut in the absorption process of these metals will be determined by comparing the absorption kinetics in controls to animals with markedly altered rates of pinocytotic activity resulting from adrenalectomy or glucocorticoid administration.
Keywords: neonates; lead; cadmium; mercury; metabolism; pathological changes; nutrition; ingestion; juveniles; adults; guinea pigs; rats; milk; risk assessment; health hazards.

34953 Hydrazine Metabolism as it Relates to Toxicity. Nelson, S.D. (University of Washington, School of Pharmacy, Seattle, WA, 98195). **Project number:** R23-ES-01717. **Contract:** R23-ES-01717. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Several synthetic hydrazines, including some used in rocket fuels, agriculture, and medicine, have proved to be tumorigenic in animals, and therefore are possible cancer causative agents in man. Only limited information is now available on the metabolism of the most prominent of these compounds in our environment, such as hydrazine, methylhydrazine, hydroxyethylhydrazine, and maleic hydrazide. Two of these compounds, hydrazine and methylhydrazine, are also either metabolites of therapeutically useful drugs or are undergoing evaluation as potentially useful drugs. The possible role of metabolism in promoting the tumorigenic response of these hydrazines will be explored by identifying those metabolites that are excreted by animals susceptible to their carcinogenicity, and by monitoring the alkylation of nucleic acids and proteins in the target organ for those metabolites that are too reactive to isolate. Specific deuterium labeling will be used to examine possible isotope effects on the carcinogenicity and metabolism of methylhydrazine, a rocket fuel propellant, and 1,2-dimethylhydrazine, a carcinogen that promotes the development of colon tumors by its metabolic activation to a potent alkylating agent.
Keywords: hydrazine; metabolism; toxicity; health hazards; carcinogens; pathological changes; drugs; organic nitrogen compounds; carcinogenesis; isotope effects; rockets; propellants; biological models.

34954 Mutagenicity of Environmental Chemicals to Human Cells. Tong, C.C. (American Health Foundation, 1370 Avenue of the Americas, New York, NY, 10019). **Project number:** R23-ES01724. **Contract:** R23-ES-01724. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$43,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this proposal are: (1) to develop techniques for detecting the mutagenic potential to mammalian cells of chemicals, particularly those requiring metabolic activation; (2) to elucidate the factors involved in the sensitivity of mammalian cells to mutagenesis such as cell cycle effects; and (3) to evaluate mutagenic hazards of specific environmental chemicals such as pesticides. Nondividing metabolically active primary rat liver cells will be cocultured as metabolizing feeder cells with various target human cell

lines as an assay for mutagenesis. The extent of mutation to purine analog- or ouabain-resistant mutants will be quantified. Synchronized human target cells will then be used in the assay so that the extent of mutation can be related to the degree of DNA synthesis. The interaction of the mutagens with DNA will be studied and attempts will be made to relate the extent of mutation to critical interactions of the mutagens with DNA. Finally, the most sensitive assay conditions will be employed to evaluate the mutagenic potential of several organochlorine pesticides.
Keywords: pesticides; organic chlorine compounds; mutagenesis; synchronous cultures; animal cells; man; mutations; dna; biosynthesis; mutation frequency; mutagen screening; biological pathways; risk assessment.

34955 Metal Carcinogensis and DNA Modification in Human Lymphocytes. Sirover, M.A. (Temple University, School of Medicine, 3420 N. Broad Street, Philadelphia, PA, 19140). **Project number:** R23-ES-01735. **Contract:** R23-ES-01735. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$44,000.
Related energy source: Coal(20); oil and gas(30); oil shale(30); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Metals have been identified as human carcinogens through occupational exposure or as carcinogens in animals through laboratory experimentation. This research proposal is designed to investigate the biological mechanisms which underlie metal carcinogenesis. The individual goals of the two parts of this proposal are: (1) to characterize the biochemical aberrations in DNA synthesis which occur when proliferating human lymphocytes are exposed to metal carcinogens; and (2) to determine whether metal carcinogens modify DNA in vivo and in vitro.
Keywords: carcinogenesis; metals; biological models; toxicity; dna; biosynthesis; pathological changes; metabolism.

34956 Carcinogen Damage and Repair of DNA in Human Chromatin. Smerdon, M.J. (Washington University, Lindell and Skinkes Blvds., St. Louis, MO, 63130). **Project number:** R23-ES01797. **Contract:** R23-ES-01797. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The broad objective of this proposal is to understand how chromatin structure affects the distribution of carcinogen damage to DNA and its repair in human cells. Recent advances in the understanding of chromatin structure along with the methodology developed in this laboratory to analyze DNA damage and DNA repair synthesis make possible a comprehensive study of the distribution, within chromatin, of DNA damage by chemical carcinogens (e.g., N-acetoxy-2-acetylaminofluorene (NA-AAF)) and a physical carcinogen (uv radiation). DNA damage and repair within the different structural regions of chromatin will be measured by analysis of the kinetics of digestion with staphylococcal nuclease and DNAase I. Recent observations indicate the uv-induced pyrimidine dimers are removed much more rapidly than are covalently bound adducts of NA-AAF. Hence, the initial phase of this study will concentrate on determining whether or not this difference is the result of differences in the distribution of damage to DNA within chromatin by a chemical and a physical carcinogen and/or differences in the repairability of the different regions of chromatin. The second phase involves a comparison of the distribution of damage and repair of NA-AAF and uv radiation in the chromatin of normal human cells and repair deficient human (xeroderma pigmentosum) and mouse cells. Once the methodology and basic concepts are worked out for these two well characterized carcinogens, the chromatin distribution patterns for the environmentally relevant carcinogens 7,8-dihydro-9,10-epoxybenz(a)pyrene, 7-bromomethylbenz(a)anthracene, and methylnitrosourea will be determined.
Keywords: ultraviolet radiation; irradiation; cell cultures; somatic cells; xp cells; biological radiation effects; chromatin; dna; biological repair; biological pathways; strand breaks; carcinogens; biological effects; carcinogenesis; dna-ase; nucleases; enzyme activity.

34957 Environmental Agents and Non-Respiratory Lung Function. Roth, R.A. (Michigan State University, Department of Pharmacology, East Lansing, MI, 48824). **Project number:** R23-ES-01861. **Contract:** R23-ES-01861. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$38,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The lung has been shown to perform important non-respiratory functions, among which are the removal and metabolism of circulating biogenic amines and drugs. Since impairment of this capacity by environmental agents could contribute to their toxicity, the effects of selected environmental toxins on pulmonary drug clearance will be examined. Since carbon monoxide and nicotine are known to cause cardiovascular changes, isolated lungs from rats pretreated with these agents will be tested for their ability to clear circulating vasoactive biogenic amines (5-hydroxytryptamine and norepinephrine) as well as selected drugs (propranolol, methadone). Paraquat produces severe lung lesions in animals and humans; therefore, the influence of this herbicide on pulmonary clearance of biogenic amines and drugs will also be examined. Studies of metabolism in broken-cell preparations have led many to believe that drug clearance by lung in vivo is minor compared to that of liver. Therefore, clearance of selected drugs and vasoactive biogenic amines will be compared in intact liver and lung at physiological perfusion rates in order to assess the relative contribution of these organs in vivo. In addition, relative metabolic clearance by intact lung and liver will be compared with relative metabolic rates in broken-cell preparations.
Keywords: respiratory system diseases; lungs; dynamic function studies; metabolism; removal; carbon monoxide; nicotine; herbicides; synergism; toxicity; liver.

34958 Photodegradation of Adsorbed Polycyclic Arenes. Daisey, J.M. (New York Univ., New York, NY, 10016). **Project number:** R23-ES-01691. **Contract:** R23-ES-01691. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

A fluidized-bed photochemical reactor will be developed and evaluated for the study of reactions of particulate-adsorbed PAH and PAH epoxides. The stability of some reactive epoxide intermediates which may be formed during the photo-degradation of adsorbed PAH (in aerosols) will be determined under various conditions of light, temperature and humidity. The rate of photo-degradation and chemical half-lives of pyrene, benz(a)anthracene and benzo(a)pyrene adsorbed on several substrates will be determined under various conditions of light, temperature and humidity. Identification of the products formed during photo-degradation will be sought, with particular emphasis on arene epoxide derivatives.
Keywords: photolysis; polycyclic aromatic hydrocarbons; epoxides; particles; absorption; reaction intermediates; aerosols; pyrene; benzanthracene; benzopyrene; chemical reaction yield.

34959 Microbial Mutagenesis and Plasmids. Nortelmans, K.E. (SRI International, Menlo Park, CA, 94025). **Project number:** R23-ES-02004. **Contract:** R23-ES-02004. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the research is to screen a large number of plasmids to find ones that will be superior to pKM101 or that will supplement pKM101 by making one or more tester strains responsive to known or suspected carcinogens not detected by the test in its present form. Making the test more sensitive will enhance its predictive value for human carcinogenicity induced by environmental mutagens.
Keywords: microorganisms; mutagenesis; plasmids; mutagens; mutagen screening; biological models.

34960 Biochemistry of DNA Repair and Mutation in Drosophila. Dusenbery, R.L. (Emory Univ., Atlanta, GA). **Project number:** R23-ES-02037. **Contract:** R23-ES-02037. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The research is directed toward a combined biochemical and genetic analysis of the molecular processes involved in DNA repair in eukaryotes. Drosophila melanogaster provides a multicellular model system for the study of the genetic control of these processes and of their relationship to mutation induction by physical and chemical agents encountered in the environment. Three approaches to the biochemical examination of these mutants are outlined. Assays will be performed to determine excision repair proficiency of selected mutant strains. A two-dimensional gel electrophoresis technique will be utilized to detect altered or missing gene products in the mutant strains. Fractionation of cellular proteins by DNA affinity techniques prior to electrophoresis will be used to enrich for DNA repair associated activities. Both autoradiographic and specific enzymatic assay methods will be used to localize proteins on gels. Specific repair associated enzymes will be isolated from mutant strains exhibiting phenotypes which strongly implicate a particular defect in DNA repair and will be examined for altered in vitro activity.
Keywords: dna; biological repair; mutagenesis; drosophila; biochemical reaction kinetics; genetic effects; in vitro; proteins.

34961 Effect of Aging on Protective Response to Lead Exposure. Vijayaraghavan, S.R. (Univ. of California, Los Angeles, CA, 90024). **Project number:** R23-ES-02047. **Contract:** R23-ES-02047. **Supported**

by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This project proposes to identify those factors which predispose the developing animal to renal and hematological injury following lead exposure. The relationship between the RBC-inducible lead-binding protein and indices of hematological toxicity and the relationship between the renal tubular nuclear inclusion body and indices of renal tubular dysfunction will be contrasted in the young and the adult rat.
Keywords: age dependence; response modifying factors; lead compounds; biological effects; rats.

34962 Assessment of Environmental Risk Factors in Cancer. Sarrif, A.M. (Univ. of Alabama, Birmingham, AL, 35294). **Project number:** R23-ES-02074. **Contract:** R23-ES-02074. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The hazardous impact of a large number of xenobiotics in the environment, naturally occurring or man-made, is not well known. Risk assessment of such agents is complex because their biological effects depend, in part, on their metabolic activation and detoxification, and on their accessibility to target cells. Since chemical carcinogens are no exception to this generalization, environmental chemicals such as insecticides, other pesticides, drugs, food additives, and industrial contaminants may be risk factors in one or two ways. The first is that they are primary carcinogens or procarcinogens. The second is that they may be secondary risk factors or cocarcinogens because of their ability to modify the levels of metabolizing enzymes of environmentally abundant and established carcinogens. This program, will exploit mouse embryo C3H 10T 1/2-CL8 cells which have been shown in the postconfluence inhibition of cell division for the detection of such primary and secondary risk factors among a selected number of insecticides, herbicide contaminants and fungicides.
Keywords: carcinogenesis; risk assessment; pesticides; cell cultures; mice.

34963 Infantile Lead Treatment Alters Drinking Behavior. Mailman, R.B. (Univ. of North Carolina, Chapel Hill, NC, 27514). **Project number:** R23-ES-02087. **Contract:** R23-ES-02087. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This research will attempt to localize and define the physiological alterations in lithium-induced drinking caused by the infantile lead administration. The involvement of the peripheral renin-angiotensis system, known to be elevated by lithium, will be investigated in lead and control animals using radioimmunoassay methodology. Other known dipsogenic agents will be administered by various routes to determine if infantile lead exposure causes increased polydipsia to other agents, either alone or after lithium pretreatment. Since central dopaminergic neurons are known to be essential to lithium-induced polydipsia, lead-treated and control rats will be depeleted of catecholamines in the central nervous system using 6-hydroxydopamine. The alterations in drinking responses to lithium and other dipsogenic agents will be measured after generalized and speciic catecholamine depletions.
Keywords: infants; lead compounds; biological effects; water; ingestion; behavior.

34964 Carcinogen Induced Alterations in Gene Expression. Chilina, A.R. (Univ. of Tennessee, Knoxville, TN, 37901). **Project number:** R23-ES-02215. **Contract:** R23-ES-02215. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objective of this proposal will be to investigate both genetic and epigenetic alterations induced by diethylnitrosamine in the normal cellular regulatory circuits which govern selective gene expression. Several model systems will be used in the proposed research to study diethylnitrosamine induced alterations in differential gene expression. These model systems include the following: (1) normal adult rat liver; (2) chemically or surgically induced regenerating rat liver; (3) rat liver undergoing chemically induced neoplastic transformation; (4) fetal rat liver; and (5) fully developed diethylnitrosamine induced rat hepatomas. Nucleic acid liquid hybridization techniques will be employed to quantitively monitor general changes in the genetic expression of both repetitive and unique RNA transcripts in normal, regenerating, neonatal and chemically transformed rat liver. Nucleic acid reassociation procedures will also be used to monitor alterations in the expression of the genes which code for rat serum albumin and alpha-fetoprotein in normal, proliferating, fetal and carcinogen exposed rat liver cells.
Keywords: nitroso compounds; amines; genetic effects; rats; liver; carcinogenesis.

34965 Excision-Repair of Benzo(a)pyrene: Modified DNA. Frankel, K. (New York Univ., New York, NY, 10016). **Project number:** R23-ES-02234. **Contract:** R23-ES-02234. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The main objective is to study the first step of the excision-repair mechanism in normal human cells and in Fraconi's anemia (FA) fibroblasts. This step would be the recognition by an enzymatic activity(ies) (BPase) of the lesion(s) on DNA caused by the environmental carcinogen benzo(a)pyrene. The first experiments will be directed towards elucidation of the nature of the putative BPase, i.e., whether it is N-glycosylase and/or endonuclease. Substrates for BPase will include cellular, PM2 and calf thymus DNA modified by either unlabelled or radioactive benzo(a)pyrene diol epoxide (I) (BPDE) or by benzo(a)pyrene, metabolized either by cells or by a rat liver microsomal activating system. BPase activity will be assayed in human placenta and in HP cells, and its nature characterized by the identification of the BPDE adducts removed from DNA. The adducts will be separated by chromatography on Sphadex LH20 and by reverse phase high pressure liquid chromatography (HPLC). Once the nature of BPase is known, its presence and activity will be evaluated in repair defective cell lines such as FA fibroblasts. To determine whether BPDE or benzo(a)pyrene may actually suppress repair enzyme activity, BPase as well as apurinic endonuclease, uracil N-glycosylase and N-3-methyl adenine N-glycosylase activities will be assayed in both normal and FA cells following exposure to the carcinogens. These latter three enzymes, in purified form, will be tested in vitro against BPDE-modified DNA to determine whether they are active against any or all of the BPDE-induced lesions.
Keywords: benzopyrene; biological repair; human populations; toxicity.

34966 Pathogenesis of Mineral Dust Toxicity. Kane, A.B. (Temple Univ., Philadelphia, PA, 19140). **Project number:** R23-ES-02251. **Contract:** R23-ES-02251. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This research will study the pathogenesis of silica cytotoxicity to mouse macrophage tumor cells P388D/sub 1/ in vitro. In this model system, various structural and functional events will be evaluated as being causally related to the production of silica cytotoxicity. The objectives of the proposed experiments are: (1) to determine what agents are able to delay or prevent cytotoxicity in P388D/sub 1/ cells exposed to silica, and (2) to measure specific biochemical changes in P388D/sub 1/ cells exposed to silica. The specific changes to be studied are lysosomal enzyme release, degradation of cellular macromolecules, cell membrane function, and specific intracellular enzyme activities.
Keywords: toxicity; pathological changes; silica; tumor cells; cell membranes; enzymes; mice.

34967 Air Pollutants Interaction with Chronic Respiratory Disease. Thomas, G.B. (St. Margarets' Hospital for Women, Dorchester, MA, 02125). **Project number:** R23-ES-02420. **Contract:** R23-ES-02420. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to establish an animal model for chronic respiratory disease to be used in air pollution studies. Chronic respiratory disease (CRD) in mice will be established by respiratory challenge with Mycoplasma pulmonis, strain M. After the mortality rate has been determined in the initial acute phase of the disease, the chronic infection will be studied using the following parameters: (1) concentration of mycoplasma in the lungs and middle ear; (2) lung edema, histopathology of lungs, tracheas, and nasal cavities using light and scanning electron microscopy; (3) circulating antibody; (4) serum immunoglobulin levels; and (5) cell-mediated immunity. Mice will be subjected to single and multiple exposures of concentrations of ozone (O3), nitrogen dioxide (NO2), and O3/NO2 mixtures that have been shown to increase susceptibility of mice to acute respiratory infection. CRD in pollutant-exposed and air-control mice will be compared using the above mentioned parameters.
Keywords: air pollution; biological effects; respiratory system diseases; mice; mortality; ozone; nitrogen dioxide; mixtures.

34968 Lead and Drug Toxicity Related to Heme Biosynthesis. Piper, W.N. (Univ. of Nebraska, Omaha, NE, 68105). **Project number:** R01-ES-02424. **Contract:** R01-ES-02424. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the proposed research are to elucidate the role that pteroylpolyglutamates serve in the regulation of inhibition of uroporphyrinogen synthetase activity by lead and other inhibitors, to learn how drugs, hormones and pteridine derivatives regulate this enzyme and the synthesis of heme, to extend these studies to extrahepatic tissues, such as the brain, kidney, bone marrow and endocrine system, and to the neonate. The results of these investigations will provide valuable information on the mechanism of the conversion of porphobilinogen to uroporphyrinogen and the synthesis of heme, and its regulation by lead and other inhibitors. This information will contribute to our knowledge of lead and drug toxicity and its treatment.

Keywords: enzymes; heme; biosynthesis; lead compounds; drugs; biological effects; toxicity.

35000 Metabolism of Chemical Carcinogens by Cultured Esophagus, Bronchus and Pancreatic Duct from Humans and Experimental Animals. Harris, C.; Autrup, H.B. (National Cancer Institute, 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** BX-348-3. **Contract:** Z01-CP-04513-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Human bronchus, pancreatic duct and esophagus can be cultured for several weeks in a chemically-defined medium. This controlled experimental setting provides an excellent in vitro system to study the metabolism of chemical carcinogens including those found in tobacco smoke and the environment. Several classes of chemical carcinogens, polynuclear aromatic hydrocarbons, N-nitrosamines, hydrazines, and mycotoxins can be metabolically activated by human tissues. The metabolic pathways leading to the formation of DNA adducts in cultured bronchus and esophagus have been defined for benzo(a)pyrene, aflatoxin B1, and N-Nitro-sodimethylamine. The pathways to organic-extractable and water-soluble metabolites of benzo(a)pyrene were qualitatively similar in all 3 tissues. The adduct between these carcinogens and DNA in human bronchus and esophagus are essentially the same as those found in experimental animals in which the chemicals are carcinogenic. When different people are compared a marked variation in binding levels is found, e.g., the inter-individual variation in the binding of BP to DNA in cultured human bronchus was 75-fold (100 patients). A variation in carcinogen binding levels in different target tissues within an individual was also found.

Keywords: metabolism; carcinogens; tobacco smokes; polycyclic aromatic hydrocarbons; organic nitrogen compounds; tissues; man; benzopyrene; hydrazine; nitroso compounds; biological pathways; bronchi; pancreas; esophagus.

35001 Derivatives of Carcinogenic Polycyclic Hydrocarbons. Harvey, R.G. (Chicago Univ., 5801 South Ellis Avenue, Chicago, IL, 60637). **Project number:** AR-537-7. **Contract:** N01-CP-33385. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

The compounds to be synthesized in this project are known or suspected metabolites of carcinogenic polycyclic hydrocarbons which are urgently needed in carcinogenesis research. Many of the compounds are relatively unstable and a high level of synthetic skill and experience is required for their preparation. Compounds synthesized in this laboratory in the current and previous years of this contract were submitted to NCI which has supplied samples to numerous investigators in the scientific community. Work in carcinogenesis research has been productively stimulated by the availability of these compounds, and a number of the significant recent advances in this field were achieved with compounds prepared in this program.

Keywords: polycyclic aromatic hydrocarbons; metabolites; synthesis; carcinogenesis.

35002 Role of DNA Repair Mechanisms in the Etiology of Cancer. Day, R.S. (National Cancer Institute, 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** ZXC-413-8. **Contract:** Z01-CP-04785-09-LMC. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(60); oil and gas(20); oil shale(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The use of the previously developed adenovirus host-cell plague assay (in which adenovirus 2 or 5 is treated with physical or chemical agents, and is then assayed for biological activity on monolayers of human cells) was extended. Eight of thirty-one human tumor cell strains were found to be deficient in their ability to repair adenovirus 5 treated with N-methyl-N'-nitro-N-nitrosoguanidine. All of 21 human skin fibroblast strains were proficient in such repair. Hydroxyurea was found to block repair of ultraviolet light damaged human adenovirus 5.

Keywords: dna; biological repair; biochemical reaction kinetics; neoplasms; etiology; animal cells; man; tumor cells; skin; ultraviolet radiation.

35003 Study of Polycyclic Hydrocarbon Metabolism. Ernster, L. (Stockholm Univ., Box 6409, Fack S-104 OS, Stockholm 50, Sweden). **Project number:** AN-328-5. **Contract:** N01-CP-33363. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The basic objectives are to study: various properties of the aryl hydrocarbon hydroxylase enzyme system in rat lung tissue including the distribution of aryl hydrocarbon hydroxylase and the substrate and products of this enzyme system; subcellular localization, assay in homogenates and subcellular fractions, relation to the microsomal mixed function oxidase, general properties, products, inhibitors, and induction; characteristics of aryl hydrocarbon hydroxylase activity of human lung tissue; and the relationship between the properties of aryl hydrocarbon hydroxylase of lung tissue and carcinogenesis.

Keywords: polycyclic aromatic hydrocarbons; metabolism; biological effects; carcinogenesis; biological models.

35004 Repair of Radiation-Induced Lesions in DNA. Smith, K.C. (Stanford University, School of Medicine, Palo Alto, CA, 94305). **Project number:** 1CA-2896-23. **Contract:** R01-CA-02896-23. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The following will be studied: (1) the role of plus uvrD in the control of the excision repair patch size produced by plus polA; (2) the genetic control and nature of high uv dose mutagenesis; (3) the question of whether repair performed during liquid holding recovery is mutagenic; and (4) the role of quantification of polA plus in low uv dose postreplication repair that is inhibitable by complex growth medium. The following will be completed: (1) the role of polB in long patch excision repair; (2) the general role of uvrD in excision repair; (3) the in vitro x-ray sensitivity of fibroblasts from patients showing an unusual skin sensitivity to radiation therapy; and (4) the role of recB and uvrD in low dose mutagenesis.

Keywords: mutagenesis; ultraviolet radiation; dna replication; biological repair; dna; biological radiation effects; x radiation; low dose irradiation.

35005 Biological Aspects of Carcinogenesis by Radiation. Kaplan, H.S. (Stanford University, Palo Alto, CA, 94305). **Project number:** 1CA-3352-23. **Contract:** R01-CA-03352-23. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This is an ongoing study of the interaction of ionizing radiation, leukemogenic viruses, target cells, the thymus microenvironment, and genetic factors in the induction and pathogenesis of thymic lymphomas in C57BL/Ka and related strains of mice. Specifically, we plan to: (1) study the molecular characteristics of the radiation leukemia virus (RadLV) in comparison to those of related non-leukemogenic viruses of the C57BL/Ka strain; (2) induce, isolate, and characterize conditional-lethal mutants of RadLV; (3) investigate the molecular mechanisms whereby radiation activates the virus; (4) ascertain whether RadLV is the causative agent of the lymphomas from which it is isolable; (5) investigate the pathogenesis of the murine lymphomas; (6) study changes in immune responsiveness of mice during the latent period of lymphoma development, and the possibility of effective immunoprevention; (7) investigate the evolution of autonomy of lymphomas in the autochthonous host; and (8) study the influence of genetic and differentiation-specific restriction mechanisms on susceptibility to lymphoma development.

Keywords: carcinogenesis; radioinduction; biological models; leukemia viruses; thymus; ionizing radiations; radiosensitivity; lymphomas; mice.

35006 Effects of X Rays on Normal and Malignant Cells. Tolmach, L.J. (Washington University, School of Medicine, 660 S. Euclid Avenue, St. Louis, MO, 63110). **Project number:** 1CA-4483-20. **Contract:** R01-CA-04483-20. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

X-ray-induced inhibition of mammalian cell growth and proliferation will be studied, with particular emphasis on DNA synthesis in the irradiated and the first postirradiation generations. Using fiber autoradiography and isopycnic banding, inhibition of synthesis will be analyzed in terms of replicon initiation inhibition in HeLa S3, EMT6, and other cells. Comparisons will be made with the inhibition caused by bromodeoxyuridine photolysis with 313 nm radiation. Caffeine-mediated suppression of the inhibition will be examined further. The relation between inhibition and cell killing will be sought. The effects of various metabolic inhibitors, including caf-

feine and its analogs, as well as other inhibitors of DNA synthesis, will be examined in irradiated cells, in further study of x-ray-induced potentially lethal damage.
Keywords: x radiation; irradiation; cell cultures; tumor cells; hela cells; biological radiation effects; cell proliferation; growth; cell division; dna; biosynthesis; inhibition; budr; photolysis; caffeine; radiosensitivity effects; cell killing; comparative evaluations.

35007 DNA Repair and Recovery in the Mammalian Cell Cycle. Humphrey, R.M. (Texas Univ., Cancer Center, P.O. Box 20036, Houston, TX, 77025). **Project number:** 1CA-4484-21. **Contract:** R01-CA-04484-21. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(75); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose an approach to studies on cell survival, mutagenesis, DNA replication, repair replication, and the assessment of DNA damage in mammalian cells as they relate to the cell cycle. Our objective is to compare these parameters and develop appropriate hypothesis concerning the relationships between the cell cycle and cellular responses to radiation chemicals. Specifically, we will compare the survival and mutagenic responses as a function of the cell cycle phase in response to uvl, uvl-like chemicals, x-rays, and x-ray-like chemicals; determine the cell cycle dependence of radiation and chemical DNA damage recognized by damage specific enzymes; and investigate ultraviolet light-irradiated G1-phase cells for uvl-specific DNA synthesis that may be involved in the bypass of DNA damage and to compare the uvl-specific synthesis with that induced by selected chemicals.
Keywords: dna; biological repair; biological recovery; animal cells; dna replication; x radiation; ultraviolet radiation; biological radiation effects; biological models; cell cycle.

35008 Effect of Chemical Carcinogens on Cells In Vitro. Diamond, L. (Wistar Inst. of Anatomy and Biology, 36th and Spruce Sts., Philadelphia, PA, 19104). **Project number:** 1CA-8936-12. **Contract:** R01-CA-08936-12. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(60); oil and gas(20); oil shale(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The carcinogenicity of the polycyclic aromatic hydrocarbons is determined by a complex interaction of many genetic and environmental factors. The objective of this proposal is to gain some understanding of the mechanisms of hydrocarbon-induced carcinogenesis by measuring in a model system, hamster embryo cell cultures, specific biological changes produced by the hydrocarbons and the various aspects of cell-carcinogen interaction that lead to these changes. The levels of aryl hydrocarbon hydroxylase activity, the extent of hydrocarbon metabolism, the metabolite profiles, and the amounts and types of hydrocarbon DNA-bound products, under different experimental conditions, will be compared to the frequencies of hydrocarbon-induced transformation, mutation and cytoxicity. In this way, those aspects of cell-carcinogen interaction that are related to the induction of each of the biological effects in these cells will be defined.
Keywords: chemical effluents; toxicity; carcinogenesis; carcinogens; in vitro; cell cultures; environmental impacts.

35009 Effects of Radiation on Stationary Cells. Little, J.B. (Harvard University, School of Public Health, 55 Shattuck Street, Boston, MA, 02115). **Project number:** 1CA-11751-10. **Contract:** R01-CA-11751-10. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The long-term goal of this research is to gain knowledge about mechanisms which determine the radiosensitivity of mammalian cells, particularly stationary or very slowly proliferating cells. We will utilize density-inhibited plateau phase cultures of several different cell strains including 10T-1/2 mouse embryo cells, human diploid cells, and human tumor cells. Three endpoints will be studied: cell survival, malignant transformation in vitro, and mutation rate. We will investigate the relationships between these cellular effects and try to correlate them with molecular DNA repair processes. Several differences have been observed between the x-ray response of stationary and exponentially growing cells, notably in the ability of stationary cells to repair potentially lethal radiation damage (PLD). The enhancement of survival which occurs during PLD repair is, however, associated with enhancement of malignant transformation. The relationship between survival and transformation will be studied by use of incubation at low temperature or with dinitrophenol, exposure to high LET and split-dose irradiation, and by studying uv transformation. Molecular repair processes will also be investigated. Cells mutant in their response to radiation and their DNA repair capacity will be studied. An overall objective is to understand and correlate events such as repair at the molecular level with cellular effects such as survival, malignant transformation, and mutation.
Keywords: animal cells; radiosensitivity; x radiation; biological radiation effects; biochemical reaction kinetics; biological repair; mice; man; tumor cells; embryos; dna; survival curves; carcinogenesis; biological models.

35010 Unsaturated Polyolefins and Hydrocarbon Carcinogenesis. Paquette, L.A. (Ohio State University, School of Math and Physical Science, 164 W. 17th Avenue, 102 Administration Building, Columbus, OH, 43210). **Project number:** 1CA-12115-9. **Contract:** R01-CA-12115-09. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

Work in progress is rather equitably divided between the development of synthetic approaches to chiral cyclic polyolefins and search for knowledge concerning the chemistry of singlet oxygen and its mechanism of action. Since early success has been realized in preparing optically active cyclooctatetraenes of known absolute configuration, further extension of these endeavors is planned to establish scope and limitations. With our recent expeditious synthesis of hepatalene from naphthalene completed, the preparation of benzo fused derivatives in optically stable form is planned. In addition, the ene reaction of singlet oxygen with a variety of new substrates, principally vinyl silanes, is being studied. Stereoelectronic control of its (4 plus 2) addition to specially constructed dienes is also beginning to prove informative.
Keywords: polycyclic aromatic hydrocarbons; synthesis; naphthalene; condensed aromatics; oxygen; biochemical reaction kinetics; carcinogenesis.

35011 Radiation Injury in Subpopulations of Lymphocytes. Anderson, R.E. (New Mexico Univ., School of Medicine, University Hill NE, Albuquerque, NM, 87131). **Project number:** 1CA-13805-7. **Contract:** R01-CA-13805-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Among the properties that distinguish thymus-derived (T) from bone marrow-derived (B) lymphocytes are specific receptor sites, homing patterns in lymphoid tissues, traffic in the intact host, the topographical appearance of the cell surface, and responses to specific mitogens. Investigations to date suggest that most, if not all, subpopulations of lymphocytes differ in radiosensitivity. Thus: (1) irradiated B cells placed in tissue culture survive less well than T cells; (2) the capacity of irradiated cells to traffic in normal fashion is inhibited at lower dose levels for B than T cells; (3) after whole body exposure to 800 rads, a proportionately greater number of T than B cells are mobilized via thoracic duct cannulation; (4) T and B cells activated to appropriate mitogens or antigens in vivo or in vitro are more resistant than their non-activated counterparts to radiation-induced interphase cell death; (5) suppressor T cells appear to be more radiosensitive than helper T cells; (6) B cells demonstrate radiation-induced morphologic alterations at lower dose levels than do T cells; (7) cortisone-sensitive T and B lymphoid cell lines are more radiosensitive than cortisone-resistant cell lines; and (8) a subpopulation of cytotoxic T cells is very resistant to radiation injury. The purpose of this project is twofold: (1) to expand the above observations on radiosensitivity of defined populations of lymphocytes; and (2) to define the physical-chemical basis of these differences in radiosensitivity and thereby gain a better understanding of the pathogenesis of radiation-induced interphase death of lymphocytes.
Keywords: radiation injuries; lymphocytes; radiosensitivity; dynamic function studies; morphology; chemical composition; immunology; ionizing radiations; biological radiation effects; cell killing; biochemical reaction kinetics.

35012 Radiation In Vitro and Mammary Cell Survival and Neoplasia. Clifton, K.H. (Wisconsin Univ., 500 Lincoln Dr., Madison, WI, 53706). **Project number:** 1CA-13881-7. **Contract:** R01-CA-13881-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The continuing goal of this project is to gain quantitative information on the number, nature, and acute radiation response of the cells involved in initiation of the neoplastic process which leads to mammary tumors following exposure of mammary cells to ionizing radiation in vitro, and how this process is related to the type of radiation, the dose, and the hormonal exposure of the cells before and after irradiation. The project is divided into short-term studies devoted to development and application of a radiation dose-mammary cell survival assay, and to long-term carcinogenesis experiments. The former will be based on grafting of monodispersed mammary cell suspensions into the mammary tissue-free fat pads of rats which are primed with injected hormones and/or grafted with mammotropin-secreting pituitary tumors. Long-term studies will involve irradiation of mammary cell suspensions in vitro, which will then be grafted in similar animals and observed for tumor development. By

these methods we hope to: (1) determine the total number of cells of the type from which the malignancy is derived and which survive exposure; (2) minimize the abscopal effects of irradiation; and (3) develop a system in which both physical and hormonal factors can be manipulated, before and after exposure, for study of cell survival, repair and neoplasia in a quantitative fashion.
Keywords: in vitro; animal cells; biological radiation effects; ionizing radiations; carcinogenesis; biological models; abscopal radiation effects; biological repair; neoplasms; survival curves; nuclear energy; health hazards.

35013 Immune Surveillance in Radiation Carcinogenesis. Anderson, R.E. (New Mexico Univ., School of Medicine, University Hill NE, Albuquerque, NM, 87131). **Project number:** 1CA-14270-7. **Contract:** R01-CA-14270-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Neonatal thymectomy, which inhibits maturation of select aspects of the immune response, renders animals more susceptible to the carcinogenic action of oncogenic viruses and select chemical carcinogens. In man, several thymus-related immunologic deficiency diseases have been shown to be characterized by a markedly increased frequency of malignant tumors as has been chronic immunosuppressive therapy. The purpose of the proposal is threefold: (1) to investigate the effect of neonatal and adult thymectomy on the prevalence of spontaneous and radiation-related tumors in germfree and conventional mice; (2) to determine if the tumorigenic effects of radiation can be modified via reconstitution with defined populations of lymphocytes post-exposure; and (3) to correlate the above with the immune status of the host, particularly with respect to the number of recirculating T cells mobilizable via thoracic duct cannulation. Other methods of evaluation include: temporal evaluation of the immunologic capabilities of thymic-dependent lymphocytes from each experimental group including evaluation of relative numbers of suppressor and helper cells; morphologic evaluation of all deaths to include histologic evaluation of tumors; and age-specific death rate from neoplasms.
Keywords: carcinogenesis; radioinduction; immunology; radiation injuries; neonates; neoplasms; biological radiation effects; mice; ionizing radiations; lymphocytes; radiosensitivity effects; thymectomy; immune reactions; germ-free animals.

35014 Tritium Damaged Mammalian Cells In Vitro. Burki, H.J. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 1CA-14310-7. **Contract:** R01-CA-14310-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); nuclear fusion(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Mouse leukemic cells (L5178Y), human cells (HeLa), and several types of Chinese hamster cells will be labeled with precursors of DNA containing tritium, 14-C, 125-I, Br, or tritiated precursors of protein and RNA, and then cooled to 4 degrees C or frozen to -196 degrees C to accumulate damage due to tritium and other isotope disintegration. After suitable time intervals, the reproductive ability, amout of chromosome damage, and induction of mutations will be measured. The efficiency of cellular inactivation and induction of genetic damage will be compared for damage accumulated in various subnuclear regions. These experiments are designed to study regions within the mammalian cell nucleus where isotopic decay appears to be most critical in the induction of reproductive death, chromosome damage, and mutations. We are particularly interested in the DNA which replicates in the cell cycle, as well as tritium damage in satellite DNA. Two other experimental parameters--the time in the cycle of the accumulation of damage, and the quality and the repairability of the damage that is formed--will also be studied. The results of these studies may provide: (1) information on the basic mechanisms which lead to the inactivation of proliferative ability and mutagenesis of mammalian cells and the induction of chromosome aberrations, and (2) quantitative estimates of the relative hazards to the population from environmental tritium.
Keywords: animal cells; in vitro; tritium compounds; leukemia; hela cells; human populations; lungs; ovaries; bone marrow; carbon 14 compounds; iodine 125; bromine; proteins; dna; labelled compounds; biochemical reaction kinetics; chromosomal aberrations; nuclear power plants; environmental impacts; radiation hazards; radionuclide kinetics; genetic radiation effects.

35015 Radiation-Induced Modifications in Protein Synthesis. Oleinick, N.I. (Case Western Reserve University, School of Medicine, 2109 Adelbert Rd., Cleveland, OH, 44106). **Project number:** 1CA-15378-6. **Contract:** R01-CA-15378-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the research are to relate: (1) the molecular damage produced by ionizing radiation in DNA to the impairment of function of the DNA, and (2) the removal of that damage and the subsequent recovery of function to metabolic repair systems dependent upon protein synthesis. Ribosomal RNA (rRNA) synthesis on the extrachromosomal rDNA gene copies in tetrahymena and on the amplified chromosomal rDNA gene copies in mammalian cells provides a unique model system for defining the coordinated structural and functional modifications of irradiated genetic material and its repair within the eukaryotic cell. We have already determined that rRNA synthesis is inhibited by gamma radiation and subsequently recovers. The rDNA will be isolated from the irradiated cells during and after the period of inhibition, and strand-breaks, alkali-labile sites, enzyme-sensitive sites, and base damage measured. Chemical sensitizers and protecting agents will be used to identify the types of damage leading to impaired genetic function, and conditions which inhibit enzymatic reactions in general or protein synthesis in particular will be imposed to assess the presence or absence of metabolic repair systems which do or do not depend upon protein synthesis.
Keywords: proteins; biosynthesis; biological radiation effects; metabolism; dna; biological repair; carcinogenesis; biological models.

35016 Cytochrome P450, Chemical Carcinogenesis Benzo(a)pyrene. Jefcoate, C.R. (Wisconsin Univ., School of Medicine, 307 North Charles Street, Madison, WI, 53706). **Project number:** 1CA-16265-5. **Contract:** R01-CA-16265-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

One form of cytochrome P450 from 3-methylcholanthrene-treated rat liver, P450-reductase and epoxide hydratase have each been purified to homogeneity, and metabolism of benzo(a)pyrene (BP) has been reconstituted with these component enzymes. UDP-glucuronic acid via action of UDPGA-glucuronyl transferase effects enhancement (2.5 times) of the formation of BP-7,8 dihydrodiol 9,10 oxides from BP and the ensuing modification of DNA. This activation is due to removal via conjugation mechanisms of BP-quinones which are potent non-competitive inhibitors of BP-metabolism and, more potently, BP-7,8 dihydrodiol metabolism. Metabolism of BP in hepatocytes from MC-treated rats resulted in modification of DNA which was highly dependent both on the amount of added EP and the medium. Modifications of guanine by BP-dihydrodiol epoxides was only detectable at BP concentrations of 15 micromoles with a cell concentration of 10 to the 6th power/ml. At 60 micromole BP, modification increased 10 times. Modification was 4 times greater in L15 medium than in Krebs-Ringer bicarbonate buffer. Modification of DNA by BP-phenol metabolies was only observed when free-SH groups were depleted by diethyl maleate. Products from BP-metabolism in 10 T1/2 mouse fibroblasts (transformed by BP) were indistinguishable from thoe in CVP mouse fibroblasts (non-transformed). Metabolic rate and cytochrome P450 were higher in 10 T1/2 cells and increased (hydrocarbon-induced) during log phase growth reading a maximum at confluence.
Keywords: benzopyrene; rats; carcinogenesis; biochemical reaction kinetics; 3-methylcholanthrene; metabolism; toxicity; animal cells.

35017 Carcinogen--DNA Complexes: Structure and Interactions. Clarke, R.H. (Boston University, School of Liberal Arts, 755 Commonwealth Ave., Boston, MA, 02215). **Project number:** 1CA-17922-3-1. **Contract:** R01-CA-17922-0351. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall goal of the research programs is to detail the geometry of complexes of polycyclic hydrocarbons bound to DNA and to elucidate the intermolecular interactions which stabilize these complexes, using the newly developed techniques of optically detected magnetic resonance. Our experiments focus on complexes with polycyclic hydrocarbons which have been postulated to be actively involved in carcinogenic activity and which may be of importance in elaborating mechanisms of chemical carcinogenesis at the molecular level.
Keywords: carcinogens; complexes; dna; polycyclic aromatic hydrocarbons; magnetic resonance; biochemistry; molecular structure; carcinogenesis; thermodynamic activity.

35018 Mechanisms of Carcinogenesis in Cell Cultures. Bertram, J.S. (Roswell Park Memorial Institute, 666 Elm St., Buffalo, NY, 14263). **Project number:** 1CA-18197-3. **Contract:** R01-CA-18197-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); nuclear fission(40); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed research is concerned with the mechanism by which chemical and physical carcinogens induce malignancy in vitro. In particular, it is proposed to investigate: (1) the cell cycle specificity for malignant transformation of two groups of carcinogen; (2) the potential of certain clinically useful drugs, which appear to inhibit DNA repair, to modify the carcinogenic response to the carcinogens; (3) the biochemical mechanism of action of the compounds actinomycin D, caffeine, chloroguine, and adriamycin; and (4) activity of natural and synthetic retinoids in inhibiting malignant transformation.

Keywords: x radiation; ultraviolet radiation; irradiation; in vitro; cell cultures; animal cells; biological radiation effects; carcinogenesis; actinomycin; caffeine; organic chlorine compounds; quinolines; antineoplastic drugs; biological effects; radiosensitivity effects; nitroso compounds; guanidines; organic fluorine compounds; amines; biochemical reaction kinetics; cell cycle.

35019 Synthesis, Photochemistry and Thermochemistry of Arene Oxides. Griffin, G.W. (Louisiana State University, School of Science, New Orleans, LA, 70122). **Project number:** 1CA-18346-4. **Contract:** R01-CA-18346-0351. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

Our future goals include: (1) extension of our successful efforts to achieve direct routes to K-region arene oxides, including those bearing oxiranyl rings flanked by substituents; (2) expansion of our program in the area of oxygen transfer reactions to nitrogen bases and sulfur compounds and definition of the scope and mechanism and the possible significance of this process in chemical carcinogenesis; (3) investigation of the photochemical properties of arene oxides--in particular their photoarrangement to oxepins as well as photoreaction with nucleophiles and the significance of these reactions in the solar induction of skin cancer; (4) synthesis of radiolabeled oxiranes such as 9-14C, 10-phenanthrene oxide using standard ground state and photochemical reactions to prepare the labeled phenanthrene which may be oxidized to 9-14C, 10-phenathrene oxide for utilization in the assay of the enzyme hydratase; (5) continued cooperation with Professors Mary and Joseph Arcos on the structural elucidation of rat metabolites such as derived from the hepatic carcinogen dioxane--present efforts are concentrated on the properties of 2,3,4,5-tetrachlorodioxanes which, based on dichloro analogs, could be highly mutagenic and/or carcinogenic; and (6) comparison of rat metabolites of naphthalene (the simplest PNAH) with hydrolysis products of anti-1,2:3,4-naphthalene dioxide obtained during the course of our direct oxide studies.
Keywords: carcinogenesis; heterocyclic compounds; organic oxygen compounds; chemical preparation; photochemistry; organic chlorine compounds; polycyclic aromatic hydrocarbons; rats; metabolites; biological pathways.

35020 3-D Fluorometric Analysis of Hydrocarbon Metabolites. Rho, J.H. (University of Southern California, School of Medicine, 2025 Zonal Ave., Los Angeles, CA, 90033). **Project number:** 1CA-19974-3. **Contract:** R01-CA-19974-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to investigate the nature and relative abundance of polycyclic aromatic hydrocarbons (PAH) metabolites formed by the microsomal enzymes of various cell lines, and their subsequent binding to chromosomal proteins, DNA, and RNA. The products of hydrocarbon metabolism will be isolated by chromatographic separation and identified by a unique and exquisitely sensitive fluorescence technique which permits three-dimensional fluorescence fingerprinting. Both activation and emission spectra for the metabolites will simultaneously be recorded. The specific binding of PAH both at the macromolecular component level and also at the progressively higher organization levels of chromatin will be investigated. By use of cell lines which are highly transformable and nontransforming control cells we will determine the extent to which cellular transformation is induced by the specific binding of carcinogenic PAH metabolites to the chromosomal constituents.
Keywords: polycyclic aromatic hydrocarbons; metabolites; fluorescence spectroscopy; dna; rna; carcinogenesis; carcinogens; biochemical reaction kinetics; animal cells; cell cultures.

35021 Reactive Heterocyclics--Cancer and Biomechanism. Rastetter, W.H. (Massachusetts Institute of Technology, School of Science, 77 Massachusetts Ave., Cambridge, MA, 02139). **Project number:** 1CA-20574-3. **Contract:** R01-CA-20574-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The synthesis of reactive epoxides of the arene oxide and oxepin class will be carried out. Nucleophilic additions to these reactive classes of epoxides will be studied in relation to the carcinogenic activation of polycyclic aromatic hydrocarbons, and in relation to the total synthesis of antiviral agents potentially useful in the treatment of virally caused cancer. Model systems will be studied to mimic the mechanism of carcinogenic activation of polycyclic aromatic hydrocarbons and the mechanism of similar oxidative transformations by the flavin cofactored monooxygenases. Reactive crown ethers, macrocyclic reagents capable of both complexing and reacting selectively with substrates in nonpolar media, will be used in mechanistic and synthetic studies. These will include further studies of the mechanism of action of flavins in enzyme oxidation systems and the development of an efficient and general macrolide synthesis.
Keywords: epoxides; synthesis; polycyclic aromatic hydrocarbons; carcinogenesis; biochemical reaction kinetics; biological models; enzymes.

35022 Role of Mutagenesis in Chemical Carcinogenesis. Maher, V.M. (Michigan State University, Soil Science Building, East Lansing, MI, 48824). **Project number:** 1CA-21247-4. **Contract:** R01-CA-21247-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(35); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The fundamental purpose of this research is to examine the effect of DNA repair on the induction of mutations by selected carcinogenic agents in normal human cells and in cells derived from persons with genetic predisposition to cancer (classical and variant XP's; ataxiatelangiectasia; Fanconi's anemia, etc.). We will: (1) investigate the effect of DNA excision repair processes acting on chemical agents induced uv-like repair, gamma-ray-like repair, cross-links, etc.; (2) determine the effect of DNA post-replication repair of such damage; and (3) determine, using radioactively-labeled carcinogens and sensitive biochemical techniques, the number and kinds of DNA-carcinogen adducts that correlate with the induction of mutations in these cells. As a corollary, we will: (4) compare the effects of simulated sunlight with those found for 254 nm; and (5) compare the effects of carcinogens in human epithelial cells with those observed in fibroblasts.
Keywords: carcinogenesis; mutagenesis; correlations; xp cells; somatic cells; mutations; dna; biological repair; hereditary diseases; carcinogens; chemical reactions; tracer techniques; ultraviolet radiation; comparative evaluations; mutations; oncogenic transformations.

35023 Modification of X-Ray Induced Damages in Phage T4. Wallace, S.S. (New York Medical College, School of Medicine, Valhalla, NY, 10595). **Project number:** 1CA-21342-4. **Contract:** R01-CA-21342-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The enzymes responsible for repairing DNA damage also function in several biologically significant pathways such as DNA replication, genetic recombination, and mutation fixation; and are thus directly implicated in the oncogenic process. Not only is little known about the repair of radiation-induced damages in DNA, but the chemical nature of these damages remains to be elucidated. The proposed research will be undertaken in an effort to define the molecular mechanisms involved in the repair to x-ray-induced damages in DNA using T4 bacteriophage and its Escherichia coli host as model systems. To this end, the DNA synthetic patterns of the recombinational repair deficient T4 x and y mutants have been examined, and the existence of aberrant DNA replicative intermediates established. An attempt will be made to isolate the products of the x and y genes by a complementation assay. Further, the E. coli x-ray endonuclease will be purified, and its properties delineated. Lastly, irradiated phage DNA will be repaired in vitro by purified enzymes of known specificities and assayed for biological activity by transformation or transfection.
Keywords: x radiation; irradiation; escherichia coli; biological radiation effects; bacteriophages; dna replication; gene recombination; genetic radiation effects; mutations; radioinduction; dna; strand breaks; biological repair; biological pathways; biochemical reaction kinetics; nucleases; enzyme activity; carcinogenesis.

35024 Carcinogenic, Mutagenic, and Cytotoxic Mechanism (DMBA). Witiak, D.T. (Ohio State University, Office of Medical Affairs, 190 W. Oval Drive, 102 Administration Bldg., Columbus, OH, 43210). **Project number:** 1CA-21371-3. **Contract:** R01-CA-21371-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(25); oil and gas(25); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

It is our primary goal to elucidate the specific deoxynucleoside-hydrocarbons responsible for the biological (cytotoxic, mutagenic, carcinogenic) effects of 7, 12-dimethylbenz(a) athracene (DMBA) and selected DMBA derivatives. Utilizing 14C labeled DMBA and related derivatives of high specific activity, we will compare the DN-HC profile of each of these compounds with one another. The differential rate of removal of the various DN-HC compounds will be determined and compared with their respective biological effects. Non-label derivatives will be utilized to access the ability of these compounds to induce DNA damage. We will further utilize selected repair deficient mutants of human fibroblast cell cultures in order to characterize these mutants and the forms of repair involved in removal of DMBA-induced DNA damage. In order to perform these studies it is necessary that we be able to detect one molecule in 20,000. It is of major importance therefore that radiolabeled DMBA (14C) of high specific activity be employed.

Keywords: condensed aromatics; hydrocarbons; mutagenesis; carcinogenesis; toxicity; carbon 14 compounds; fibroblasts; cell cultures; dna; strand breaks; biological repair; biochemical reaction kinetics; carcinogens.

35025 Metabolism of 3-Methylcholanthrene in Liver and Lung. Stoming, T.A. (Medical College of Georgia, School of Medicine, 1459 Gwinnett St., Augusta, GA, 30902). **Project number:** 1CA-21481-3. **Contract:** R01-CA-21481-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Considerable evidence has been accumulated which indicates that the ultimate carcinogens of polycyclic aromatic hydrocarbons (PAHs) are diol-epoxides. In order to gain additional insight into the mechanism of activation of PAHs, we propose to study the metabolism of 3-methylcholanthrene (3-MC). No diols of this compound have yet been isolated which would support the diol-epoxide theory. The aims of the proposed research are to: (1) identify all primary metabolites of 3-MC; (2) compare the primary metabolites of 3-MC to the known metabolites of other carcinogenic hydrocarbons and determine if a common pathway for activation exists; (3) compare the levels of the primary metabolites of 3-MC from the livers and lungs of susceptible and resistant strains of mice to establish if the formation of a certain metabolite is related to susceptibility; and (4) determine if there is a relationship between lung epoxide hydrase levels and susceptibility to lung tumor formation. Preliminary studies show that high pressure liquid chromatography provides an effective means of separating the metabolites of 3-MC. These investigations are designed to increase our understanding of the mechanism of metabolic activation in relation to chemical carcinogenesis.
Keywords: polycyclic aromatic hydrocarbons; metabolism; liver; lungs; mice; tissue cultures; in vitro; metabolites; glycols; epoxides; carcinogenesis; synergism; comparative evaluations.

35026 Radiation-Induced Thyroid Cancer. Schneider, A.B. (Michael Reese Hospital and Medical Center, 2929 S. Ellis Avenue, Chicago, IL, 60616). **Project number:** 1CA-21518-3. **Contract:** R01-CA-21518-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objective of this research proposal is to study radiation-induced thyroid cancer by a coordinated program of clinical and basic endocrinological investigations. The clinical studies are designed to determine the current risk and continuing incidence of radiation-induced thyroid cancer and to evaluate methods of diagnosis and medical and surgical approaches to treatment. Among those examined, a 31% prevalence of nodules was found, and among those who had surgery, a 32% rate of carcinoma was determined. Laboratory studies will focus on the role of plasma thyroglobulin in the diagnosis of thyroid tumors. An in vitro system will be used to determine at what point thyroglobulin is released from the thyroid into the circulation. The early events in radiation-induced thyroid cancer formation will be studied by irradiating rat thyroid glands. The immediate and long term effects of radiation in causing hormonal changes and tissue damage will also be determined.
Keywords: carcinogenesis; ionizing radiations; local irradiation; head; neck; children; patients; radiotherapy; side effects; thyroid; delayed radiation effects; carcinomas; radioinduction; thyroglobulin; diagnostic uses; diagnosis; ionizing radiations; local irradiation; thyroid; rats; early radiation effects; carcinomas; radioinduction; ionizing radiations; local irradiation; thyroid; rats; early radiation effects; delayed radiation effects; hormones.

35027 Study of Respiratory Carcinogenesis. Little, J.B. (Harvard University, 55 Shattuck Street, Boston, MA, 02115). **Project number:** AN-281-6. **Contract:** N01-CP-33273. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The contractor shall: determine the role of hematite carrier particles in radiation carcinogenesis; identify doses of BP and 210-Po which, given individually, will result in a small but measurable tumor incidence; administer both BP and 210-Po simultaneously and sequentially to determine the synergistic action; and administer DEN systematically following treatment with either BP or 210-Po to determine possible synergism of local and systemic carcinogens.
Keywords: polonium 210; benzopyrene; inhalation; laboratory animals; biological radiation effects; lungs; carcinogenesis; neoplasms; radioinduction; radiosensitivity effects; synergism; dose-response relationships; hematite.

35028 Study of Polycyclic Hydrocarbon Metabolism. Wattenberg, L.W. (Minnesota Univ., 1305 Mayo, Minneapolis, MN, 55455). **Project number:** AN-329-6. **Contract:** N01-CP-33364. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Specific objectives are to determine the relationship between the activity and composition of the aryl hydrocarbon hydroxylase system and the binding of metabolites of polycyclic hydrocarbons to macromolecules of pulmonary structures, and to attempt to relate the amount of binding to the development of pulmonary neoplasia. In addition, it has been demonstrated that several types of antioxidants will inhibit pulmonary neoplasia resulting from administration of polycyclic hydrocarbons. It is hoped to achieve the elucidation of this inhibition. Further specific objectives are to determine the conditions under which inhibition occurs and to ascertain optimal methods of utilizing antioxidants to inhibit pulmonary neoplasia.
Keywords: polycyclic aromatic hydrocarbons; carcinogenesis; inhibition; hydroxylase; enzyme activity; lungs; proteins; nucleic acids; metabolites; neoplasms; antioxidants; response modifying factors; biological effects; biochemistry; metabolism; biological pathways.

35029 Synthesis of Polycyclic Hydrocarbon Derivatives. Engel, J.F. (Midwest Research Institute, 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** AR-540-7. **Contract:** N01-CP-33387. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

The objectives are synthesis, characterization, and radiolabeling of metabolites of polynuclear aromatic hydrocarbons. Unequivocal synthesis routes are adapted from available literature references and/or new routes are devised. Those compounds of greatest interest as metabolites are then radiolabeled with 14-C and/or 3-H. In addition conjugates, such as sulfate esters, glucuronides, and glutathione adducts, of metabolites are synthesized. Adducts of the most active metabolites with DNA bases are also prepared. All samples are distributed world-wide via the NCI Repository.
Keywords: polycyclic aromatic hydrocarbons; metabolites; synthesis; labelling; carbon 14 compounds; tritium compounds; adducts; pyrimidines.

35030 Radiation Response of Mammalian Cells (Hamsters). Belli, J.A. (Harvard University, 25 Shattuck Street, Boston, MA, 02115). **Project number:** AZ-1938-3. **Contract:** P01-CA-12662-080003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 12662-06). This program project, a specialized Cancer Research Center within the Department of Radiation Therapy, Harvard Medical School, supports a variety of research projects addressed to the interactions between the major therapeutic modalities used in the treatment of cancer. These are radiation, chemotherapeutic agents, and immunologic factors. The research projects span the study of these interactions at the molecular through tissue levels. Therefore, the major purposes of this program are to provide the focus for multi-disciplinary research directed to the improved management of human cancer and to establish opportunities for research collaboration between individuals whose major interest is oncologic medicine.
Keywords: biological radiation effects; hamsters; radiotherapy; carcinogenesis; biological models; chemotherapy; immunology; animal cells; neoplasms; tumor cells; radiosensitivity.

35031 Cellular Recovery Mechanisms, DNA Repair, and Radiation Sensitization. Howardflanders, P. (Yale University, 333 Cedar Street, New Haven, CT, 06510). **Project number:** BD-534-3. **Contract:** P01-CA-06519-170022. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Radiological physics research includes magnetic control of the dose distributions produced by high energy electron beams, calorimetric determination of dosimetric parameters and general medical physics. Laboratory investigation includes experimental radiation therapy of rodent solid tumors, radiation reaction preventive agents and normal tissue response, the response of vascular endothelium to ionizing radiation, NMR detection of hypoxic cells, and the influence of the red blood cell concentration of 2,3-diphosphoglycerate on the radiation response of the rat rhabdomyosarcoma R1112. Also included are: (1) enzymatic mechanisms in postreplication repair; (2) study of error-prone DNA repair pathways in mammalian cells, study of herpes virus genome structure, and site specific mutagenesis in gene for thymidine kinase of herpes simplex virus; (3) molecular mechanisms of DNA repair in E. coli, hypoxic radiosensitizers--structure-function relations and mechanisms of sensitization and toxicity; (4) analysis of gene function involved in genetic recombination in E. coli; (5) site directed mutagenesis and role of secondary structure in gene regulation; and (6) cell proliferation in EMT6 tumors and examination of new agents for altering the radiation response of solid tumors.
Keywords: ionizing radiations; irradiation; cell cultures; animal cells; tumor cells; escherichia coli; biological radiation effects; dna; bio-

logical repair; biological pathways; biological recovery; radiosensitivity; radiosensitizers; anoxia; mutagenesis; gene recombination.

35032 Cross-Links Between Strands Produced by Psoralen and Near Ultraviolet Light. Howardflanders, P. (Yale University, 333 Cedar Street, New Haven, CT, 06510). **Project number:** BD-581-5. **Contract:** P01-CA-06519-170105. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

Radiological physics research includes magnetic control of the dose distributions produced by high energy electron beams and calorimetric determination of dosimetric parameters and general medical physics. Laboratory investigation includes experimental radiation therapy of rodent solid tumors, radiation reaction preventive agents and normal tissue response, the response of vascular endothelium to ionizing radiation, NMR detection of hypoxic cells, the influence of the red blood cell concentration of 2,3-diphosphoglycerate on the radiation response of the rat rhabdomyosarcoma R1112. Also included are (1) enzymatic mechanisms in postreplication repair; (2) study of error-prone DNA repair pathways in mammalian cells, study of herpes virus genome structure, and site specific mutagenesis in gene for thymidine kinase of herpes simplex virus; (3) molecular mechanisms of DNA repair in E. coli, hypoxic radiosensitizers--structure-function relations and mechanisms of sensitization and toxicity; (4) analysis of gene function involved in genetic recombination in E. coli; (5) site directed mutagenesis and role of secondary structure in gene regulation; and (6) cell proliferation in EMT6 tumors and examination of new agents for altering the radiation response of solid tumors.
Keywords: near ultraviolet radiation; neoplasms; head; hodgkins disease; prostate; mammary glands; radiation doses; strand breaks; psoralen; cross-linking; dna; biological repair; biochemical reaction kinetics; animal cells.

35033 Study of the Release of RNA Tumor Viruses and Its Genetic Control. Bentvelzen, P.A. (Organization for Applied Scientific Research TNO, Lange Kleiweg 151, Rijswijk, Netherlands). **Project number:** BF-763-3. **Contract:** N01-CP-43328. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine the ubiguity of murine mammary tumor virus in the C57BL, BALB/c, Gr, and C3H strains of mice by examination of the various body organs by immunofluorescence electron-microscopy and radio-immunoassay techniques; (2) determine the influence of aging, exposure to various doses of x irradiation, and exposure to chemical carcinogens (i.e., urethane, methylcholanthrene, or dimethylnitrosamine) on the appearance and detection of MMTV entities by testing singly and in various combinations; (3) study by genetic breeding experiments (with the above mentioned strains of mice) whether the expression of the types of MMTV found in these strains is governed by PROVIRAL genes and/or classical regulator genes; and (4) study the cellular and humoral immunological response of mice to MMTV-specific proteins.
Keywords: neoplasms; viruses; rna; genetics; mammary glands; mice; immunology; electron microscopy; carcinogens; radioimmunoassay; genetic control; amines; condensed aromatics; age dependence; biological radiation effects; x radiation.

35034 Carcinogenesis Screening Using Cell Culture Assays. Sivak, A. (Arthur D. Little Inc., 15 Acorn Avenue, Cambridge, MA, 02140). **Project number:** BN-404-4. **Contract:** N01-CP-55711. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) standardize culture techniques which include selection of low density clones from stock BALB/C-3T3, clone 31, and determination of saturation density and clone stability under optimal growth conditions; (2) carry out initial transformation studies with MNNG to determine optimal conditions; (3) carry out metabolic activation studies including measurement of different cell pools for water soluble metabolites from benzo(a)pyrene, effects of epoxyhydrase inhibitors and/or enzyme inducers, AAH activity of liver microsomal preparations, and toxicity of liver microsomes to cells in culture; (4) correlate criteria for transformation including morphological alteration in clonal and monolayer cultures, growth in semi-solid media, and oncogenesis in vivo; and (5) determine whether tumor promoters enhance yield of transformed clones.
Keywords: mutagen screening; cell cultures; bioassay; metabolism; enzymes; morphology; cloning; benzopyrene; carcinogenesis.

35035 Radiation Carcinogenesis (Rats). Shellabarger, C.J. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-228-4. **Contract:** P01-CA-12536-090001. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 12536-09). The biological effects on eukaryotic cells of low doses of ionizing radiation are to be investigated within the framework of a biophysical theory. The determination of certain parameters should permit extrapolation of the dependence of cellular effects to doses too low for experimental determination. Modifications of the dose response curves by environmental factors such as oxygen tension and sensitizing drugs are an important related objective of investigation. In addition to intrinsic scientific significance, the results of this research are of pragmatic value in radiation protection and radiotherapy. A variety of radiations are to be applied, including neutrons of a wide range of energies, x- and gamma-rays, alpha radiation and energetic ions up to Z equals 18. The higher organisms irradiated will be principally mammals, but insects and plants are to be used in certain studies. The effects under investigation include carcinogenesis, cell transformation, chromosome aberrations and genetic impairment.
Keywords: biological radiation effects; carcinogenesis; rats; radioinduction; low dose irradiation; radiation doses.

35036 Dependence of Chromosome Injury on Radiation Quality. Rossi, H.H. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-230-2. **Contract:** P01-CA-12536-070005. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 12536-09). The biological effects on eukaryotic cells of low doses of ionizing radiation are to be investigated within the framework of a biophysical theory. The determination of certain parameters should permit extrapolation of the dependence of cellular effects to doses too low for experimental determination. Modifications of the dose response curves by environmental factors such as oxygen tension and sensitizing drugs are an important related objective of investigation. In addition to intrinsic scientific significance, the results of this research are of pragmatic value in radiation protection and radiotherapy. A variety of radiations are to be applied, including neutrons of a wide range of energies, x- and gamma-rays, alpha radiation and energetic ions up to Z equals 18. The higher organisms irradiated will be principally mammals, but insects and plants are to be used in certain studies. The effects under investigation include carcinogenesis, cell transformation, chromosome aberrations and genetic impairment.
Keywords: chromosomal aberrations; radioinduction; animal cells; ionizing radiations; low dose irradiation; biological radiation effects.

35037 X-Ray Cell Transformation of Rat and Hamster Embryos. Borek, C. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-233-4. **Contract:** P01-CA-12536-090009. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 12536-09). The biological effects on eukaryotic cells of low doses of ionizing radiation are to be investigated within the framework of a biophysical theory. The determination of certain parameters should permit extrapolation of the dependence of cellular effects to doses too low for experimental determination. Modifications of the dose response curves by environmental factors such as oxygen tension and sensitizing drugs are an important related objective of investigation. In addition to intrinsic scientific significance, the results of this research are of pragmatic value in radiation protection and radiotherapy. A variety of radiations are to be applied, including neutrons of a wide range of energies, x- and gamma-rays, alpha radiation and energetic ions up to Z equals 18. The higher organisms irradiated will be principally mammals, but insects and plants are to be used in certain studies. The effects under investigation include carcinogenesis, cell transformation, chromosome aberrations and genetic impairment.
Keywords: rats; hamsters; embryos; low dose irradiation; biological radiation effects; x radiation; animal cells; transformations; teratogenesis; radioinduction.

35038 Radiation Cytogenetics (Plants). Geard, C.R. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-234-4. **Contract:** P01-CA-12536-090011. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 12536-09). The biological effects on eukaryotic cells of low doses of ionizing radiation are to be investigated within the framwework of a biophysical theory. The determination of certain parameters should permit extrapolation of the dependence of cellular effects to doses too low for experimental determination. Modifications of the dose response curves by environmental factors such as oxygen tension and sensitizing drugs are an important related objective of investigation. In addition to instrinsic scientific significance, the results of this re-

search are of pragmatic value in radiation protection and radiotherapy. A variety of radiations are to be applied, including neutrons of a wide range of energies, X- and gamma-rays, alpha radiation and energetic ions up to Z equals 18. The higher organisms irradiated will be principally mammals, but insects and plants are to be used in certain studies. The effects under investigation include carcinogenesis, cell transformation, chromosome aberrations and genetic impairment.
Keywords: alpha particles; protons; deuterons; synchronous cultures; hamsters; cell cycle; chromosomal aberrations; biological radiation effects; gamma radiation; let; radioinduction.

35039 Experimental Radiation Skin Carcinogenesis (Rats, Mice). Albert, R.E. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** CB-403-4. **Contract:** P30-CA-13343-070012. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 13343-07). The proposal seeks continued support for a NCI Center Grant entitled Research in Environmental Cancer. This Center Grant provides core support for the Institute in the area of cancer research including partial salary support for professional staff, developmental funds, and limited support for items of shared equipment and central services. The research and teaching program in cancer at the Institute has the broad objectives of identifying environmental causes of cancer and developing methods for the control of carcinogenic hazards. The program is interdisciplinary in character and ranges from studies at the subcellular level on mechanisms of action to whole animal, epidemiological and environmental studies. This NCI Center Grant on Research in Environmental Cancer is complementary to the larger National Institutes of Environmental Health Sciences Center Grant, Research in Environmental Health Sciences, and serves to strengthen the Institute's Program in cancer. The activities of the Institute in the area of environmental cancer are included as one of the divisions of the NYU Cancer Center although funding for this purpose is provided solely through the present grant.
Keywords: biological radiation effects; neoplasms; skin; rats; mice; preventive medicine; radioinduction; carcinogenesis.

35040 Evaluating Exposure of Miners to Radon with Lead-210. Wrenn, M.E. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** CB-408-2. **Contract:** P30-CA-13343-070017. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Health protection, safety, and industrial hygiene.

This project is part of a broader program (CA 13343-05). The proposal seeks continued support for a NCI Center Grant entitled Research in Environmental Cancer. This Center Grant provides core support for the Institute in the area of cancer research including partial salary support for professional staff, developmental funds, and limited support for items of shared equipment and central services. The research and teaching program in cancer at the Institute has the broad objectives of identifying environmental causes of cancer and developing methods for the control of carcinogenic hazards. The program is interdisciplinary in character and ranges from studies at the subcellular level on mechanisms of action to whole animal, epidemiological and environmental studies. This NCI Center Grant on Research in Environmental Cancer is complementary to the larger National Institutes of Environmental Health Sciences Center Grant, Research in Environmental Health Sciences, and serves to strengthen the Institute's program in cancer. The activities of the Institute in the area of environmental cancer are included as one of the divisions of the NYU Cancer Center although funding for this purpose is provided solely through the present grant.
Keywords: neoplasms; preventive medicine; miners; carcinogenesis; animal cells; epidemiology; radon; lead 210.

35041 Tumor Cell Radiobiology (Mice). Maruyama, Y. (Kentucky Univ., Limestone and Euclid, Lexington, KY, 40506). **Project number:** CB-714-4. **Contract:** P01-CA-17786-050002. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 17786-05). The aim of the research to be conducted under the proposed program is directed toward a better understanding of basic radiation and tumor biology with single cell systems, animal and tumor systems, tumor detection and staging research, and applied research in human cancer and radiotherapeutic problems. The Radiation Oncology Program utilizes the patient population of this region for study and attempts to coordinate and combine the efforts of the laboratory with those of the clinic. We will conduct long-term multi-disciplinary programs in cancer treatment as well as cancer biomedical research, both applied and fundamental. This program's goals are to develop through research means to cure patients who develop cancer, to provide maximum palliation to patients not cured, to control the progress of disease and to assess the extent and localization of lesions by isotopic diagnostic tests.
Keywords: mice; tumor cells; radiobiology; biological models; radiotherapy.

35042 Modification of Radiation Effects (Mice). Utley, J.F. (Kentucky Univ., Limestone and Euclid, Lexington, Ky, 40506). **Project number:** CB-715-4. **Contract:** P01-CA-17786-050003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 17786-05). The aim of the research to be conducted under the proposed program is directed toward a better understanding of basic radiation and tumor biology with single cell systems, animal and tumor systems, tumor detection and staging research, and applied research in human cancer and radiotherapeutic problems. The Radiation Oncology Program utilizes the patient population of this region for study and attempts to coordinate and combine the efforts of the laboratory with those of the clinic. We will conduct long-term multi-disciplinary programs in cancer treatment as well as cancer biomedical research, both applied and fundamental. This program's goals are to develop through research means to cure patients who develop cancer, to provide maximum palliation to patients not cured, to control the progress of disease and to assess the extent and localization of lesions by isotopic diagnostic tests.
Keywords: mice; biological radiation effects; biological repair; tumor cells; radiosensitivity effects; radiotherapy; radiosensitivity.

35043 Effects of High Energy Neutron Sources in Tissue-Like Media. Laughlin, J.S. (Sloan-Kettering Institute for Cancer Research, 410 E. 68th St., New York, NY, 10021). **Project number:** CC-323-3. **Contract:** P30-CA-08748-145506. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 08748-12). The grant is to provide core support for the research program of the Sloan-Kettering Institute through provision of: salaries and benefits for essential scientific and administrative personnel; facilities, such as animal maintenance, secretarial services, etc., required by many laboratories; consultant services; renovations, and initial funding for new developmental programs.
Keywords: laboratory animals; maintenance; mass rearing; financing; manpower; biological radiation effects; research programs.

35044 Effects of Neutrons on Hypoxic HeLa Cells. Laughlin, J.S. (Sloan-Kettering Institute for Cancer Research, 410 E. 68th St., New York, NY, 10021). **Project number:** CC-329-3. **Contract:** P30-CA-08748-145514. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 08748-12). The grant is to provide core support for the research program of the Sloan-Kettering Institute through provision of: salaries and benefits for essential scientific and administrative personnel; facilities, such as animal maintenance, secretarial services, etc., required by many laboratories; consultant services; renovations, and initial funding for new developmental programs.
Keywords: hela cells; neutron beams; biological radiation effects; radiosensitivity; radiosensitivity effects; anoxia.

35045 Production of Oncogenic Purine N Oxides by Ionizing Radiation. Brown, G.B. (Sloan-Kettering Inst. for Cancer Research, 410 East 68th Street, New York, NY, 10021). **Project number:** CC-389-3. **Contract:** P30-CA-08748-145720. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 08748-12). The grant is to provide core support for the research program of the Sloan-Kettering Institute through provision of: salaries and benefits for essential scientific and administrative personnel; facilities such as animal maintenance, secretarial services, etc., required by many laboratories; consultant services; renovations; and initial funding for new developmental programs.
Keywords: purines; oxides; ionizing radiations; chemical radiation effects; radiation chemistry; carcinogenesis; carcinogens.

35046 Cellular Radiobiology (Human, Hamsters). Rubin, P. (University of Rochester, 601 Elmwood Ave., Rochester, NY, 14627). **Project number:** CC-613-3. **Contract:** P01-CA-11051-110065. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

This project is part of a broader program (CA 11051-09A1). The Clinical Radiation Research Center (CRRC) programs consti-

tute the major inestigative activities of the Division of Radiation Oncology of the University of Rochester Cancer Center (URCC). The unique aspect of the CRRC and the URCC is the integration of research in the clinical sphere and the laboratory setting. The Radiation Oncology Clinical Investigative Program of the CRRC utilizes the laboratory to model and simulate clinical problems to better understand the pathophysiologic effects of irradiation in humans with malignant disease. The Radiobiology and Biophysics Program investigates methods for combining radiation and other modalities for effective cell killing by the use of tumor models in vitro and in vivo. When promising results are found in the laboratory, pilot protocols are written and implemented in the University of Rochester Medical Center through the collaboration of the Divisions of Radiation and Medical Oncology. The Radiation Physics Program provides special support for the other programs and conducts its own research in treatment planning, developing clinical guidelines, mathematical optimization, and applying CT scanning imagery. Personnel and programs interact at different levels and combine efforts in various theme projects such as combined modality treatment of brain tumors, radiosensitizers, and bone marrow regeneration.
Keywords: human populations; hamsters; man; radiobiology; animal cells; biological radiation effects; carcinogenesis; radiotherapy; radiosensitivity.

35047 Application of Crystallographic Techniques. Glusker, J.P. (Inst. for Cancer Research, 7701 Burholme Avenue, Philadelphia, PA, 19111). **Project number:** 1AM-2884-30. **Contract:** R01-CA-10925-30. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

X-ray crystallographic techniques are being used to study some acridine, benz(a)anthracene and chrysene derivatives that are frameshift mutagens, carcinogens and/or antitumor agents. Studies will be made of metabolic products of carcinogenic polycyclic aromatic hydrocarbons, such as arene oxides and dihydrodiols. Molecular complexes of the hydrocarbons with more polar planar molecules will also be studied. Trinitrobenzene, pyromellitic dianhydride and naphthalene 1,4,5,8-tetracarboxylic acid dianhydride are presently being used as complexing agents. Studies of the mechanisms of some enzymes, particularly those of the Krebs cycle, are being made by detailed studies of substrates, inhibitors and the enzymes themselves. Work on substrates and inhibitors is concentrated on enzymes utilizing citrates (citrate synthase, citrate lyase, ATP citrate lyase and aconitase) and on delta5-3-ketosteroid isomerase. Studies on crystalline enzymes involve work on xylose isomerase, citrate synthase and aconitase.
Keywords: crystallography; x-ray diffraction; benzanthracene; chrysene; metabolism; polycyclic aromatic hydrocarbons; enzymes; biochemical reaction kinetics.

35048 Molecular Basis of Radiation Lethality. Smith, K.C. (Stanford Univ., School of Medicine, Palo Alto, CA, 94305). **Project number:** 1CA-6437-18. **Contract:** R01-CA-06437-18. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to map, purify, and study the repair deficiencies and mutation frequencies after ionizing irradiation of a new class of mutants of E. coli, which we have isolated, that are uv resistant but ionizing radiation sensitive. The strains currently being purified are called irrA, irrB, and irrC, and map near serB, leu, and bgl, respectively.
Keywords: ionizing radiations; x radiation; oxygen; dna; strand breaks; enzymes; biological repair; bacteria; mammals; animal cells; mutagenesis; biological radiation effects; genetic radiation effects; air pollution; radiation protection; health hazards; land pollution.

35049 Possible Neoplastic Effects of Non-Neoplastic Viruses. Duran Reynals, M.L. (Yeshiva Univ., Albert Einstein School of Medicine, 1300 Morris Park Ave., Bronx, NY, 10461). **Project number:** 1CA-7160-16. **Contract:** R01-CA-07160-15S1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(60); oil and gas(20); oil shale(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The induction in mice of the enzyme system aryl hydrocarbon hydroxylase (AHH) by 3-methylcholanthrene (MCA) is governed by the Ah gene; mice with the dominant Ahb allele are inducible for AHH and mice with the recessive Ahd allele are noninducible. Mice of strains with each of these alleles were painted with MCS. In the AHH inducible mice MCA induces skin tumors, but cannot elicit a leukemogenic response; in the noninducible mice MCA painting rarely induces skin tumors, but these are so far the only mice in which it induces lymphomas. However, some of these noninducible strains appear to be resistant to these leukemogenic effects of MCA painting. From these results it appears that host factors other than noninducibility play a perhaps decisive role in the induction of lymphoma by MCA painting in noninducible mice. The objective of this proposal is to identify the nature of these host factors and to further verify preliminary results which suggest that these factors might also influence the leukemogenic response to x-irradiation in both noninducible and inducible mice, but play no role in the occurrence of spontaneous lymphoma in either group of mice. To this end mice of inbred strains either inducible for AH or noninducible as well as hybrids of the cross between these strans will be observed for the development of lymphoma untreated, after receiving MCA paintings or after x-irradiation.
Keywords: leukemia viruses; mice; synergism; leukemia; carcinogenesis; biochemical reaction kinetics; etiology; infectivity; biological effects; skin absorption; skin; neoplasms; fossil fuels; combustion products; 3-methylcholanthrene; leukemogenesis; vaccinia virus; hydroxylase; enzyme activity.

35050 Chemistry of Carcinogenic Hydrocarbons. Harvey, R.G. (Chicago Univ., 5801 S. Ellis Ave., Chicago, IL, 60637). **Project number:** 1CA-11968-8. **Contract:** R01-CA-11968-08. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

This investigation is part of a long-range program directed towards elucidation of the mechanism of hydrocarbon carcinogenesis at the chemical-molecular level. In this phase of the project it is intended to complete studies of the comparative chemical properties of a series of diolepoxide and arene oxide derivatives of polycyclic hydrocarbons of varying biological activity. Reactions of these oxidized metabolites with water, with the model nucleophiles tert-butylthiol and cysteine (models for in vivo reactions with proteins and glutathione), and with nucleic acids are to be investigated in detail. A second major goal will be to test a proposed theory of carcinogenesis through (a) synthesis of the proposed active metabolites (diolepoxides, K-oxides, etc., as appropriate) of a series of carcinogenic hydrocarbons of varying structural types, (b) determination of their effectiveness in alkylating DNA and RNA, and (c) determination of their susceptibility to the action of epoxide hydratase. These compounds will also be made available to interested investigators for metabolism studies and determination of their mutagenic, carcinogenic, and other biological activities. The knowledge gained in all the foregoing studies will be correlated with MO theoretical concepts insofar as possible and incorporated in a more comprehensive theory of metabolic activation and carcnogenesis.
Keywords: polycyclic aromatic hydrocarbons; epoxides; chemical properties; dna; rna; alkylation; metabolic activation; biochemical reaction kinetics; carcinogenesis; metabolites.

35051 DNA Repair and Its Relationship to Cancer. Friedberg, E.C. (Stanford Univ., Palo Alto, CA, 95305). **Project number:** 1CA-12428-10. **Contract:** R01-CA-12428-09. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

These studies will be concerned with investigations into the molecular mechanisms of DNA repair in normal human cells and in cells from the hereditary cancer-prone disease xeroderma pigmentosum. Studies will focus on aspects of the excision of ultraviolet radiation-induced DNA damage in living cells and on the isolation, purification, and characterization of human nucleotide excision repair enzymes in cell-free systems. The identification of possible non-enzyme factors required for the excision of damaged bases from chromatin of normal cells will be investigated. Aspects of the enzymology of the excision of uracil derived in DNA by the deamination of cytosine will be investigated in both eukaryote and prokaryote systems.
Keywords: dna; biological repair; carcinogenesis; biochemical reaction kinetics; ultraviolet radiation; biological effects; cytosine; uracils.

35052 Effects of Fast Neutrons On Cultured Mammalian Cells. Moss, A.J. (Univ. of Arkansas, 4301 W. Markham St., Little Rock, AR, 72201). **Project number:** 1CA-13270-6. **Contract:** R01-CA-13270-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study is concerned with the cellular and molecular effects of fast neutrons on cultured mammalian cells. The experiments involve the production of damage in intracellular DNA, which is later measured, as well as an assessment of the cells' ability to repair the damage. The results with fast neutrons will be contrasted with those obtained with 250 kVp x-rays. The data will provide estimates of the RBE and OER for fast neutrons using both molecular and cellular end points. The influence of various conditions such as pH, hypoxia, and available energy (ATP) on the rate and extent of DNA repair will provide information on the basic mechanisms of fast neutron effects on mammalian cells.
Keywords: fast neutrons; animal cells; mammals; cell cultures; biological radiation effects; radiation injuries; dna; biological repair; rbe; oxygen enhancement ratio; x radiation; comparative evaluations.

35053 Photochemical Reactions Related to Skin Cancer. Black, H.S. (Baylor Univ., Coll. of Medicine, 1200 Mounsund Ave., Houston, TX, 77025). **Project number:** 1CA-13464-7. **Contract:** R01-CA-13464-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The photochemical conversion of sterols in skin to carcinogenic chemicals has been suggested as a possible explanation for the carcinogenic activity of ultraviolet light (uvl). Since the demonstration of the occurrence of a naturally occurring carcinogenic sterol in uvl-irradiated skin, this laboratory's efforts have centered around the elucidation of the role this compound plays in the development of actinic skin cancer. During the course of these studies, a mixture of dietarily supplemented antioxidants were shown to not only inhibit the formation of the carcinogenic sterol but to markedly suppress the formation and development of uvl-induced tumors as well. In view of the prophylactic potential of dietary antioxidants and their usefulness as a tool to discern the role of photochemical products in the etiology of uvl-induced cancer, this proposal seeks to determine: (1) the most efficacious antioxidants in tumor suppression; (2) the minimal levels of antioxidants required to significantly suppress tumor formation and whether such suppression involves tumor initiation, developmental stages, or both; (3) whether tumor suppression by antioxidants is mediated by an umbrageous or physiological response; and (4) the role sterol epoxide metabolites play in uvl-induced tumor development.
Keywords: skin; carcinogenesis; sterols; ultraviolet radiation; biological effects; photosensitivity; neoplasms.

35054 Enzymes and Reactions for Repair of DNA in Human Cells. Brent, T.P. (St. Jude Children's Hospital, 332 N. Lauderdale Street, P.O. Box 318, Memphis, TN, 38101). **Project number:** ICA-14799-5. **Contract:** R01-CA-14799-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Two enzymes from human cells that act specifically on damaged DNA will be further purified and characterized. The first is an endonuclease that acts on uv- or x-irradiated DNA. The second is an N-glycosidase that acts on methylated DNA. The levels of these enzymes will be examined in mutant human cell lines that are characterized both by unusual sensitivity to radiation or alkylation and by elevated incidences of neoplasia. These enzymes will also be used as probes to identify and measure DNA lesions induced by genotoxic agents in normal and mutant human cell lines, with a view to determining relative efficiencies of repair in such cell lines.
Keywords: x radiation; ultraviolet radiation; irradiation; cell cultures; animal cells; man; biological radiation effects; dna; strand breaks; biological repair; nucleases; glycosyl hydrolases; enzyme activity; mutants.

35055 Chemotherapeutic Agents and Ultraviolet Carcinogenesis. Epstein, J.H. (California Univ., 551 Parnassus Ave., San Francisco, CA, 94122). **Project number:** ICA-15605-6. **Contract:** R01-CA-15605-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The influence of a number of chemotherapeutic agents on the development of cutaneous squamous cell carcinomas induced in hairless mice by ultraviolet energy will be investigated. The chemicals to be studied are primarily cancer chemotherapeutic agents which not only have profound effects on cellular kinetics but also are being utilized for prolonged periods in non-cancerous diseases. They will be administered systemically or topically depending on the methods utilized in human disease. The formation and growth of the cancers will be monitored. In addition, the acute and chronic effects of these chemicals on DNA synthesis, repair of ultraviolet damaged DNA, and mitosis formation will be evaluated with radioactive tracer and colcemid techniques. Their influence on immune responses will be examined with skin homografts and immune diffusion procedures.
Keywords: ultraviolet radiation; drugs; chemotherapy; neoplasms; radioinduction; dna; mice; biological repair.

35056 Modification of Procarcinogen Enzymatic Activation. Franklin, M.R. (Univ. of Utah, 1400 E. 2nd Street, Salt Lake City, UT, 84112). **Project number:** 1CA-15760-6. **Contract:** R01-CA-15160-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Many carcinogenic compounds occurring in the environment require metabolic activation before they will interact with cellular constituents and initiate tumor formation. For polycyclic hydrocarbons and carcinogenic amines, the activation reaction is an oxidation catalyzed by cytochrome P-450. It is proposed to study how these reactions are modified by drugs and environmental contaminants in the organs where exposure is likely (liver and lung). The modifiers of the oxidation reaction scheduled for study are those compounds known to form inhibitory complexes with cytochrome P-450 during their metabolism, e.g., amphetamines, SKF 525-A and piperonyl butoxide. Also, the inductive effects of these compounds on procarcinogen activation will be studied. The formation of inhibitory cytochrome P-450 metabolic intermediate (MI) complexes and their effects on the oxidation reactions will be investigated in isolated perfused organs (liver, lung), in isolated cells (liver), in microsomal fractions, and in reconstituted purified enzyme systems. Analysis of metabolism, both for MI complex formation and procarcinogen activation (benzopyrene), will use high pressure liquid chromatography to obtain metabolic profiles. The project will result in the elucidation of the nature of the intermediate or reaction responsible for MI complex formation, and an understanding of how this affects procarcinogen activation and, hence, the incidence of cancer in the organism.
Keywords: polycyclic aromatic hydrocarbons; amines; carcinogens; oxidation; cytochromes; enzyme activity; enzyme inhibitors; metabolism; metabolites; biological effects; perfused organs; somatic cells; microsomes; carcinogenesis.

35057 Effects of Radiation on Human Cells Cultured In Vitro. Kantor, G.J. (Wright State University, Dayton, OH, 45431). **Project number:** 1CA-16477-5. **Contract:** R01-CA-16477-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed research is a study of the effects of low doses (sublethal) of ultravolet (uv) and ionizing radiation on cultured human diploid fibroblasts (HDF). Emphasis is on (1) defining the effects of these radiations on arrested non-mitotic populations of various HDF strains and (2) inducing with these radiations HDF transformants in culture. Experiments are proposed to study this effect in XP strains from other complementation groups and the parental presumed heterozygotes. Mechanisms of DNA repair will be studied in these non-dividing cells. The objective is to define the significance of DNA repair in this assay. Other experiments to induce and detect HDF transformants in culture are proposed. Emphasis is placed on using HDF strains isolated from individuals with a predisposition to cancer, using fresh primary isolates (1st passage), using x-rays and uv with chemicals defined as co-carcinogens (phorbol esters, diethylstilbestrol, anthralin), and using various culture procedures that may permit expression of a transformation event.
Keywords: x radiation; ultraviolet radiation; low dose irradiation; sublethal irradiation; cell cultures; man; fibroblasts; xp cells; radiosensitivity; biological radiation effects; dna; transcription; biological repair; oncogenic transformations; carcinogens; cultivation techniques; radiosensitivity effects; radioinduction.

35058 Follow-up Study of Irradiated Tinea capitis Cases. Albert, R.E. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** 1CA-17188-4. **Contract:** R01-CA-17188-0352. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The purpose of the proposed research is to further characterize the nature and magnitude of late radiation damage due to x-ray therapy for ringworm of the scalp. A third survey is in progress of a population of 3,600 children with Tinea capitis in the period 1940 to 1959, 2,200 of whom received x-ray therapy. The survey consists of a health questionnaire to subjects with diagnostic confirmation of tumors and other significant conditions from medical sources. A clinical evaluation of a subsample of irradiated and unirradiated subjects will be undertaken, which will include tumor, hair, visual and audio examinations. Major health effects will be related to dose and temporal patterns of occurrence.
Keywords: delayed radiation effects; x radiation; radiotherapy; head; skin; tumor cells; health hazards; medical surveillance; children; fungi; radiosensitivity; reviews; diseases.

35059 Kinetic Studies of Aryl Epoxide Reactions. Whalen, D.L. (Maryland Univ., 1420 N. Charles St., Baltimore, MD, 21201). **Project number:** 1CA-17278-5. **Contract:** R01-CA-17278-4A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

There is evidence that the toxic and carcinogenic nature of certain aromatic hydrocarbons may be linked to their initial conversion to reactive epoxides. It is now thought that the ultimate carcinogens responsible for the carcinogenic nature of benzo(a)pyrene, a widely-spread environmental carcinogen, are 7,8-diol-9,10-epoxide metabolites. A knowledge of the chemical mechanisms whereby such highly reactive epoxides undergo enzymic and non-enzymic (including hydrolysis) reactions becomes therefore very important. The goal of this research is to carry out a kinetic investigation of the

catalytic and non-catalytic reactions of epoxides that are either carcinogenic, or related in structure to carcinogenic epoxides, in aqueous media. The kinetic data, along with product analyses, will be essential to the understanding of the mechanisms of hydrolysis and other competing reactions that such epoxides undergo. A knowledge of the mechanisms of non-enzyme-catalyzed reactions of these epoxides will be most helpful and may provide some insight into understanding the mechanisms involved in their reactions with biological molecules.
Keywords: epoxides; chemical reaction kinetics; chemical reactions; catalysts; carcinogenesis; hydrolysis; hydrolases; biological pathways.

35060 Photoaugmentation and Carcinogenesis. Willis, I. (Emory University, School of Medicine, 1364 Clifon Road NE, Atlanta, GA, 30322). **Project number:** 1CA-17555-5. **Contract:** R01-CA-17555-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Past personal investigations into the deleterious effects of sunlight on skin (viz. sunburn, premature aging, pe-malignant and malignant lesions) resulted in the important new finding that contrary to common beliefs, UVA radiation is neither harmless nor helpful to human skin; instead, UVA severely enhances the effects of the sunburning UVB rays. In more recent studies it was conclusively determined that this effect is not additive but augmentative. Moreover, it was determined that different wavelengths of UVA possess different photoaugmentative potentialities. Further studies conducted under this grant revealed that tumors could be induced in hairless mice irradiated at the same test site using escalating doses of photoaugmentative radiation within a much shorter period of time than has been peviously reported. It immediately became apparent that this rapid tumor induction method would be most useful for providing a large number of young test animals to study the mechanism of carcinogenesis (specifically genetic, biochemical, and electron microscope) as well as provide a tremendous opportunity to study the effectiveness of both systemic and topical drugs and agents for the prevention of cancer induction and treatment.
Keywords: ultraviolet radiation; biological effects; carcinogenesis; skin; mice; photosensitivity; biological models.

35061 Enzymology of Radiation-Induced Intestinal Carcinoma. Osborne, J.W. (Iowa Univ., College of Medicine, Jessup Hall, Iowa City, IA, 52240). **Project number:** 1CA-18327-2. **Contract:** R01-CA-18327-03S1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Animals will be irradiated throughout the coming year to maintain a pool of intestinal tumor-bearing rats. T cAMP phosphodiesterase (PD) activities of tumor tissue will be further characterized. This will involve the subcellular localization of the enzymes followed by their publication. The kinetic parameters will then be measured in order to verify that preliminary results were correct and that, in fact, there is only a single PD in the intestinal cancer while normal intestinal cells have two PD enzymes. The cAMP synthetic activity of tumor tissue will be measured. It will then be possible to determine which pathway in the cell is responsible for the lower cAMP concentration found in tumor tissue. The responsiveness of the synthetic activity of the adenylate cyclase to stimulation will be defined. The significance of the intracellular nucleotide concentrations in the lymphocytes from normal and tumor-bearing rats will be investigated further. Correlations between cyclic nucleotide concentrations in the tumor and degree of lymphocyte cytotoxicity to cancer cells in culture will be made when possible.
Keywords: neoplasms; intestines; radioinduction; enzymes; rats; biochemistry; cell cultures; lymphocytes; cytology.

35062 Separation and Determination of Carcinogens. Pietrzyk, D.J. (Iowa University, School of Liberal Arts, Jessup Hall, Iowa City, IA, 52240). **Project number:** 1CA-18555-5. **Contract:** R01-CA-18555-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

A number of porous, high surface area polystyrene-divinylbenzene copolymers, polar copolymers, modified copolymers, and inorganic adsorbents are to be examined as adsorbents for the isolation and concentration of organic matter in biological and atmospheric samples. All variables will be examined for these stripping techniques through the use of model compounds, and the direction will be focused on carcinogens and related compounds. Specific classes of organic compounds to be studied in the biological sampling studies are organic acids, bases, ampholytes (such as amino acids, peptides, and catecholamines), aromatic hydrocarbons and their chlorinated derivatives, plasticizers, steroids, and sugars. For atmospheric sampling studies low molecular weight organic compounds, including benzene and halogenated hydrocarbons, will be studied. Basic techniques to be used will be HPLC and GC and typical adsorbents to be studied are Amberlite XAD copolymers and Tenax GC.
Keywords: carcinogens; aromatics; hydrocarbons; chlorinated aromatic hydrocarbons; plasticizers; steroids; saccharides; sampling; environmental materials; benzene; adsorption; sorptive properties; copolymers; liquid column chromatography; gas chromatography.

35063 Reaction of Carcinogens and Cell Extracts with RF-DNA. Taylor, W.D. (Pennsylvania State University, Coll. of Science, 211 Whitmore Lab., University Park, PA, 16802). **Project number:** 1CA-18970-4. **Contract:** R01-CA-18970-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A large proportion of human cancer is a consequence of the action of external carcinogenic chemicals. This carcinogenicity may be a consequence of the alteration of cellular deoxyribonucleic acid (DNA). One possible type of alteration of DNA that could be of significance is a modified base or nucleotide in one of the duplex strands which might lead to errors in DNA duplication and information readout. In the proposed experiments, we will determine the potential of two series of chemical carcinogens for producing nucleotide damage in DNA in vitro. As a sensitive test system, we will utilize phi X174 replicative form (RF) I DNA, a closed circular, supercoiled, double-stranded DNA of MW 3.4 x 10 to the 6th power. With this DNA, as little as 1 in 10 to the 5th power altered nucleotides can be easily detected under neutral conditions; this amounts to 1 per 10 molecules. The carcinogens to be used are: (1) acetylaminofluorene (AAF) and its derivatives, N-hydroxy-acetylaminofluorene (HO-AAF), and N-acetoxy-acetylaminofluorene (AcO-AAF) and (2) benz(a)anthracene (BA) and dibenz(a,h)anthracene (DBA) and several dihydrodiol and epoxide derivatives. Particular attention will be paid to the suspected ultimate carcinogenic forms of these, AcO-AAF and the K-region epoxides of BA and DBA.
Keywords: carcinogenesis; human populations; dna; in vitro; nucleotides; polycyclic aromatic hydrocarbons; metabolism; epoxides; toxicity; pathological changes.

35064 Microbial Degradation of Carcinogenic Hydrocarbons. Gibson, D.T. (Texas Univ., School of Natural Sciences, 200 West 21st Street, Austin, TX, 78712). **Project number:** 1CA-19078-4. **Contract:** R01-CA-19078-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The mechanisms used by bacteria and fungi to oxidize carcinogenic polycyclic hydrocarbons will be investigated at the chemical and enzymatic levels. A Beijerinckia sp. and a mutant strain, Beijerinckia sp. B836, that oxidizes polycyclic hydrocarbons to cis-dihydrodiols will be used to investigate the metabolism of benzo(a)pyrene, benzo(a)anthracene, and 3-methylcholanthrene. Similar experiments will be conducted with fungus Cunninghamella elegans. Products will be isolated by high-pressure liquid chromatography and identified on the basis of the information provided by infrared, visible and ultraviolet spectrophotometry, and mass and proton magnetic resonance spectrometry. The enzymes responsible for the oxidation of benzo(a)pyrene in C. elegans will be characterized in terms of cellular location and physical properties. It is anticipated that cytochrome p-450, reductase, epoxide hydratase, and glutathione S-transferase activity will be detected in this eucaryotic microorganism. The results will establish the different metabolic pathways used by bacteria and fungi for the metabolism of polycyclic hydrocarbons. Such reactions will almost certainly occur in the environment. Also, polycyclic hydrocarbon derivatives should be obtained that will be useful in studies on the initiation of chemical carcinogenesis in mammals. In addition to providing potential microbial model systems for drug metabolism and chemical carcinogenesis the proposed research should establish the fundamental biochemical differences between procaryotic and eucaryotic organisms in terms of polycyclic hydrocarbon oxidation.
Keywords: biodegradation; polycyclic aromatic hydrocarbons; enzymes; biochemical reaction kinetics; metabolism; microorganisms; fungi; biological pathways; bacteria; mammals; drugs; carcinogenesis; benzopyrene; 3-methylcholanthrene.

35065 Nature and Repair of a New Form of DNA Damage. Feldberg, R.S. (Tufts University, School of Liberal Arts, Medford, MA, 02155). **Project number:** 1CA 19419-4. **Contract:** R01-CA-19419-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The role of DNA repair in protecting the cell against mutagens and carcinogens has been suggested by a variety of studies. Most of this work, however, has focused exclusively on the cyclobutane pyrimidine dimer form of damage in ultraviolet (uv) irradiated DNA. The objective of the proposed project is to broaden our

knowledge to include nondimer damage in DNA. To this end, a nondimer damage-specific DNA binding protein isolated from human placenta will be employed as a probe for such damage. The protein itself will be examined in terms of its molecular weight, subunit composition, cellular location and binding site amino acid residues. This protein will also be employed in the isolation of nondimer damage from uv-irradiated poly d(A-T) and from uv- and x-irradiated DNA. The sequence/structural specificity of nondimer damage introduction will be examined, as will the radiation chemistry of nondimer damage introduction with ionizing radiation. Finally, cell lines from normal individuals as well as those derived from individuals with Fanconi's anemia, xeroderma pigmentosum, ataxia-telangiectasia and Bloom's syndrome will be examined both for the presence of bindng protein and for their ability to remove protein-recognizable sites from their DNA after irradiation.
Keywords: dna; radiation injuries; biological repair; ultraviolet radiation; carcinogenesis; mutagenesis; x radiation; cell cultures; fibroblasts; man.

35066 Human Radiation Carcinogenesis Study. Woodward, E.D. (Rochester Univ., 601 Elmwood Avenue,. Rochester, NY, 14642). **Project number:** 1CA-19764-3. **Contract:** R18-CA-19764-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

This project represents a continuation of a long-term prospective study of radiation-induced carcinogenesis in three human populations: (1) persons who were treated in infancy with x-rays for alleged enlargement of the thymus gland; (2) women who received x-ray treatments to the breasts for post-partum mastitis; and (3) persons given x-ray and/or radium treatments to the head in early childhood for lymphoid hyperplasia of the nasopharynx. Health data are collected by mail questionnaires from treated persons and from their untreated sibling controls. Significant reported illnesses are verified through the attending physician and hospital. Histological reviews are performed on slides from tumors of primary interest in the studies. A program of mammographic-thermographic screening of the women who received breast irradiation will be repeated. In addition, a sample of their untreated sisters (controls) who meet NCI recommended eligibility requirements for mammographic-thermographic screening will also be examined. The objectives of the program are (1) to determine the qualitative nature and quantitative risk of radiation-induced neoplastic disease and of conditions with abnormal immunological features, and (2) to effect, by screening, the early diagnosis and treatment of breast cancer in a high-risk population.
Keywords: carcinogenesis; radioinduction; human populations; x radiation; radiotherapy; thymus; mammary glands; head; pharynx; delayed radiation effects; risk assessment; diagnosis; neoplasms.

35067 Modifiers of Chemical Carcinogenesis in Cell Structure. Baird, W.M. (Wistar Institute of Anatomy and Biology, 36th and Spruce Streets, Philadelphia, PA, 19104). **Project number:** 1CA-19948-4. **Contract:** R01-CA-19948-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We have developed methods for analyzing both organic solvent extractable and a major portion of the water-soluble metabolites formed from polycyclic aromatic hydrocarbons by hamster embryo cell cultures. With both a methyl-substituted hydrocarbon, 7,12-dimethylbenz(a)anthracene, and an unsubstituted hydrocarbon, benzo(a)pyrene, the major organic solvent extractable metabolites are dihydrodiols and a major portion of the water-soluble metabolites are glucuronic acid conjugates of hydrocarbon phenols. We are presently using the methods developed for the studies described above, organic solvent extraction, cleavage of water-soluble metabolites with beta-glucuronidase and high-pressure liquid chromatography, to determine the effect of cocarcinogens such as benzo(e)pyrene and tumor promoters such as 12-0-tetradecanoylphorbol-13-acetate on the pathways of metabolism of both methyl-substituted and unsubstituted hydrocarbons in hamster embryo cell cultures. The effects of these modifiers on the DNA adducts formed from carcinoenic hydrocarbons in hamster embryo cells are also determined.
Keywords: animal cells; molecular structure; carcinogenesis; chemical activation; metabolism; polycyclic aromatic hydrocarbons; benzopyrene; toxicity; biological pathways; hamsters; embryos; oxidation; biological models.

35068 Polycyclic Hydrocarbon Metabolism and Binding in Skin. Slaga, T.J. (Tennessee Univ., W. Cumberland Avenue SW, Knoxville, TN, 37916). **Project number:** 1CA-20076-4. **Contract:** R01-CA-20076-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The mechanism of carcinogenic action of polycyclic aromatic hydrocarbons is being investigated through the use of metabolism, binding and tumorigenicity studies. The results from our metabolism studies of benzo(a)pyrene (BP) and 7,12-dimethylbenz(a)antracene (DMBA) in tumor sensitive and resistant mice as analyzed by HPLC and our tumorigenesis studies of various BP and DMBA metabolites and derivatives suggest that diol-epoxides in the bay region of these hydrocarbons are important in their tumorigenic activity. Our binding studies suggest that BP-diol-epoxide interacts to a greater extent and with some degree of specificity to the internucleosomal region of chromatin. Approximately 85% of the binding of BP-diol-epoxide to chromatin is to DNA with a high specific activity to G-C rich regions of DNA. Through the use of inhibitors of BP tumorigenicity, our data suggest that the interactions of BP-diol-epoxide with the exocyclic nitrogen of guanines are important adducts in the initiation of the carcinogenic process.
Keywords: benzopyrene; dimethylbenzanthracene; metabolism; carcinogenesis; skin; mice; metabolic activation; carcinogens; chromatin; epoxides; chemical reactions.

35069 Polycyclic Hydrocarbon Metabolism and Carcinogenesis. Bresnick, E. (Vermont Univ., College of Agriculture, 85 S. Prospect St., Burlington, VT, 05401). **Project number:** 1CA-20711-4. **Contract:** R01-CA-20711-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this research proposal are to: (1) ascertain if cytochrome P448 is found in nucleoli; (2) determine the metabolite spectrum after incubation of nuclei and microsomes with 3-metylcholanthrene (3MC); (3) establish any interaction of 3MC with cytosolic receptor proteins and determine the role of this interaction in the delivery of 3MC to the nucleus for metabolism; (4) ascertain the spectrum of adducts of 3MC (metabolites) to the DNA bases as formed in microsomal and nuclear systems; and (5) establish the role of the various prostaglandins in the promotion phase of the 2-stage mechanism of sin tumorigenesis, particularly in relation to 3MC-induced skin cancer.
Keywords: polycyclic aromatic hydrocarbons; metabolism; carcinogenesis; epoxides; hydroxylase; prostaglandins; hormones; prostate; skin; animal cells; biological models; cytology.

35070 Activated Mutagenic and Carcinogenic Hydrocarbons. Vollhardt, K.P. (California Univ., Berkeley, CA, 94720). **Project number:** 1CA-20713-3. **Contract:** R01-CA-20713-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

A synthetic approach to a dicyclobutadieno benzene is being explored which should furnish a number of examples of this highly interesting series of compounds bearing protons directly bound to the pi-framework. The target compound constitutes a formally highly activated yet aromatic pi-electron system. Similar approaches will be instituted en route to a dihydro analog, a cyclobutadieno cyclooctatetraene. We are currently instituting a collaborative project on the 1,5,9-cyclododecatriyne-hexaradialene potential energy surface. The photoelectron spectrum will be interpreted by quantum mechanical calculations and we will attempt to generate the radical anion. In addition, a high pressure reaction is being tested as a potential way of effecting ring-closure to tricyclobutabenzene. An intramolecular trapping experiment will be conducted to prove the existence of a complexed tricyclooctatetraene in the gas phase. Using our preliminary data and our newly developed synthetic methodology we are planning synthetic schemes en route to other activated polycyclic hydrocarbons of known carcinogenic potential, e.g., cyclobutabenzanthracene, and cyclobutabenzpyrene. The Ames test will be applied in preliminary mutagenicity screenings.
Keywords: mutagenesis; carcinogenesis; benzene; polycyclic aromatic hydrocarbons; mutagen screening; toxicity; chemical activation.

35071 Characterization of Carcinogen--Nucleic Acid Complexes. Geacintov, N.E. (New York Univ., 421 1st Ave., New York, NY, 10012). **Project number:** 1CA-20851-3. **Contract:** R01-CA-20851-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The central objective of the proposed study is to identify and characterize the reaction products of the polycyclic aromatic carcinogens with DNA, both in vivo and in vitro. During the project period, it is proposed to characterize the DNA-carcinogen adducts produced in vivo. The in vivo reactions are thought to proceed by way of reactive metabolic intermediates of the carcinogens. It is proposed to identify the major intermediates by comparison of the products of in vivo reactions with the in vitro reaction products of DNA, with suspected likely intermediates synthesized separately. It will then be possible to synthesize, in vitro, large quantities of DNA adducts which are similar to the adducts produced in vivo. The excited singlet and triplet states of the polycyclic aromatic moieties in the DNA-carcinogen adducts will be used as probes of the structure of these complexes. To obtain guidelines for the application

of these techniques to the covalent adducts, analogous experiments will also be performed with physical intercalation-type complexes of DNA with polycyclic carcinogens and with acridine-type dyes, the structures of which are comparatively better understood.
Keywords: carcinogens; dna; complexes; chemical bonds; spectroscopy; chromatography; polycyclic aromatic hydrocarbons; adducts; in vivo; tissue cultures; skin; molecular structure.

35072 Molecular Events in Chemical Carcinogenesis. Weinstein, I.B. (Columbia University, 630 W. 168th Street, New York, NY, 10032). **Project number:** 1CA-21111-3. **Contract:** P01-CA-21111-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objective of this program project grant is to elucidate at the molecular level the structural and functional changes in nucleic acids that occur as a result of their modification by chemical carcinogens. Nucleic acid-carcinogen complexes will be isolated from in vivo sources as well as from in vitro reactions between specific nucleic acids and activated derivatives of these carcinogens. After identification of the reactive form of specific chemical carcinogens, we shall identify the chemical structures and stereochemistry of the covalent adducts formed with nucleoside residues in RNA and DNA. We will then determine the conformational changes which occur in the nucleic acids as a result of chemical modification by these carcinogens. Finally, we will ascertain the way in which the chemical structure of the carcinogen adduct, and the associated conformational changes in the modified nucleic acid impair the function of these nucleic acids in terms of translation, transcription, replication and organization of the chromatin structure. An understanding of these early events in the process of chemical carcinogenesis could lead to the development of methods for altering host metabolic and defense mechanisms so as to prevent cancer induction. In more practical terms, an understanding of the mechanism of chemical carcinogenesis could lead to the development of more rapid and reliable methods for identifying environmental carcinogens.
Keywords: carcinogenesis; biochemistry; molecules; dna; rna; benzopyrene; pesticides; organic chlorine compounds; condensed aromatics; sterols; in vivo; metabolism; immunology; neoplasms.

35073 Biological Effects of DNA-Protein Crosslinks. Larcom, L.L. (Clemson University, Clemson, SC, 29631). **Project number:** 1CA-21479-3. **Contract:** R01-CA-21479-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

DNA isolated from bacteriophage SPO2 c12 is irradiated in vitro and used to transfect competent Bacillus subtilis cells. The slope of the survival curve is used to measure the sensitivity of DNA irradiated in a particular solvent or solution. Irradiation is being done in buffers of different ionic strengths to determine how alterations in the secondary and tertiary structures of DNA affect its sensitivity. Various amino acids and proteins are being tested for their effects on the uv sensitivity of DNA and the ability of irradiated DNA to be photoreactivated. Similar studies will be done with carcinogens to determine how these affect: (1) the uv sensitivity of DNA, and (2) the ability of host cells to repair uv-induced lesions. Radioactively labelled compounds are being used to determine whether the observed changes in sensitivity result from cross-link formation.
Keywords: dna; irradiation; in vitro; bacillus subtilis; radiosensitivity; molecular structure; ultraviolet radiation; tracer techniques; cross-linking; biological effects.

35074 Interactions of Drugs, Radiation and Hormones. Weichselbaum, R.R. (Harvard University, 25 Shattuck Street, Boston, MA, 02115). **Project number:** 1CA-21848-2. **Contract:** R01-CA-21848-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Estrogen and other hormones are known to interact with both normal and malignant cells through specific receptor mechanisms and to affect changes in cell growth, division, and metabolism. The specific changes in cell cycle parameters as well as the interaction of these hormones with radiation and cytotoxic drugs is unknown. In this proposal we outline methods of examining the effects of estrogen and other hormones on viability as a function of cell cycle position as well as the interaction of hormones and radiation and hormones and cytoxic drugs on an in vitro human breast carcinoma line. To determine the in vitro kinetic parameters, we will employ examination of growth curves and percent labeled mitosis curves. Clonogenic survival curves and exponentially growing and plateau phase cultures will be employed to ascertain the effect of hormone--x ray and hormone--drug--x ray interactions in this cell line.
Keywords: x radiation; irradiation; cell cultures; tumor cells; biological radiation effects; radioinduction; hormones; antimitotic drugs; mitotic delay; cell cycle; radiosensitivity effects; biological effects.

35075 Metabolic Activation of the Polycyclic Hydrocarbons. Sims, P. (London University, Gower Street, WCIE 7HU, England, United Kingdom). **Project number:** 1CA-21959-3. **Contract:** R01-CA-21959-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the research is the identification of the non-K-region diols that are formed in vivo from carcinogenic polycyclic hydrocarbons and that are further metabolized to vicinal diol-epoxides that react with cellular nucleic acids. The situation with regard to benzo(a)pyrene is now clear and there is considerable evidence pinpointing the 7,8-dihydrodiol and the related 7(beta),8(alpha)-dihydroxy-9(alpha),10(alpha)-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene as the important metabolites. With other hydrocarbons that give rise to metabolites that react with DNA, the particular diols and diol-epoxides involved have not been identified. Preliminary studies have been carried out with benz(a)anthracene and these need to be continued and extended to include other polycyclic hydrocarbons like 7-methylbenz(a)anthracene, 7,12-dimethyl-benz(a)anthracene, 3-methylcholanthrene, and dibenz(a,h)anthracence. The long term aim of the work is, of course, an understanding of the way in which the modification of nucleic acids by polycyclic hydrocarbon metabolites causes biological effects that include mutagenesis and carcinogenesis.
Keywords: polycyclic aromatic hydrocarbons; metabolites; glycols; epoxides; chemical reactions; dna; mutagenesis; carcinogenesis; biological pathways.

35076 Biological and Chemical Studies of New DMBA Compounds. Morreal, C.E. (Roswell Park Memorial Inst., 666 Elm St., Buffalo, NY, 14263). **Project number:** 1CA-22001-3. **Contract:** R01-CA-22001-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed work involves the synthesis and biological testing of several 7,12-dimethylbenz(a)anthracene dihydrodiols and their epoxy derivatives. These potential metabolites of DMBA will be prepared from the intermediate quinones in the 1,2; the 3,4; the 7,8; and the 9,10 positions of the DMBA molecule. The biological testing will be accomplished by local dusting of rat mammary gland and the degree of subsequent mammary carcinoma will be assessed.
Keywords: dimethylbenzanthracene; metabolism; rats; toxicity; neoplasms; mammary glands; quinones.

35077 Ultraviolet Light Radiation and Immunoregulation. Daynes, R.A. (University of Utah, 1400 E. 2nd St., Salt Lake City, UT, 84112). **Project number:** 1CA-22126-3. **Contract:** R01-CA-22126-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

During the third year of our project we hope to extend our knowledge of syngeneic host-tumor interactions. The uv-tumor model has provided us with an easy way to manipulate a syngeneic system so that either an effector or suppressor mechanism will dominate following tumor challenge. This provides a potential means of investigating numerous questions about immunoregulatory influences and effector cell responses. We propose to study the nature of the effector T-cell-suppressor T-cell interaction and to acquire knowledge of the lymphocyte and macrophage subpopulations necessary to generate the antitumor immune state. Tumors will be evaluated with respect to the various types of membrane-bound antigens they possess (both TSTA and TAA). The immunologic responses (effector and regulatory) will be studied as they relate to these tumor antigens.
Keywords: ultraviolet radiation; irradiation; mice; biological radiation effects; immune reactions; tumor cells; antigens; lymphocytes; macrophages.

35078 Adrenal Carcinogen Metabolism. Colby, H.D. (Virginia Univ., Box 246, Charlottesville, VA, 22901). **Project number:** 1CA-22152-3. **Contract:** R01-CA-22152-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Previous investigations have established that carcinogenic polycyclic aromatic hydrocarbons such as benzo(a)pyrene (BP) are rapidly metabolized by human fetal and guinea pig adrenal glands. Since in some tissues BP is converted to highly reactive metabolites by cytochrome P-450-dependent enzymes, studies will be carried out to characterize the products of adrenal BP metabolism and to examine the factors affecting adrenal BP metabolism. Using the guinea pig as the experimental animal, adrenal conversion of BP to activated metabolites that covalently bind to cellular macromole-

cules (DNA, RNA, protein) will be evaluated and compared with hepatic activation. Effects of epoxide hydrase and/or BP hydroxylase inhibitors on the formation of macromolecule-binding metabolites will be assessed simultaneously. The identity of BP metabolites produced by adrenal tissue will be determined using high pressure liquid chromatography (HPLC) and compared with that of metabolites produced by hepatic microsomes. In related studies, the effects of various physiological factors (age, sex, ACTH, androgens) known to influence adrenal mixed function oxidases, and of pharmacological agents (3-methylcholanthrene, polychlorinated biphenyls, BP, phenobarbital) on adrenal BP metabolism will be investigated. In addition, using human adrenals obtained from breast carcinoma patients, we will determine if adult adrenal tissue, like that in human fetus, metabolizes BP. If so, we will also determine if DNA, RNA or protein-binding metabolites are formed and, using HPLC, attempt to identify BP metabolites produced by human adrenal tissue.
Keywords: adrenal glands; metabolism; benzopyrene; metabolites; metabolic activation; guinea pigs; enzyme inhibitors; mixed-function oxidase systems; man; age dependence; sex dependence; acth; androgens; drugs; biological effects; carcinogenesis.

35079 Repair and Mutagenesis of DNA. Tessman, I. (Purdue Univ., Executive Blvd., Lafayette, IN, 47907). **Project number:** 1CA-22239-3. **Contract:** R01-CA-22239-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to understand DNA repair and mutagenesis at a molecular level. Ultraviolet-reactivation is a repair process that is highly mutagenic for the DNA that is repaird. Bacterial viruses inactivated by ultraviolet radiation are reactivated by infection of bacteria that have received a small dose of radiation; over 10% of the reactivated viruses are mutagenized. It is predicted that a substantial proportion of the mutants induced by uv-reactivation will contain the double mutation CC yields TT. From the genetic code we know that in some instances the mutation CC yields TT will result in the amino acid substitution proline yields phenylalanine in the product of the mutant gene. The mutation of the tryptophan codon to an ochre nonsense codon in one step is another test of the theory. The most direct test proposed is to analyze the nucleotide sequence of the mutant DNA. The mutagenic repair of chemically induced lesions will also be examined.
Keywords: dna; biological repair; mutagenesis; biochemistry; bacteriophages; bacteria; amino acids; ultraviolet radiation; genetic radiation effects; host-cell reactivation; mutations; radioinduction.

35080 Diol Epoxide and Other Derivatives of PAH and AZA-PAH. Lehr, R.E. (Oklahoma Univ., 660 Parrington Oval, Norman, OK, 73069). **Project number:** 1CA-22985-03. **Contract:** R01-CA-22985-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Increasing evidence that diol epoxides are important intermediates in the mutagenesis and carcinogenesis of polycyclic aromatic hydrocarbons has been amassed during the past year. Quantum chemical calculations which we applied to estimate the reactivity of diol epoxides have proven successful in correctly predicting that bay region epoxides should be the most reactive for a given PAH, and have correctly predicted the relative reactivity of diol epoxides derived from different PAH. PAH ring-substituted with nitrogen (aza-PAH) are being increasingly recognized as significant environmental contaminants, but have received meager attention from the standpoint of determining the structure-activity relationships. The dihydrodiol and diol epoxide derivatives of benz(c)acridine will be synthesized in the author's laboratory and will be tested for biological activity through the collaboration of D.M. Jerina, Laboratory of Bio-organic Chemistry, NIAMDD and A.H. Conney at Hoffmann-LaRoche. The biological testing will entail studies of the ability of the dihydrodiols to be metabolically activated by a cytochrome P-450 enzyme system to species mutagenic to mutant Salmonella strains as well as examination of the intrinsic mutagenicity of the diol epoxide and other derivatives of benz(c)acridine. A new stereospecific synthesis has been designed to make available benzo ring diol epoxides that are very difficult to prepare by current methods, and which will later be studied.
Keywords: polycyclic aromatic hydrocarbons; mutagenesis; carcinogenesis; mutagen screening; salmonella; organic nitrogen compounds; epoxides; glycols; toxicity.

35081 DNA Repair: Human E. coli Photoreactive Enzymes. Sutherland, B.M. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 1CA-23096-3. **Contract:** R01-CA-23096-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We are purifying and characterizing photoreactivating enzymes from procaryotes (E. coli) and eucarotes (human placenta, Thermobia domestica, orchid, Drosophila). We are studying the substrate range, specificity, wavelength dependence and mechanism of action of these enzymes. We are also investigating the function of the photoreactivating enzyme in repair of pyrimidine dimers in cellular DNA of cultured cells, human leukocytes, and human skin. We have developed a system for uv induction of transformation to anchorage-independent growth in human cells. We are investigating the properties of the transformants and the role of DNA repair processes in preventing or enhancing the transformation process.
Keywords: dna; biological repair; escherichia coli; photoreactivation; molecular structure; radiation injuries; enzymes; biochemical reaction kinetics; animal cells.

35082 Carcinogen Testing: A Mouse Lymphoma Mutation System. Coffino, P. (California Univ., 551 Parnassus Avenue, San Francisco, CA, 94122). **Project number:** 1CA-23218-2. **Contract:** R01-CA-23218-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies with both prokaryotic and eukaryotic cells suggest that the mutagenic activities of an organic compound can be used to test for and predict its carcinogenicity. It is proposed that S49 mouse lymphoma tissue culture cells be used as the target for mutation induction in a carcinogen screening system. Multiple genetic markers have been studied in these cells. Mutants resistant to dibutyryl cyclic AMP, dexamethasone, 6-thioguanine, or ouabain are well-suited for quantitative analysis of induction. Beginning with aflatoxin B1 and benzo(a)pyrene, S49 cells will be incubated with carcinogens and, after a suitable expression time, cloned in agar with each of the selective media to determine the frequency of induced mutation for each marker. Because many compounds become active only after metabolic conversion, liver microsomal fractions will be added to the incubation mixture as a source of mixed function oxidases. By extending this analysis to a large number of compounds, the sensitivity and efficacy of each marker for carcinogen testing will be determined. The use of multiple markers may make it possible to infer plausible mechanisms of carcinogen action.
Keywords: aflatoxin; benzopyrene; carcinogens; screening; tissue cultures; tumor cells; lymphomas; mice; mutation frequency; mutagenesis.

35083 Radiation-Induced Mutagenesis and Carcinogenesis. Evans, H.H. (Case Western Reserve University, 2109 Adelbert Road, Cleveland, OH, 44106). **Project number:** 1CA-23427-2. **Contract:** R01-CA-23427-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The characteristics of radiation-induced mutagenesis and carcinogenesis will be investigated in the mouse embryo cell line, C2H 10T1/2. In order to determine the role of error prone repair in mutagenesis and carcinogenesis, we hope to isolate and study repair-deficient strains of this cell. Wild-type cells will be mutagenized with ethyl methanesulfonate, and repair deficient variants will be isolated after selection by a host-cell reactivation viral suicide technique. Repair-deficient strains will then be compared to the wild-type parental cells with regard to the frequency of mutation and transformation induced by uv and ionizing radiation delivered under varying conditions. Specific defects in DNA repair will then be characterized in each variant strain showing an altered frequency of induced mutagenesis and/or carcinogenesis, so that the role of various repair pathways in these processes can be delineated.
Keywords: ionizing radiations; ultraviolet radiation; irradiation; cell cultures; embryonic cells; mice; mutants; biological radiation effects; genetic radiation effects; mutations; radioinduction; oncogenic transformations; biological repair; biological pathways; errors; carcinogenesis; mutagenesis.

35084 DNA Repair After Polycyclic Hydrocarbon Administration. Bresnick, E. (Vermont University, College of Agriculture, 85 S. Prospect Street, Burlington, VT, 05401). **Project number:** 1CA-23514-2. **Contract:** R01-CA-23514-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

We plan to utilize the hamster model in which benzo(a)pyrene -Fe2O3 is instilled intratracheally to study DNA repair in the trachea. In this regard, we will determine the stability of benzo(a)pyrene (BP)-DNA adducts in trachea, the aralkylation pattern of LH-20 Sephadex of the deoxyribonucleoside-polycyclic hydrocarbon complexes and the DNA damage as assessed by an alkaline elution technique. As a final aspect of this study, we will determine the effects of vitamin A deficiency upon the above parameters. It is known that this deficiency greatly increases the polycyclic hydrocarbon-induced incidence of squamous cell carcinomas in these hamsters. It is hoped that these studies will shed some light upon the interrelationships between carcinogenesis, vitamin A deficiency and DNA repair.

Keywords: dna; biological repair; polycyclic aromatic hydrocarbons; toxicity; hamsters; benzopyrene; vitamin a; nutritional deficiency; diet; carcinogenesis; biological models.

35085 Pulmonary Metabolism of the N-Heterocyclic Aromatics. Warshawsky, D. (Cincinnati University, School of Medicine, Eden and Bethesda Avenue, Cincinnati, OH, 45221). **Project number:** 1CA-23515-2. **Contract:** R01-CA-23515-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The important contribution of various polycyclic aromatic hydrocarbons to carcinogenic potency of complex mixtures has been demonstrated. Whether the complex mixture is from petroleum, coal, shale oil, or automobile exhaust, the investigation of metabolic fate of these compounds is an important step in understanding their carcinogenic action. We will investigate the metabolism of an environmental pollutant from a complex mixture, dibenzo(c,g)carbazole, using an isolated perfused lung under various experimental conditions that influence its carcinogenic potency. The clarification and understanding of how certain environmental factors, known to enhance the carcinogenic response by heterocyclic aromatics and cause formation of certain metabolites and changes in the metabolic pathway, will contribute heavily to the study of the mechanism of bronchiogenic carcinoma.
Keywords: lungs; dynamic function studies; metabolism; aromatics; polycyclic aromatic hydrocarbons; carcinogenesis; petroleum; coal; shale oil; automobiles; exhaust gases; health hazards; respiratory tract cells; biological models; perfused organs; neoplasms.

35086 Activation and Reactivity of Nitroheterocyclics. Olive, P.I. (Johns Hopkins University, 725 North Wolfe Street, Baltimore, MD, 21205). **Project number:** 1CA-24519-1. **Contract:** R01-CA-24519-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Humans are exposed to nitroheterocyclic compounds through extensive use in medicine and industry; these chemicals are metabolically activated to toxic, DNA damaging, and in many cases, tumorigenic agents. We will attempt to determine the relationship between drug activation, DNA damage, mutagenicity, and transforming ability of selected nitroheterocyclics. Specifically, we will determine whether the electronegativity (reactivity) of these chemicals, as reported in the literature, is correlated with their ability to damage DNA, as measured by hydroxylapatite chromatography, their mutagenicity in bacterial tester strains, or their ability to transform cultured C3H/10T1/2 mammalian cells. In addition, we intend to determine whether the amount of nitrogen-induced DNA damage or its rate of repair differs in the specific target organ for tumor production, and further, whether this damage is due solely to metabolic activation in the target tissue or to transfer of activated intermediates of nitrofuran metabolism.
Keywords: nitro compounds; heterocyclic compounds; metabolism; mutagenesis; carcinogenesis; bacteria; mutations; cell cultures; animal cells; mammals; oncogenic transformations; dna; biological repair.

35087 Carcinogenesis Studies in Human Tissues. Harris, C.C. (National Cancer Inst., 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** ZXC-861-5. **Contract:** Z01-CP-04567-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(60); oil and gas(20); oil shale(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Model systems for studying carcinogenesis in human target tissues (bronchus, pancreatic duct, breast and colon) are being developed to link investigations using experimental animals with human cancer. Metabolism of chemical carcinogens is being studied in human tissues maintained in these model systems. For example, a marked variation among individuals in their capacity to metabolize carcinogenic polynuclear aromatic hydrocarbons has been observed. This interindividual variation may, in part, be due to genetic factors. Cultured human bronchi convert chemical carcinogens, e.g., benzo(a)pyrene, into metabolites that are mutagens in mammalian cells (V-79 cells). This mutagenesis assay is an important new screening test for chemical carcinogens. Chemical and physical carcinogens cause basal cell hyperplasia and atypical squamous metaplasia in cultured and xenotransplanted human bronchi. Model systems using human tissues should be useful in several areas of cancer research including: (1) identifying environmental carcinogens, their metabolic pathways and host factors determining susceptibility; and (2) testing new methods of prophylactic intervention in populations at high risk of developing cancer.
Keywords: tissues; carcinogenesis; biological models; human populations; chemical effluents; benzopyrene; mutagenesis; risk assessment; response modifying factors.

35088 Control of Benzo(a)pyrene Metabolism in Cells from Animal and Human Sources. Okano, P. (National Cancer Institute, 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** ZXC-1183-2. **Contract:** Z01-CP-04473-03-LMC. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D catcgories:** Biological effects of pollutants in experimental systems.

The benzo(a)pyrene (BP) metabolite pattern formed by monocytes and lymphocytes includes three dihydrodiols, a major 7,8-diol, low or moderate levels of 4,5-diol and barely detectable levels of 9,10-diol, at least three phenols, the 3-OH, 7-OH, and 9-OH and two major separable guinones, the 1,6 and 3,6. BP metabolite patterns formed by benz(a)anthracene (BA)-induced monocytes and lymphocytes from the same individual show that each cell type has characteristic differences in the relative ratios of the BP metabolites formed. Relatively greater proportions of 7,8-diol and 9-OH are synthesized by monocytes, while lymphocytes form relatively higher levels of 3-OH and the BP-quinones. Thus, it appears that monocytes and lymphocytes contain different patterns of cytochrome P-450 mixed function oxidase or metabolically related enzymes which are active in BP metabolism. The ratio of BP metabolites formed by BA-induced to that of control monocytes and lymphocytes is greater for the 7-OH and 9-OH and lesser for the 3-OH and 7,8-diol in most samples examined. The total amount of BP metabolies formed is quantitatively higher in BA-induced cells. This data suggests that induction by BA in these cells is selective and favors the formation of certain forms of cytochrome P-450 which change the metabolite patterns in induced cells.
Keywords: benzopyrene; metabolism; animal cells; man; animals.

35089 Cellular and Molecular Effects of Psoralen Plus Ultraviolet Light. Kraemer, K.H. (National Cancer Institute, 9000 Rockville Pike, Bethesda, MD, 20014). **Project number:** ZXC-1184-2. **Contract:** Z01-CP-04516-03-LMC. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The cellular and molecular effects of the combination of psoralen and long wavelength ultraviolet light (uv-a) are being studied. This combination, which induces DNA-psoralen binding is being used experimentally for treatment of psoriasis and the cutanecus lymphoma mycosis fungoides. Psoralen plus uv-a has been found to be mutagenic in bacteria and carcinogenic in mice. There is a significant decrease in DNA synthesis in circulating leucocytes from patients following this treatment. The present research involved development of an in vitro assay to measure the effects of psoralen plus uv-a on cell proliferation and DNA synthesis using rapidly dividing human lymphoblastoid cells. These studies may be useful in governing the use of psoralen plus uv-a by indicating conditions of toxicity and possible mutagenicity to human cells and in clarifying the mechanism of cell damage by psoralen.
Keywords: ultraviolet radiation; biological effects; psoralen; dna; chemical bonds; lymphomas; bacteria; mice; patients; in vitro; bioassay; man; toxicity; mutagenesis; biological models.

35090 DNA Insult Induced by BUDR and Irradiation (Rats, Hamsters, Human). Tso, P O. (Johns Hopkins Univ., 34th and Charles St., Baltimore, MD, 21218). **Project number:** CC-1176-3. **Contract:** P01-CA-16043-040001. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective of this research is to establish the relationship between the genetic apparatus (DNA sequence organization and gene expression) and mutagenesis/carcinogenesis as the basis of the assessment of the biomedical risks caused by the environmental mutagens/carcinogens. Considerable progress toward this goal has been made in the past three years. The objective is to be achieved: (1) by the additional acquisition/establishment of knowledge/methodology for the characterization of carcinogenesis with special emphasis on promotion and demotion; (2) by defining the relationship between mutagenesis and carcinogenesis, with special emphasis on the development of somatic mutation markers closely related to neoplasia; (3) by development of special perturbation only to DNA (or portion of DNA) leading to carcinogenesis/somatic mutagenesis; (4) by analysis of the genetic nature of neoplasia through somatic genetics techniques; (5) by comparison of the alteration in phenotypes and genetic apparatus of tumor cells from both fibroblasts and epithelial cells; (6) by analysis of the basic mechanism in the neoplastic transformation induced by Herpes simplex virus or HSV-DNA; (7) by comparing basic mechanisms in carcinogenesis initiated by physical, chemical and viral agents; and (8) by defining the alteration of the genetic apparatus (DNA sequence and RNA sequence) in mutagenesis/carinogenesis. The above achievements will lead to the identification and location of the target DNA sequences most sensitive or susceptible in carcinogenesis/mutagenesis, as well as the indication of the malfunctioning of the genetic apparatus through the appearance of RNA bearing previously quiescent DNA sequences. This study will also be extended for the Syrian hamster cells to the human cells. This will provide the basic science about carcinogenesis/mutagenesis needed for the establishment of a

biomedical risk assessment system for the environmental mutagens/carcinogens.
Keywords: dna; mutagenesis; carcinogenesis; risk assessment; neoplasms; health hazards; chemical effluents; biological models.

35091 Biological Interaction and Radiotherapy. Clifton, K.H. (Univ. of Wisconsin, 307 N. Charles St., Madison, WI, 53706). **Project number:** CK-800-3. **Contract:** P01-CA-19278-040016. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objectives are: (1) to initiate and continue clinical studies in radiation therapy with emphasis on tumor localization, treatment planning and quality control, normal tissue tolerance, therapy with combined modalities (including hyperthermia and/or intra-arterial chemotherapy), altered time-dose fractionation schedules, and half-body irradiation; (2) to continue preclinical research in radiation biology expanding the range to include biologic effects of combined modality therapy (especially on normal tissues), the carcinogenic aspects of ionizing radiations, the effects of microwave and water bath hyperthermia (with or without ionizing irradiation) on membranes, cells, and tissues, and mechanisms of in situ repair; (3) to continue research on the dosimetry of high energy electrons and photons and apply these findings clinically and to explore improving high energy electron beam dose distribution with magnetic fields; (4) to further clinical studies and development with ultrasound and CT to improve tumor detection and margin delineation and to develop practical methods for using CT information for treatment planning; (5) to develop suitable tumor-localizing radionuclides for improved detection and definition of tumors and for predicting responses to cytotoxic therapy and to evaluate dynamically physiologic changes which occur in tumors and normal tissues following irradiation or therapy with cytotoxic drugs, particularly adriamycin; (6) to provide an excellent setting for training in radiation therapy, radiation biology and radiation physics at the predoctoral and postdoctoral level; and (7) to promote optimal use of radiation therapy as part of a multidisciplined approach to the treatment of cancer within the U.W. Clinical Science Center and in the region serviced by the Wisconsin Clinical Cancer Center.
Keywords: radiotherapy; tumor cells; biological radiation effects; temperature dependence; chemotherapy; microwave radiation; dosimetry; magnetic fields; radiobiology; optimization; carcinogenesis; cytology; animal cells.

35092 Modification of Radiation Injury. Yatvin, M.B. (Univ. of Wisconsin, 307 N. Charles St., Madison, WI, 53706). **Project number:** CK-801-3. **Contract:** P01-CA-19278-040017. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objectives are: (1) to initiate and continue clinical studies in radiation therapy with emphasis on tumor localization, treatment planning and quality control, normal tissue tolerance, therapy with combined modalities (including hyperthermia and/or intra-arterial chemotherapy), altered time-dose fractionation schedules, and half-body irradiation; (2) to continue preclinical research in radiation biology expanding the range to include biologic effects of combined modality therapy (especially on normal tissues), the carcinogenic aspects of ionizing radiations, the effects of microwave and water bath hyperthermia (with or without ionizing irradiation) on membranes, cells, and tissues, and mechanisms of in situ repair; (3) to continue research on the dosimetry of high energy electrons and photons and apply these findings clinically and to explore improving high energy electron beam dose distribution with magnetic fields; (4) to further clinical studies and development with ultrasound and CT to improve tumor detection and margin delineation and to develop practical methods for using CT information for treatment planning; (5) to develop suitable tumor-localizing radionuclides for improved detection and definition of tumors and for predicting responses to cytotoxic therapy and to evaluate dynamically physiologic changes which occur in tumors and normal tissues following irradiation or therapy with cytotoxic drugs, particularly adriamycin; (6) to provide an excellent setting for training in radiation therapy, radiation biology, and radiation physics at the predoctoral and postdoctoral level; and (7) to promote optimal use of radiation therapy as part of a multidisciplined approach to the treatment of cancer within the U.W. Clinical Sciences Center and in the region serviced by the Wisconsin Clinical Cancer Center.
Keywords: radiation injuries; radiotherapy; optimization; neoplasms; post-irradiation therapy; biological recovery; radiobiology; radioassay; radiation protection.

35093 Follow-up Fluoroscopically Examined Tuberculosis Patient. Monson, R.R. (Harvard Univ., School of Public Health, Boston, MA, 02138). **Project number:** DX-219-1. **Contract:** N01-CP-81058. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objectives are to: (1) recontact former Massachusetts tuberculosis sanatoriums and obtain necessary permission and clearances to conduct the study; (2) select the population to study (both women and men who were discharged alive and who received various treatments for pulmonary tuberculosis); (3) design forms to abstract medical information and location information from medical records; (4) abstract medical and location information on all subjects selected for study; (5) locate the population selected for study; (6) design a patient questionnaire to obtain information on current and past disease status, especially cancer history; (7) mail the questionnaire to all patients located alive; (8) validate all reported cancer diagnosis; (9) computerize the medical record data, questionnaire response data, and death certificate data; and (10) determine radiation organ doses as accurately as possible.
Keywords: lungs; tuberculosis; carcinogenesis; medical surveillance; diagnosis; data acquisition; radiotherapy; epidemiology; reviews; patients.

35094 Isolation and Purification of Human Polycyclic Hydrocarbons. Arnott, M. (Univ. of Texas, P.O. Box 20036, Houston, TX, 77025). **Project number:** DX-266-1. **Contract:** N01-CP-85671. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) Phase I, preliminary studies on the characterization of enzyme types and levels in liver samples from six to ten donors and assessment of shortage and microsomal preparation methods; (2) Phase II, purification and characterization of soluble, non-microsomal enzymes and antibody preparation; (3) and Phase III, purification and characterization of microsomal enzymes and antibody preparation.
Keywords: man; polycyclic aromatic hydrocarbons; purification; separation processes; liver; enzymes; antibodies; biochemical reaction kinetics.

35095 Isolation and Purification of Human Polycyclic Hydrocarbons. Guengerich, P.F. (Vanderbilt Univ., 21st Ave. S. and Garland, Nashville, TN, 37232). **Project number:** DX-267-1. **Contract:** N01-CP-85672. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) purification of human liver microsomal NADPH-cytochrome P-450 reductase to homogeneity; (2) purification of human liver microsomal epoxide hydratase to homogeneity; (3) purification of individual human liver microsomal cytochromes P-450 to homogeneity; (4) preparation of monospecific antibodies to each of the above purified proteins; (5) reconstitution of enzyme activity towards polycyclic hydrocarbons and other substrates; (6) physical characterization of purified human liver proteins for comparison to animal enzymes; and (7) comparison of substrate specificities of purified human liver enzymes with those obtained from animals.
Keywords: human populations; man; polycyclic aromatic hydrocarbons; purification; separation processes; enzymes; proteins; biochemical reaction kinetics; liver.

35096 Mechanism of Aryl Hydrocarbon Hydroxylase Induction (Rat). Avdalovic, N. (Wistar Inst. of Anatomy and Biology, 36th and Spruce St., Philadelphia, PA, 19104). **Project number:** 02-31-1. **Contract:** P01-CA-21778-020002. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The project is designed to utilize the expertise and facilities at the Wistar Institute to study exogenous and endogenous components of environmental carcinogenesis and to serve as the nucleus of an Environmental Carcinogenesis Center at the Institute. In vitro and in vivo model systems will be used to investigate the mechanisms by which environmental chemicals interact with the host cell and with each other and the mechanisms by which the host can respond to these chemicals. This multidisciplinary approach to a multifaceted problem will increase our understanding of how environmental chemicals cause cancer.
Keywords: hydrocarbons; hydroxylase; biochemical reaction kinetics; human populations; carcinogenesis; chemical effluents; metabolism.

35097 Phenotyping Mice and Human Beings for Responsiveness to Aromatic Hydrocarbons. Polland, A. (Univ. of Wisconsin, 307 N. Charles St., Madison, WI, 53706). **Project number:** DZ-48-1. **Contract:** P01-CA-22484-020005. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 22484-02) whose summary states: This program-project encompasses a broad fundamental approach to the chemistry, biochemistry, and biology of tumor initiation, promotion, and progression by chemicals. The

program includes major studies on the activation of chemical carcinogens, the interactions of ultimate carcinogens with cellular macromolecules, biochemical events associated with the promotion of initiated cells leading to the development of gross tumors, factors that affect the differentiation of cells and the progression and regression of neoplastic or preneoplastic cells, and the biological and biochemical diversity of preneoplastic and neoplastic lesions. The program includes investigations at the subcellular level, in cell culture, and in the whole animal.
Keywords: human populations; radiobiology; aromatics; hydrocarbons; tumor cells; cell differentiation; animal cells; metabolism; biochemistry.

35098 Measurement of Normal Tissue Change in Therapeutically Irradiated Brain (Human). Kramer, S. (Thomas Jefferson Univ., 1025 Walnut Street, Philadelphia, PA, 19107). **Project number:** ED-1190-1. **Contract:** P01-CA-11602-100032. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.
Keywords: radiotherapy; brain; man; pathological changes.

35099 Analyze Research on Effects of Ionizing Radiation. Weiss, D.L. (National Academy of Sciences, 2101 Constitution Ave. NW, Washington, DC, 20037). **Project number:** ES-168. **Contract:** N01-CO-95466. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

The objective is to conduct an analysis of the federal government's activities in ionizing radiation research, with emphasis on the human health and related biological aspects of that research, with respect to effects of ionizing radiation.
Keywords: ionizing radiations; health hazards; human populations; biological radiation effects; electromagnetic radiation.

35100 Biochemical Studies on DMBA Induced Mammary Cancers. Dao, T.L. (Roswell Park Memorial Inst., 666 Elm St., Buffalo, NY, 14263). **Project number:** Cc-1074-3. **Contract:** P01-CA-14812-060007. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is part of a broader program (CA 14812-06) whose summary states: The objectives of this program/project can be summarized as follows: (1) to undertake a multidisciplinary study to elucidate the mechanisms of carcinogenesis of the mammary gland in the rat; (2) to study the biochemical mechanical mechanism of the action of three major hormones, prolactin, estrogen and progesterone, on the mammary gland during normal physiological processes and during the process of carcinogenesis; (3) to elucidate the morphogenetic and host factors which contribute to the development of breast cancer; (4) to carry out biochemical studies to elucidate the nature of hormone dependency of breast cancer in humans; (5) to study serum and tissue sialyltransferase in patients with breast cancer; (6) to study the hormonal control of lactose synthetase in mammary gland and mammary tumors; and (7) to study estrogen metabolism in women with breast cancer and investigate the possible sources and disposition of extragonadal estrogens.
Keywords: mammary glands; carcinogenesis; neoplasms; dimethylbenzanthracene; biological effects; toxicity; biochemical reaction kinetics.

35101 Cell Kinetics of Irradiated Tumors. Goldfeder, A. (New York Univ., 421 1st Ave., New York, NY, 10012). **Project number:** 1-CA-12076-8. **Contract:** R01-CA-12076-0751. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim of this renewal project is to apply detailed information on morphologically defined G1 phase cells and their cycling counterparts, acquired during studies reported in this application. Planned studies will be conducted in vivo on transplantable lines of murine mammary carcinomas and sarcomas, and on lines of human mammary carcinomas propagated in athymic-nude mice. Studies will be concerned with several problems: (1) the capacity of G1 phase-confined cells to recover from sublethal or potentially lethal radiation damage; (2) comparison of both types of repair in vivo; (3) exploration of a possibility that repair of radiation damage in some instances might be an artifact caused by dispersion procedures of tested tumor cells; (4) relationship between hypoxic cells and G1 phase-confined or proliferating cells; (5) kinetics and clonogenic potential of the fast and slow components of G1 phase-confined cells in untreated as well as in irradiated tumors; (6) automatization of nuclear screening in tumor cells; and (7) application of diffusion chamber-semisolid medium technique to human carcinomas. Since these experiments will be performed on mouse tumor systems as well as on human carcinomas, the clinical implication is inherent. The overall goals of the proposed research are: (a) to extend the current knowledge of G1 phase-confined cells in experimental as well as in human tumors under in vivo conditions, (b) to develop an in vivo experimental testing and screening system applicable to human cancers, and (c) to apply this system to further exploration of combination therapy.
Keywords: tumor cells; biochemical reaction kinetics; mammary glands; mice; neoplasms; man; carcinogenesis; biological repair; radiation injuries; biological radiation effects; radiotherapy; animal cells.

35102 In Vitro Chemical Carcinogenesis. Heidelberger, C.D. (Univ. of Southern Califorina, Los Angeles, CA, 90033). **Project number:** 1CA-21036-4. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to continue our integrated study of oncogenic transformation, DNA damage, synthesis and repair, mutation, and cytotoxicity in C3H/10T1/2 cells treated with four alkylating agents and four polycyclic aromatic hydrocarbons of different oncogenic potency. We have already generated dose response data for the above parameters in cells treated with alkylating agents and with that data it has proved possible to assign biological effects to molecular lesions. We have yet to quantitate oncogenic transformation with alkylating agents and to measure alkylation products in DNA. Completion of these projects will provide: (1) information on the role of DNA damage in oncogenesis; and (2) a cell line (C3H/10T1/2 cells), which, when coupled with metabolic activation, can be used for early identification of most classes of mutagens and carcinogens.
Keywords: tumor cells; dna; biosynthesis; biological repair; mutations; toxicity; alkylating agents; polycyclic aromatic hydrocarbons; carcinogens; mutagens; mutagen screening; biological effects.

35103 Transformation In Vitro with Split Doses of Radiation. Miller, R.C. (Columbia Univ., 630 W. 168th St., New York, NY, 10032). **Project number:** 1-CA-23952-2. **Contract:** R23-CA-23952-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In a practical situation, when radiation is received by radiation workers or members of the general public, the dose is delivered in a series of small dose-fractions or continuously at low dose-rate. By contrast, most carcinogenesis studies with experimental animals have involved single large doses of radiation. It is planned to use the recently developed powerful methods of in vitro oncongenic transformation to investigate the effect of dose fractionation and variations in dose-rate, both for x-rays and for cyclotron produced neutrons. The C3H/10T 1/2 cell line has been shown to be readily transformable with chemical carcinogens or ionizing radiations. The rate of transformations will be determined for single and split doses over a wide range of dose levels, both for x-rays and for neutrons. Preliminary experiments with x-rays indicate that at low dose levels, below 100 rad, splitting the dose into two fractions separated by a time interval of 5 hours increases the incidence of transformed clones compared with the same total dose delivered in a single exposure. By contrast, at high doses, dose fractionation results in a decrease in the transformation rate. These findings, which have important implications for radiation protection and for the interpretation of risk estimates, will be confirmed and extended. In addition, the effect of continuous low dose-rate exposures will be investigated.
Keywords: nuclear energy; carcinogenesis; dose rates; x radiation; radiation protection; fractionation; in vitro; biological models; radiotherapy.

35104 Radiobiology of Normal Tissues. Withers, H.R. (Univ. of Texas, P.O. Box 20036, Houston, TX, 77025). **Project number:** 1-CA-11138-11. **Contract:** R01-CA-11138-11. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to pursue two broad objectives: an investigation of the pathobiology and dose-response relationships of the late effects of irradiation, and the quantitation of the responses of tissues to doses in a range used daily in clinical radiotherapy. Late effects will be studied in the lung, kidney, and testis, and low dose response relationships in the jejunum, kidney, and testis.
Keywords: radiobiology; tissues; delayed radiation effects; lungs; kidneys; testes; low dose irradiation; dose-response relationships; x radiation.

35105 Localization of Repaired Sites in Chromatin Following Ultraviolet Damage. Bustin, M. (National Cancer Inst., 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** ZXC-1320-1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The mechanism of repair of uv-induced DNA damage is studied. Human lympho-blastcid cell lines, including normal and xeroderma pigmentosum, which differ in their ability to repair uv-induced DNA damage, are exposed to different doses of 254 nm uv radiation. The cells are allowed to repair the damage in the presence of radioactive nucleotides. Chromatin from these cells is isolated and the location of the repair site identified with the aid of specific nucleases. DNA synthesis in the presence of hydroxyurea results in incorporation of counts which are particularly sensitive to DNAase digestion. The major aim of the project is to identify repair sites and to explore the possibility that differences among various cells in uv sensitivity reflect some differences in the repair sites.
Keywords: ultraviolet radiation; biological effects; chromatin; biological repair; man; animal cells; sensitivity.

35106 Separation Identification and Quantitation of Cytochromes P-450 in Mammalian Tissues. Robie Suh, K.M. (National Cancer Inst., 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** ZXC-1319-1. **Contract:** Z01-CP-04499-02-LMC. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Several forms of cytochrome P-450 are known to exist in mammalian liver. The type and amount of these cytochromes P-450 present are affected by exposure of the animal to some drugs, polycyclic hydrocarbons, and other substances in the environment. Cytochrome P-450 is a major component of a mixed-function oxidase enzyme system which catalyzes the metabolism of many compounds including polycyclic hydrocarbons known to produce cancer in humans. The ability of the individual to activate or de-activate chemical carcinogens and thus his susceptibility to cancer induction by a given agent may depend on the absolute amounts or relative proportions of particular cytochrome P-450 species present. Hence, it would be useful to be able to recognize and quantitate the cytochrome P-450 forms. In this study methods for the identification of these proteins are being developed using rat and rabbit liver microsomes. These methods include (1) iso-electric focusing followed by enzymatic determination of mixed-function oxidase activity, (2) SDS-polyacrylamide gel electrophoresis, (3) spectrophotometric examination, and (4) immunological techniques. Once established, the methods will be used to analyze cytochromes P-450 of human monocytes and lymphocytes.
Keywords: mammals; animal cells; tissues; cytology; toxicity; metabolism; polycyclic aromatic hydrocarbons; carcinogenesis; bioassay.

35107 Role of DNA Repair Damage and Its Repair Mechanisms in In Vitro Chemical Transformation. Lo, K. (National Cancer Inst., 9000 Rockville Pike, Bethesda, MD, 20205). **Project number:** ZXC-1323-2. **Contract:** Z01-CP-05001-02-LMC. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this project is to study the biochemical mechanism of in vitro transformation by chemical carcinogens in variants subcloned from BALB 3T3. Present interests are focused on the repair functions of these cells. Kinetic studies of benzo(a)pyrene (BP) binding to DNA and its intracellular pool size have been investigated, since they can provide information to select experimental conditions in which the cellular repair capacity is accurately represented by the observed rate of excision of damaged DNA. The excision repair of BP bound in DNA in cell cultures was measured in both dividing and non-dividing states. The results indicated that the carcinogen adducts remained in DNA under all conditions studied. This carcinogen nucleoside adduct was identified as (7R)-benzopyrene diol epoxide I-9, 10-trans deoxyguanosine.
Keywords: dna; biological repair; biological recovery; chemical radiation effects; benzopyrene; biological effects; in vitro.

35108 Biological and Physical Action of Radiation on DNA. Achey, P.M. (Univ. of Florida, School of Agriculture, Gainsville, FL, 32601). **Project number:** 1-CA-12447-7. **Contract:** R01-CA-12447-07A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The object of this proposal is to study the molecular action of ionizing radiation and ultraviolet radiation on DNA. Radiation effects on both the single-strand mature form of bacteriophage phi X174 DNA and its circular convently closed double-strand replicative intermediate (called RFI) will be studied. Purified DNA in dilute aqueous solution will be exposed to ionizing radiation (ior) and ultraviolet (uv) radiation. Physical damage will be measured by the appearance of strand breaks. Biological damage will be measured as the loss of ability of the DNA to form phage when DNA is incubated with calcium-treated cells. The radiosensitivities of the single-strand and the double-strand forms of the DNA will be compared. Also, the ability of cellular repair systems, in particular the inducible repair pathway, to enhance survival for ior and uv irradiated single-strand and double-strand DNA will be studied. Bacterial cells are known to be sensitized to radiation killing by incubation with the antibiotic rifampicin prior to irradiation. In vitro studies have shown that rifampicin inhibits RNA synthesis by inhibiting the initiation of RNA synsthesis. RNA polymerase binds to DNA in the presence of rifampicin, but it is not able to begin the synthesis of the RNA polymer. The possible influence of RNA polymerase association with the phi X174 molecule on its radiosensitivity will be stuided. These in vitro experiments should help to determine whether RNA polymerase association with cellular DNA at the time of irradiation influences the radiosensitivity of cells. The changes in radiosensitivity of bacterial cells as a function of their physiological state (for example, log phase vs stationary phase) and in mammalian cells as a function of their cell cycle stage could in part be related to variations in RNA polymerase association with the DNA.
Keywords: dna; biological radiation effects; ultraviolet radiation; biological effects; radiosensitivity; ionizing radiations.

35109 Cellular Repair of Potentially Mutagenic Damage. Ward, J.F. (Univ. of California, 900 Veteran Ave., Los Angeles, CA, 90024). **Project number:** 1CA-13437-6. **Contract:** R01-CA-13436-06A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fusion(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this research are: (1) to develop highly sensitive serologic assays for DNA base damage, (2) to apply the assays to the study of cellular damage and its repair, and (3) to study the relation of base damage to carcinogenesis and mutagenesis. The serologic approach is important since current physical-chemical methods for the study of base damage at low dose and within the DNA macromolecule are inadequate. Serologic assays are highly sensitive and specific and permit quantitation of particular ionizing radiation damaged bases. Assay systems are being developed for quantitation of products in isolated DNA and for localization within cell preparations. Antibodies have been prepared to the ionizing radiation products, 5-hydroxymethyluridine and 8,5'-cycloadenosine, and by phage neutralization; assay yields have been measured in irradiated solutions of parent compounds under several conditions. Both products have been detected in irradiated DNA. We have developed a radioimmunoassay for uv photoproducts and production and repair of damage in HeLa cells has been followed. Antibodies have been prepared to 06-ethylguanosine and a highly sensitive method for the detection of this product in ethylnitrosourea treated DNA has been developed. Repair studies will be extended to include ionizing radiation and chemical carcinogen damaged bases. Damage accumulation and repair will be correlated with survival and mutagenesis in cell systems.
Keywords: mutagenesis; biological repair; biological models; dna; biological radiation effects; radiation injuries.

35110 Effect of Chloroquine on Radiation Repair in Tumor Cells (Human, Mice). Laughlin, J.S. (Sloan-Kettering Inst. for Cancer Research, 410 E. 68th St., New York, NY, 10021). **Project number:** CC-330-3. **Contract:** P30-CA-08748-145515. **Supported by:** Sloan-Kettering Inst. for Cancer Research, New York (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This grant is to provide core support for the research program of the Sloan-Kettering Institute through provision of salaries and benefits for essential scientific and administrative personnel; facilities, such as animal maintenance and secretarial services required by many laboratories; consultant services; renovations; and initial funding for new developmental programs.
Keywords: radiation injuries; biological repair; man; mice; tumor cells; research programs; financing; organic chlorine compounds; radiosensitivity effects.

35111 Clearance of Tracers in Radiation Damaged Lungs (Dogs). Laughlin, J.S. (Sloan-Kettering Inst. for Cancer Research, 410 E. 68th St., New York, NY, 10021). **Project number:** CC-335-3. **Contract:** P30-CA-08748-145529. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This grant is to provide core support for the research program of the Sloan-Kettering Institute through provision of salaries and benefits for essential scientific and administrative personnel; facilities, such as animal maintenance and secretarial serivces required by many laboratories; consultant services; renovations; and initial funding for new developmental programs.
Keywords: lung clearance; radioisotopes; radionuclide kinetics; tracer techniques; dogs.

35112 Comparative Metabolism Study of PAH Analogues. Wong, L.K. (Ohio State Univ., 370 W. 9th Ave., Columbus, OH, 43212). **Project number:** 1-CA-24075-2. **Contract:** R23-CA-24075-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The main objectives of this project are to: (1) distinguish the metabolic pathways which are responsible for activation and detoxification of the widely occurring carcinogenic polycyclic aromatic hydrocarbons (PAH); and (2) test the validity of the bay region concept of aromatic hydrocarbon carcinogenicity. To achieve these goals we will: (1) perform detailed in vivo and in vitro comparative metabolism studies of PAH carcinogens and their non-carcinogenic analogues; (2) determine the structures, quantities, deposition and elimination of the metabolites; and (3) examine the chemical reactivities of the potentially active metabolite(s) derived from the PAH carcinogen and contrast with those obtained from its non-carcinogenic analogues. Through these studies, we will determine which specific metabolic pathway dictates PAH tumor induction, and how structural parameters influence the metabolism of these compounds and the carcinogenic activities of the resulting metabolites. The information obtained from the proposed project will be useful in establishing structural correlates of carcinogenesis, and hence provide a chemical approach to the risk assessment of other potentially carcinogenic agents.

Keywords: polycyclic aromatic hydrocarbons; metabolism; biological pathways; carcinogenesis; biological models; comparative evaluations; biochemical reaction kinetics.

35113 Conjugations and Carcinogen Metabolism. Gessner, T. (Roswell Park Memorial Inst., 666 Elm St., Buffalo, NY, 14263). **Project number:** 1-CA-24127-2. **Contract:** RO1-CA-24127-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Polycyclic aromatic hydrocarbons undergo activation by the AHH mediated biotransformation, and deactivation by conjugating pathways (glucuronidation, sulfation and glutathione conjugation). Since the net carcinogenic effect of a hydrocarbon carcinogen will be affected by the levels of both activating and deactivating processes, it is important to test what role the deactivating pathways play in protection from carcinogenicity by polycyclic hydrocarbons. It is proposed to elucidate the role of glucuronidation in this process, and to obtain basic information regarding the occurrence, properties and substrate specificity of various forms of glucuronyltransferases in various tissues, and the factors controlling these activities - environmental (such as inducibility with polycyclic hydrocarbons) and genetic (such as variations in responsiveness to inducing agents). Another major objective is to determine whether suitable model drug substrates can be found, for the various forms of glucuronyltransferases involved in carcinogen metabolism, which would mimic the behavior of the corresponding carcinogenic polycyclic hydrocarbons and thus could be used as probes for the potential metabolism of the carcinogen by those enzymes.

Keywords: metabolism; carcinogens; polycyclic aromatic hydrocarbons; biological pathways; drugs; environmental transport.

35114 Ultraviolet Carcinogenesis and Immunity. Fortner, G.W. (Kansas State Univ., Anderson Hall., Manhattan, KS, 66502). **Project number:** 1-CA-24196-1. **Contract:** R01-CA-24196-O1A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Epidemiological studies have indicated that some human skin tumors may be a consequence of exposure to the ultraviolet wavelengths of sunlight. Likewise, chronic ultraviolet irradiation induces highly antigenic spindle cell skin tumors on the back of inbred mice. This tumor system offers a unique model to study the lymphocyte mediated suppressive effects of ultraviolet light (uvl) as well as antitumor immunity in these hosts. The majority of tumors induced by uvl are immunogenic and, thus, rapidly rejected when transplanted into syngeneic hosts; however, uvl-induced tumors grow progressively in autochthonous and syngeneic uvl-irradiated hosts. Suppressor T cell activity and not panimmunosuppression has been established as the mechanism for this tumor progression. Through the use of established in vivo and in vitro methodology, it will be undertaken to determine the basic immune response to uv light-induced murine skin tumors. The primary objective is to gain a better understanding of how tumors regress or progress by studying the tumors in situ. The infiltrating host cells will be analyzed as to type by identification of cell surface markers and as to function by measuring cytotoxicity to tumor targets. A comparison will be made in regressor and progressor mice of both normal and uvl-irradiated origin. The interactions of infiltrating host cells with each other and within the local tumor environment will be analyzed. The relationship between peripheral anti-tumor reactivity and the immunologic response in situ will be determined.

Keywords: ultraviolet radiation; carcinogenesis; immunity; biological models; biological effects.

35115 Chemical Carcinogens and Their Cellular Receptors. Whitlock, J.P. (Stanford Univ., School of Medicine, Stanford, CA, 94305). **Project number:** 1-CA-24580-1. **Contract:** R01-CA-24580-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Environmental pollutants are important contributors to human disease, particularly cancer. The long-term goal of the studies proposed here is to increase our understanding of the interactions between foreign compounds and cellular macromolecules; we are particularly interested in those interactions which lead to phenotypic changes, such as increases in microsomal drug-metabolizing enzyme activity or neoplastic transformation. We will evaluate the interactions between reactive small molecules and chromatin. The approach will be to chemically modify chromatin, using the reactive forms of various chemical carcinogens. We will ask whether differences in the level of chromatin organization of alterations in chromatin conformation affect the relative ability of the various chromatin components to undergo modification.

Keywords: carcinogens; biological effects; oncogenic transformations; chromatin; chemical reactions.

35116 Kidney Response to Fractionated Radiation. Moulder, J.E. (Medical College of Wisconsin, 561 N. 15th St., Milwaukee, WI). **Project number:** 1CA-24652-1. **Contract:** R01-CA-24652-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This research program will study the response of the rat kidney to fractionated irradiation. Specifically, it will determine how the radiation tolerance of the kidney changes with fractionation, determine whether there are early indicators of kidney damage that correlate with late kidney damage, and determine whether nonlethal kidney damage is repaired between treatment courses 6 to 18 months apart. Information will also be gained concerning the slope of the dose-response curve for late radiation damage, and concerning optimal radiotherapy schedules. Rats will receive bilateral kidney irradiations in several fractionation schedules, ranging from single doses to 32 fractions in 72 days. Animals will be followed for at least 18 months, with periodic determinations of blood pressure, blood chemistry, urine chemistry and iodohippurate clearance times. Kidney doses will range from those producing only light neophritis to those that will cause death within 12 months. Some of the animals surviving the first course of treatment will be given a second fractionated treatment 6 to 18 months later.

Keywords: kidneys; radiosensitivity; fractionated irradiation; rats; radiotherapy.

35117 Photo-Induced Cell Killing, Mutation, and DNA Repair. Ritter, M.A. (Univ. of Pennsylvania, 36th and Hamilton Walk, Philadelphia, PA, 19104). **Project number:** 1-CA-24657-1. **Contract:** R01-CA-24657-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study will measure photochemically induced cell lethality and mutagenesis (6-thioguanine resistance) in normal and xeroderma pigmentosum human diploid cells as a function of wavelength. Selected wavelengths in the far uv, near uv, and visible range will be used. We will investigate the role of DNA damage and repair phenomena in cell lethality and mutagenesis. At each wavelength, DNA strand breaks, pyrimidine dimers, unscheduled DNA synthesis, and the average site of repair-synthesized DNA regions will be determined. The oxygen dependence of cell lethality, mutagenesis, and DNA damage and repair will also be measured as a function of wavelength.

Keywords: cell killing; mutagenesis; photochemical reactions; xp cells; ultraviolet radiation; strand breaks; animal cells; man.

35118 Cell Irradiations with Molecular Ions. Rossi, H.H. (Columbia Univ., 630 W. 168th St., New York, NY, 10032). **Project number:** 1-CA-15307-6. **Contract:** R01-CA-15307-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In order to investigate the dependence of radiobiological effects on energy distribution in cells, the latter are irradiated with molecular ions. When striking matter, these ions dissociate and pairs of triplets of particles traverse the cells with mean separations that can be varied. In addition, the effects of equal numbers of randomly incident particles can be determined. The results support the theory of dual radiation action and provide numerical parameters for its application. The cells irradiated are Chinese hamster cells in tissue culture and the effects assessed are reproductive cell death and chromosome aberrations.

Keywords: animal cells; radiosensitivity; hamsters; tissue cultures; chromosomal aberrations; reproduction.

35119 X-Ray Dose Rate Effects on Cell Kinetics. Schwarz, G. (St. Vincent's Hospital and Medical Center of New York, 153 West

11th Street, New York, NY, 10011). **Project number:** 1-CA-17582-5. **Contract:** R01-CA-17582-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this study is to obtain a detailed picture of cellular kinetics and lethality under conditions of continuous irradiation and to investigate whether and how the effects of continuous irradiation can be predictably reproduced by fractionated treatment in four different in vitro cell lines. The dose-rate effect due primarily to the accumulation of radiation damage and repair was studied by continuous irradiation at various dose rates at temperatures which slow down or prevent the movement of cells through the cycle. These studies will also include stationary cell populations in plateau phase. Dose-rate effects due to differences in the characteristics of the mitotic cycle will be studied by incubating cells during irradiation at temperatures between 28 and 37 degrees C. The potential advantages of combining mild hyperthermia with continuous irradiation, as well as the effects of short heat treatments followed by continuous irradiation at various temperatures, will be studied.
Keywords: x radiation; dose-response relationships; lethal radiation dose; biological radiation effects; cell division; in vitro; cell cultures; temperature effects.

35120 Radiation Induced Effects in Cell Kinetics. Gerner, E.W. (Univ. of Arizona, 1501 N. Campbell Ave., Tucson, AZ, 85721). **Project number:** 1-CA-18273-5. **Contract:** R01-CA-18273-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The use of radiotherapy in the treatment of cancer is based on the fact that ionizing radiation inhibits the proliferative capacity of tissues and results in cell death. The objective of this proposal is to study the effects of radiation in a related sequence of biochemical events which occur during the mammalian cell cycle and are involved in cell proliferation control. Previous studies have shown that the non-histone chromosomal proteins may be very important in the control of DNA replication, gene activation and cell division. The application proposes to study the effects of radiation on these proteins, as well as the enzymes and factors, specifically the protein kinases and cyclic nucleotides, which modify these proteins and possibly affect their regulatory functions. These studies should add fundamental insight to the understanding of radiation induced defects in cell cycle kinetics, and ultimately contribute to the optimization of the use of radiation for the treatment of human neoplastic disease.
Keywords: neoplasms; radiotherapy; animal cells; tissues; cell cycle; biological radiation effects.

35121 Radiation Sensitization Applied to Cancer Radiobiology. Epp, E.R. (Massachusetts General Hospital, 32 Fruit Street, Boston, MA, 02114). **Project number:** 1-CA-18614-4. **Contract:** R01-CA-18614-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The mechanisms by which oxygen and chemical radiosensitizing agents act in irradiated mammalian cells will be studied, both independently and interactively. Aspects of the nature of radiation sensitization will be examined in detail in CHO cells under conditions where both hypoxic cell sensitizers and low levels of oxygen are present. In the clinical application of sensitizers such as the nitroimidazoles, e.g., misonidazole, to cancer radiotherapy, it is likely that there will be an important subpopulation of tumor cells that contain a low concentration of oxygen, but are not radiobiologically hypoxic. The effects of sensitizers on such cells will be determined in this project. Also to be investigated is the possibility of an additive or synergistic effect between radiosensitization and the specific hypoxic cell toxicity recently observed with many sensitizer compounds.
Keywords: radiosensitizers; cell cultures; radiosensitivity effects; synergism; oxygen; mammals; radiotherapy.

35122 Radiation Induced Alterations of Chromosomal Proteins. Roti Roti, J.L. (Univ. of Utah, 1400 E. 2nd St., Salt Lake City, UT, 84112). **Project number:** 1-CA-16465-5. **Contract:** R01-CA-16465-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed research is designed to determine the role of chromatin function and structure in the radioresponse of mammalian cells. Regarding chromatin function, we hope to determine: (1) whether radiation induces any changes in the rate of addition or replacement (turnover) of chromosomal proteins, and (2) whether any radiation-induced changes in the turnover of chromosomal proteins play a role in radiation-induced division delay. Regarding chromatin structure, the objectives are: (1) to determine whether the in situ arrangement of chromosomal proteins on the DNA molecule or changes therein affect the induction of DNA damage and its repair, and (2) to determine what role thermally induced structural changes in the protein-DNA interaction in chromatin play in heat induced killing. Chromatin isolation from cultured mammalian cells will be used to assay both radiation and thermal effects. The isolated chromatin will be fractionated by gel electrophoresis so that alterations of individual protein components may be examined. The particular class of DNA damage we will study is the 5,6-dihydroxydihydrothymine (T gamma)-type products. T gamma-type products are formed in DNA by OH radicals and are removed by an excision repair process. We will examine the formation and repair of T gamma-type products as a function of the cell's position in the cell cycle and as a function of the DNA-protein organization of chromatin.
Keywords: chromosomal aberrations; radioinduction; proteins; animal cells; dna; chromatin.

35123 Risk Assessment for Radioinduced Mammary Neoplasms. Hempelmann, L.H. (Univ. of Rochester, 601 Elmwood Ave., Rochester, NY, 14627). **Project number:** 1-CA-21452-3. **Contract:** R01-CA-21452-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

This population of 606 women treated with x-rays for acute post-partum mastitis and their controls (554 sisters, 539 women with post-partum mastitis not treated with x-rays, and their 206 sisters) have been followed by mail questionnaire since 1955. The irradiated women have an increased risk of developing breast cancer. This application proposes continuation of the mail health survey, the review of histopathology of the breast cancers experienced by the treated women and the controls, and periodic mammographic-thermographic screening of the treated women and eligible controls (NCI guidelines).
Keywords: delayed radiation effects; mammary glands; radiotherapy; neoplasms; radioinduction; patients.

35124 Metabolism and Carcinogenicity of Haloaromatic Pollutants. Safe, S.H. (Univ. of Guelph, Guelph, Ontario, Canada N1G 2W1). **Project number:** 1-CA-21814-2. **Contract:** R01-CA-21814-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Chlorinated aromatic pollutants such as the polychlorinated biphenyls, benzenes, terphenyls, and naphthalenes are among the most persistant and widespread chemicals in the environment and these have been identified in wildlife and human tissue. This research proposal is concerned with a detailed investigation of the uptake, metabolism, mechanism of metabolism, tissue and organ levels of the pollutants and their metabolites in model mammalian systems (rabbit, rat). The effects of both degree of chlorination and substitution on the in vivo pollutant pharmacodynamics will also be evaluated. The in vitro metabolism (i.e., detoxication) of the chlorinated aromatic pollutants using liver microsomal enzymes will also be investigated. The binding of the metabolically activated arene oxides with cellular macromolecules (i.e., toxication) such as RNA, DNA, protein, lipid, and polysaccharide will be studied with particular emphasis on the precise identity of the bound macromolecule, the specificity of the binding, and the effects of chemical inducers on the detoxication/toxication ratios. Parallel to these studies the pollutant substrates and their diverse metabolites will be screened in the Ames bacterial test for mutagenic and carcinogenic activity using specific mutant strains of Salmonella typhimurium.
Keywords: chlorinated aromatic hydrocarbons; metabolism; toxicity; rabbits; rats; uptake; chemical bonds; in vivo; in vitro; mutagen screening.

35125 Interaction of Antioxidants with Benzopyrene and Derivatives. Sullivan, P.D. (Ohio Univ., Athens, OH, 45701). **Project number:** 1CA-22209-1. **Contract:** R01-CA-2209-O1A2. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Certain antioxidants are known to inhibit the production of cancers from polycyclic hydrocarbons in test animals. The mechanism of this inhibition is not fully understood. In this study it is proposed to investigate the effects of various antioxidants and combinations of antioxidants on the in vitro metabolism of benzo(a)pyrene by rat liver microsomes. The methods to be used in this study will be electron paramagnetic resonance spectroscopy which will be used to monitor the production of 6-hydroxybenzo(a)pyrene via the formation of the 6-oxybenzo(a)pyrene free radical, high pressure liquid chromatography which will be used to monitor the production of stable benzo(a)pyrene metabolites, and the Ames test which will be used to study the effect of antioxidants on the production of mutagenic metabolites. Additional experiments will be concerned with the

effect of alkyl substituents on the oxidative and carcinogenic properties of benzo(a)pyrene.
Keywords: benzopyrene; polycyclic aromatic hydrocarbons; neoplasms; inhibition; toxicity; growth; antioxidants; metabolism.

35126 Radiation and Chemical in Vitro Malignant Transformation. Kennedy, A.R. (Harvard Univ., 55 Shattuck St., Boston, MA, 02115). **Project number:** 1CA-22704-2. **Contract:** R01-CA-22704-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The basic objective of this research program is to gain specific information about the mechanisms of radiation carcinogenesis using in vitro assay system. Previous results indicate that x-ray transformation in vitro can be thought of as involving at least two steps: (1) the fixation of the transformed state (presumably irreversible DNA damage) and (2) its subsequent expression in terms of morphologically altered cells. We will investigate in detail the conditions necessary for fixation and ultimate expression of the cellular damage induced by ultraviolet light and ionizing radiation which results in malignant transformation of cells. In particular, we plan to study the role that DNA repair processes play in radiation-induced transformation and the interactions between radiations and chemical agents in malignant transformation. At present, little information is available on the interactions between radiation and other agents from in vivo carcinogenesis studies or in vitro transformation work, although human populations are continually being exposed to a variety of carcinogenic agents as well as to other agents that can influence carcinogenesis. The cell system we will use is an established mouse embryo cell line which has been used for several years in this laboratory for radiation transformation experiments and is particularly appropriate for studying interactions between radiation and chemical agents. The specific chemical agents we wish to study have known interactive effects on carcinogenesis in vivo; studies in an in vitro system in which cell proliferation and other environmental conditions can be precisely controlled should yield further information about the mechanisms of carcinogenesis.
Keywords: biological radiation effects; neoplasms; carcinogenesis; chemical radiation effects; mice; animal cells; biochemical reaction kinetics.

35127 Animal Model: Oat Cell Lung Carcinoma. Blair, W.H. (Mercy Hospital and Medical Center, 2510 S. Parkway Blvd., Chicago, IL, 60616). **Project number:** 1-CA-22346-2. **Contract:** R01-CA-22346-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this program are to induce oat cell carcinoma of the lung in rodents and to thoroughly characterize the tumors. In addition, tumor transplantation and tissue culture isolation will be used to perpetuate a tumor line of pulmonary oat cell carcinoma. Male and female Sprague--Dawley (laboratory-bred) rats were exposed to mixtures of dimethylbenzanthracene with charcoal and benzo-a-pyrene and ferric oxide. After exposure, Type II cell proliferation was observed, followed by squamous metaplasia. Squamous cell microtumors were in evidence six weeks after exposure to the carcinogens. Oat cell-like neoplasms have not been observed as yet (6 months) and are not anticipated for several more months.
Keywords: rats; lungs; carcinogenesis; neoplasms; tissue cultures; benzopyrene; benzanthracene.

35128 Carcinogen-Chromatin Interaction in Cultured Cells. Spelsberg, T.C. (Mayo Foundation, 200 1st Street SW, Rochester, MN, 55901). **Project number:** 1-CA-22272-2. **Contract:** R01-CA-22272-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Based on the inheritable traits which chemical carcinogens induce in living cells and recent knowledge that these compounds alter gene expression, a direct action on the chromosomal material is suspect. This proposal is concerned with the analysis of the interaction of carcinogenic polycyclic aromatic hydrocarbons (PAHs) with nuclear chromatin in an in vitro system (cloned lines of mouse embryo cells). The carcinogenic PAHs have been shown to trigger malignant transformation in these cells. A high affinity, saturable class of binding sites has been localized in a transcriptionally active nuclear fraction.
Keywords: polycyclic aromatic hydrocarbons; carcinogenesis; cell cultures; mice; chromosomes; pathological changes; chemical bonds.

35129 Probing Carcinogens Active Sites by F-Substitution. Sardella, D.J. (Boston College, Chestnut Hill, MA, 02167). **Project number:** 1CA-23454-1. **Contract:** R01-CA-23454-O1A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

We propose to undertake an investigation of the detailed effects of fluorine substitution on the electronic structures, chemical properties and carcinogenic activities of four typical polycyclic aromatic carcinogens: benzo(a)pyrene, dibenzo(ai)pyrene, dibenzo(a,h)pyrene, and 5-methylchrysene. This will be done experimentally, using NMR spectroscopy to define the effects of fluorine on bond localization, electron densities and rates and sites of deuteriodeprotonation; and theoretically using self-consistent field molecular orbital calculations. We will investigate the stability of C-F bonds in polycyclic carcinogens in vitro. Compounds will also be tested for carcinogenic activity. Our biological and deuteriodeprotonation data for fluorinated dibenzo(ai)-pyrene suggest that fluorine can exert long-range deactivating effects across the entire molecule, in addition to its direct blocking effect on metabolic transformations. Thus, this study will constitute a critical evaluation of the fluorine substitution methodology for identifying sites of metabolic transformation. The data will also allow an experimental test of the bay-region hypothesis of carcinogenicity.
Keywords: carcinogenesis; biological models; benzopyrene; polycyclic aromatic hydrocarbons; fluorine.

35130 Transfer Mechanisms in Irradiated Biological Systems. Box, H.C. (Roswell Park Memorial Inst., 666 Elm St., Buffalo, NY, 14263). **Project number:** 76X-4231-14. **Contract:** R01-CA-25027-14. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is a study of radiation damage in nucleic acid constituents using a variety of experimental approaches including ESR, ENDOR and 13C NMR spectroscopy, and HPLC and mass spectrometry. Attention will be given to radiation effects in the carbohydrate and phosphate moieties of nucleic acids. Also of interest are the mediative effects of halogen substituted bases on the overall radiation damage process. For example, cocrystals of 5 bromouridine and adenosine, x irradiated at 4.20K, are being studied by ESR-ENDOR spectroscopy to determine how halogenation alters the primary radiation damage process.
Keywords: radiation injuries; dna; biochemical reaction kinetics; x radiation; organic halogen compounds; radiosensitivity effects.

35131 Heavy Ion Radiation and Multicellular Spheroids. Alpen, E.L. (Univ. of California, Berkeley, CA, 94720). **Project number:** 1CA-24789-1. **Contract:** R01-CA-24789-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to examine the relative biological effectiveness of heavy ion radiation on cell lines grown as multicellular spheroids. These spheroids have some properties associated with organized tissue systems. We will examine the mechanisms underlying the apparent fraction of radioresistant cells in spheroids. The role of cell cycle redistribution and anoxia will be evaluated and potential for repair of sub-lethal damage and potential lethal damage will be determined. The equivalent of a tumor cure dose for this in vitro system will be measured, along with growth delay as a function of LET of the heavy ion radiation. Alteration of cell cycle distribution in regrowing tumors will also be evaluated.
Keywords: animal cells; heavy ions; biological radiation effects; radiosensitivity; tumor cells; cell cycle.

35133 Comparative Metabolism Study of PAH Analogues. Wong, L.K. (Univ. of Pittsburgh, 1106 Salk Hall, Pittsburgh, PA, 15213). **Project number:** 1CA-27928-1. **Contract:** R23-CA-27928-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this project are: (1) to investigate the activation/detoxification pathways of a series of polycyclic aromatic hydrocarbons (PAH) by a comparative metabolism study; and (2) to evaluate the Bay Region hypothesis. In vivo and in vitro metabolites of methyl- and fluoro-derivatives of benz(a)anthracene will be examined in Sprague-Dawley rats in order to determine how these structural parameters influence the biotransformation of these compounds. In addition, the effect of these parameters on the reactivities of potentially active metabolites will be investigated by studying the reactions between these metabolites and nucleophiles.
Keywords: metabolism; polycyclic aromatic hydrocarbons; toxicity; rats.

35134 Ultraviolet Transformation, DNA Repair in Human Cells and Skin. Sutherland, B.M. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 1-CA-26492-1. **Contract:** R01-CA-26492-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We have developed a system for ultraviolet light (200 nm less than lambda less than 400 nm) transformation to anchorage-independent growth of human cells in culture. We will characterize the transformation process wavelength dependence, influence of age and origin of cells, effect of irradiation and growth schedule, as well as the role of DNA and/or misrepair. We will characterize the growth patterns, efficiency of anchorage-independent growth, karyotype and chromosomal banding patterns and tumorigenicity of the transformants. We will use alkaline agarose gel techniques to detect low levels of DNA damage and repair in small quantities of non-radioactive human fibroblasts, leukocytes and skin. We will obtain action spectra for pyrimidine dimer formation in human skin and compare it to those for ultraviolet oncogenesis in the mouse. We will determine rates of repair of dimers by excision and by photoreactivation in human skin. We will determine the relationship between uv transformation in vitro and solar oncogenesis in human skin, and the possible roles of DNA repair or misrepair in these processes.
Keywords: ultraviolet radiation; dna; biological repair; animal cells; skin; man; biological effects.

35135 In Vivo Nitrosamines and Cancer in Renal Failure. Simenhoff, M.L. (Thomas Jefferson Univ., 1025 Walnut Street, Philadelphia, PA, 19107). **Project number:** 1-CA-26571-1. **Contract:** R01-CA-26571-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Clinical studies in humans.

N-nitroso compounds (nitrosamines) are potent mutagens and carcinogens in experimental animals. Although suggestive, no role has been determined in man. A chance observation while investigating amine generation in chronic renal failure pointed to a human model in uremic patients who have been reported to have an increased incidence of malignancies. This model describes the coexistence of 3 conditions for nitrosamine formation: (1) intestinal nitrates (nitrites) endogenous and exogenous (in food and water, including dialysate); (2) small intestinal secondary amines especially dimethylamine (DMA); and (3) appropriate bacterial species in same location permitting reduction of nitrate and possibly nitrosation itself, at physiologic pH and temperatures. The proposed research will identify the extent to which these three conditions exist and determine whether nitrosamine (specifically dimethylnitrosamine) is formed in vivo.
Keywords: nitroso compounds; carcinogenesis; biological models; man; biosynthesis.

35136 Mutagenic Specificity of Environmental Carcinogens. Eisenstadt, F. (Harvard Univ., 55 Shattuck St., Boston, MA, 02115). **Project number:** 1CA-26135-1. **Contract:** R01-CA-26135-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: oil shale(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The basic objective of this research program is to develop specific information about the spectrum of mutations that can be induced by environmental carcinogens. We propose to study, at the nucleotide level, the DNA alterations that are generated by carcinogens in the lacI gene of Escherichia coli. We will determine the mutagenic spectrum induced by benzo(a)pyrene, 2-acetylaminofluorene, aflatoxin B1, and ultra-violet light in bacteria with different DNA repair capabilities. The information we expect to obtain from these studies includes: (1) the full range of mutational events that arise from damage to DNA by selected environmental carcinogens; (2) the influence of certain genes governing the enzymatic repair of DNA lesions on the mutagenic spectrum of carcinogens; and (3) the effect of primary structure (sequence) on the conversion of DNA lesions to mutations.
Keywords: mutagenesis; carcinogenesis; biological models; dna; escherichia coli; benzopyrene; hydrocarbons; ultraviolet radiation; biological repair.

35137 Radiation-Chemical Induction of Mutagenesis. Richmond, R.C. (Mary Hitchcock Memorial Hospital, 2 Maynard Street, Hanover, NH, 03755). **Project number:** 1-CA-26045-1. **Contract:** R01-CA-26045-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Ionizing radiation will be applied to bacterial suspension of Salmonella typhimurium TM677 in the presence and absence of chemical radiation sensitizers and antitumor drugs. The effect of these combined treatments will be assessed for both cell killing (survival curve analysis) and for forward mutation frequency (8-azaguanine resistance). Radiation-induced cell lethality and radiation-induced mutagenesis may derive in part from common lesions to DNA. If this is true, then modulation of irradiated cell survival would correlate in some positive manner with mutagenesis. Radiation sensitization of cell killing by organic and inorganic compounds is widely studied, and several of these compounds will be introduced into the irradiated bacterial system in order to obtain the desired modulation of end points. The spectrum of correlation between sensitized cell killing and mutagenesis will be evaluated in light of various postulated mechanisms of sensitizer action. Results of experiments using different kinds of radiation sensitizers will then help to understand the effects of antitumor drugs on radiation-induced cell inactivation and mutagenesis.
Keywords: biological radiation effects; radiosensitivity effects; salmonella typhimurium; antimitotic drugs; radiosensitizers; synergism; cell killing; survival curves; mutation frequency; radioinduction; mutagenesis; dna.

35138 Evaluation of Low Level Plutonium-4 Cancer. Johnson, C.J. (Jefferson County Health Dept., 260 S. Kipling St., Lakewood, CO, 80226). **Project number:** 1CA-25729-1. **Contract:** R01-CA-25729-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

Because of documented contamination of about 50 square kilometers of land with plutonium in the vicinity of the Rocky Flats nuclear weapons plant, there is community concern regarding possible health effects for populations living in this area as well as concern for the safety of further residential development near the plant. A preliminary study of age-connected death rates from leukemia in eight census tracts around the plant and in the city of Golden (a small city near Rocky Flats) compared with a control area consisting of 19 census tracks with a similar population in the relatively uncontaminated part of the county disclosed a significant increase in deaths from leukemia in the contaminated areas. An evaluation of age-specific death rates (45 to 64 years) for each of the contaminated areas compared with the control area disclosed a death rate from lung cancer more than twice as great as that for the control area.
Keywords: low dose irradiation; plutonium; neoplasms; health hazards; leukemia; utah; contamination; risk assessment; epidemiology.

35139 Carcinogenesis by Hydrocarbons: a Molecular Approach. Olson, W.K. (Rutgers Univ., Douglas College, New Brunswick, NJ, 08903). **Project number:** 1CA-25981-1. **Contract:** R01-CA-25981-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

The proposed application of polymer chain statistics, or configurational statistics, to model carcinogen-nucleic acid covalent complexes is intended to provide an essential first step in relating the subtle features of chemical architecture to the unique physical and biological properties of these systems. Through a combination of semiempirical energy calculations and statistical mechanical analyses, it is now possible to obtain reliable predictions of the secondary and tertiary structures of various nucleic acid systems of established biological significance. A primary objective of this research program then is to elucidate by use of the above techniques the unique conformational features of nucleic acids chemically modified by metabolites of 2-aminofluorene and benzo(a)pyrene. A second goal is to comprehend the configuration-dependent properties of these complexes in terms of basic chemical structure and conformation. Once agreement is established between the theoretically determined quantities and those measured in experiments, it may be possible to identify the structural characteristics of the carcinogens that underlie the unusual physical behavior of such modified polynucleotides. It is further hoped that these studies may offer some unifying principles for understanding the effects of carcinogen binding on nucleic acid conformation. With this knowledge as a conceptual basis, it then may be possible also to rationalize the changes in biological function that accompany the covalent binding of aromatic carcinogens to the nucleic acids.
Keywords: hydrocarbons; carcinogenesis; toxicity; biological models.

35140 Stem Cell Age and X-Ray/Chemotherapy Leukemogenesis. Greenberger, J.S. (Sidney Farber Cancer Center, Inc., 44 Binney St., Boston, MA, 02115). **Project number:** 1CA-25412-1. **Contract:** R01-CA-25412-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: oil shale(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Acute myelogenous leukemia (AML) occurs with increased frequency in patients or experimental animals exposed to x-rays or alkylating agents. To study the role of age and accumulated proliferative stress on the marrow pluripotent hemopoietic stem cell (PHSC) compartment in this process, marrow from weanling, young adult, or retired breeder mice of a low AML incidence strain (NIH/Swiss) and high incidence strain (Rfm) will be serially transferred to lethally irradiated syngeneic transplant recipients of a single age (4 to 6 months). Mice in each generation will be exposed to a leukemogenic dose of x-radiation or nitrogen mustard and marrow explanted 3 weeks later to an in vitro culture system which maintains proliferation of PHSC (DFUs) and granulocyte-macrophage progenitor cells (CFUc) for 10 to 20 weeks. Weekly culture harvests will be tested in vitro for the number of leukemogenic clones generated. Methods

will include: x-ray and drug treatment of mice, serial marrow transplant, long-term marrow cultures, colony assays for CFUc, spleen colony assay for CFUs, establishment of leukemia cell lines and leukemogenicity tests of established cell lines in syngeneic newborn mice.
Keywords: stem cells; age dependence; x radiation; chemotherapy; radioinduction; leukemogenesis.

35141 Complementation of Cellular Radiation Repair Pathways. Elkind, M.M. (Univ. of Chicago, 5801 S. Ellis Ave., Chicago, IL, 60637). **Project number:** 1CA-25259-1. **Contract:** R01-CA-25259-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

A genetic basis of repair deficiency has been reported principally in two types of human-derived cells, in Xeroderma pigmentosum and Ataxia telangiectasia cells. In general, however, the molecular biology underlying radiation response, and how it is influenced by repair processes, is less well understood in eucaryotes than in procaryotes; progress with procaryotes has reflected the availability of a number of repair deficient mutants. Recently, a method of producing clones of V79 Chinese hamster cells having heritable, enhanced responses to radiation (ionizing and non-ionizing) was discovered in the applicant's laboratory. V79 Chinese hamster cells resistant to the metabolic inhibitor ouabain (i.e., spontaneous mutants) may be classified as small- and as large-colony formers. The latter appear to have normal radiation responses while the former generally have enhanced responses. Thus, the metabolic impairment(s) made evident by reduced colony size appears to be tightly coupled to radiation responsiveness.
Keywords: biological repair; biological pathways; animal cells; hamsters; biological radiation effects.

35142 Carcinogen Induced Facilitation of Tumor Growth. Hill, P.H. (Univ. of South Carolina, Admin. Bldg. Room 115, Columbia, SC, 29208). **Project number:** 1CA-25361-1. **Contract:** R01-CA-25361-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

A possible mechanism for interaction of environmental carcinogens such as hydrocarbon emissions may be specific or nonspecific deleterious effects on immunoregulation during chemical carcinogenesis. Treatment of C3H mice with 1.0 or 0.05 mg of 3-methylcholanthrene (3-MC) has been found to result in acceleration of growth of transplanted syngeneic fibrosarcomas. Use of 1.0 mg 3-MC induced greater facilitation of tumor growth than did using 0.05 mg 3-MC. However, treatment of mice with 0.05 mg 3-MC also facilitated growth of two transplanted tumors. This lower dose of 3-MC induced primary tumors in only 50% of injected mice. The purpose of this study is to further investigate the immunobiology of 3-MC induced facilitation of syngeneic tumor growth. The study will determine if the effect is (a) due to immunosuppression, (b) transferable to a syngeneic recipient, (c) immunologically mediated, (d) a general phenomenon or demonstrable with only occasional tumors, and (e) observed during chronic administration of split doses of carcinogen. The study will determine the effect of 1.0 mg and 0.05 mg 3-MC on the hemolysin plaque assay, skin graft rejection, lymphocyte mitogen stimulation, in vitro tumor cytotoxicity, macrophage phagocytic function, and mixed lymphocyte culture 1, 4, 8, and 12 weeks after carcinogen treatment.
Keywords: carcinogenesis; tumor cells; biological models; hydrocarbons; metabolism; toxicity.

35143 Ultraviolet Light and Epidermal Polyamine and DNA Synthesis. Lowe, N.J. (Univ. of California, 2025 Zonal Ave., Los Angeles, CA, 90033). **Project number:** 1-CA-25970-1. **Contract:** R01-CA-25970-1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The molecular basis for ultraviolet light carcinogenesis is a matter of speculation. Recently, the principal investigator has found that uv-l produces dramatic increases in epidermal ornithine decarboxylase (ODC). ODC, which forms putrescine by decarboxylation of ornithine, is the first and probably the rate limiting enzyme in the biosynthesis of the polyamines, spermidine and spermine. The activities of ODC and the levels of its biosynthetic products are elevated in various systems stimulated to proliferate. Furthermore, numerous studies indicate that the polyamine biosynthetic enzymes are implicated in neoplastic growth. For example, application of a potent tumor promoting agent, 12-0-tetradecanoyl-phorbol-13-acetate (TPA) to mouse skin lead to more than 250-fold increases in epidermal ODC activity and this phenotypic change is thought to be essential for skin tumor promotion. In view of the potential significance of ODC for growth carcinogenesis, it is proposed to study in greater detail the response of epidermal ODC to uv-l.
Keywords: ultraviolet radiation; skin; dna; biosynthesis; biological effects; carcinogenesis.

35144 Analysis of X-Ray and Heat-Induced Mutagenesis. Hopwood, L.E. (Medical College of Wisconsin, 561 N. 15th St., Milwaukee, WI, 53233). **Project number:** 1CA-25192-1. **Contract:** R01-CA-25192-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The principal objective of this research is to obtain quantitative data on dose-response relationships for the induction of mutation in an in vitro mammalian cell system. CHO and HeLa cells will be selected for their resistance to 8-azaguanine, a toxic analogue which selects for a mutation in the gene for hypoxanthineguanine phosphoriboxyl transferase; and to ouabain, which in its binding to ATPase is toxic to wild-type cells. Factors which influence the quantitative nature of the mutation system, such as drug concentration, cell density and expression time, will be carefully controlled to obtain accurate responses. The mutation induction by x-rays will be determined for different stages of the cell cycle, various dose-rates and fractionations. The possible influence of hyperthermia on mutation production will be investigated. Various agents and treatments will be used to measure the repair of the mutation lesions in comparison with that of the lethal lesion. An analysis of mutations selected under several conditions will be aimed at determining the nature of the mutation lesion.
Keywords: mutagenesis; x radiation; heat treatments; biological models; biological radiation effects; toxicity.

35145 Interaction of Benzo(a)Pyrene with Nuclear Proteins. Litman, G.W.; Marquardt, H.W. (Sloan-Kettering Inst. for Cancer Research, 410 E. 68th St., New York, NY, 10021). **Project number:** 1-CA-24861-1. **Contract:** R01-CA-24861-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the proposed research is to characterize the interaction of the polycyclic aromatic hydrocarbon (PAH) benzo(a)pyrene with histone and nonhistone chromosomal proteins (NHCP). Analyses will be carried out with both a model target (calf thymus nuclei) and with a well characterized carcinogen transformable cell line. In the model system, BP will be converted to reactive metabolites employing a NADPH dependent rat liver microsomal-activating system. The covalent binding of BP to both histone and NHCP will be characterized utilizing high resolution analytical techniques. Particular attention will be directed at histone 1 (H1), which, based on preliminary experiments, represents the principal histone target of covalent BP binding. The possible restricted binding distribution of BP to H1 subfractions and the localization of BP in the primary structure H1 (utilizing chemical modification, restricted proteolysis and N terminal sequencing approaches) will be examined. The effect of BP binding on the association of both histones and NHCP with double-stranded DNA as well as histone 1 with NHCP will be studied using affinity chromatography. Concurrent studies initially will examine BP-chromosomal protein interactions with the M2 cell line and compare the covalent binding of of BP to that of BP 4,5-oxide, a non-carcinogenic analog. The binding of BP also will be compared in a transformable vs a non-transformable cell line. It is anticipated that the proposed studies will yield valuable insights into those chromosomal protein target(s) (interactions) which may be essential components of malignant transformation(s) induced by PAH carcinogens.
Keywords: benzopyrene; metabolism; proteins; biochemical reaction kinetics; bioassay.

35146 Radiation Repair in Drosophila melanogaster. Wallace, S.S. (New York Medical College, Valhalla, NY, 10595). **Project number:** 1-CA-24953-1. **Contract:** R01-CA-24953-01A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Drosophila melanogaster, a genetically well-characterized organism, is especially suitable for the elucidation of the biochemical basis of DNA repair mechanisms in eucaryotes. Since the various modes of DNA repair are intimately related to DNA replication, mutagenesis, and recombination, the enzymes involved in the correction of DNA damages may be instrumental in the carcinogenic process. The proposed research is designed to screen for specific repair endonuclease activities in wild-type Drosophila and in various known repair-deficient mutants. In order to assay for such damage-specific endonucleases, DNA substrates will be prepared by treatment with ultraviolet light, x-rays and alkylating agents. Endonuclease activities will also be investigated at different defined developmental stages of Drosophila, so as to estimate the organism's potential for repair during its life cycle.
Keywords: drosophila; biological repair; radiation injuries; radiosensitivity; biochemical reaction kinetics.

35147 Specificity in BAP Diol Epoxide Covalent Beading to DNA. Meehan, T.D. (Michigan Foundation for Advanced Research, 1910 W. St. Andrews Dr., Midland, MI, 48640). **Project number:** 1-CA-25106-1. **Contract:** R01-CA-25106-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

We have synthesized the activated form of the carcinogen benzo(a)pyrene, which is plus or minus 7 alpha,8 beta-dihydroxy-9 alpha,10 alpha-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene (I), and determined through fluorescence, absorbance and circular dichroism spectroscopy and high resolution mass spectroscopy that the hydrocarbon reacts to form six adducts with DNA. Two adducts each are formed with deoxyguanosine, deoxyadenosine and deoxycytidine, and the relative levels with each base were 92, 5, and 3%, respectively. The hydrocarbon was shown to be bound through its C10-position to the exocyclic amino groups of quanine and adenine and probably cytosine as well. Resolution of plus or minus I and reaction of the optically pure enantiomers with DNA demonstrate that the pair of adducts with each base were diastereomers. The ratio of disastereomers derived from the plus and minus enantiomers of (I) was 20:1 for guanine, 5-10:1 cytosine and 1:1 adenine. This proposal is designed to investigate (1) the nature of the stereoselectivity in the non-enzymatic reactions of plus I and DNA, (2) the role of intercalation, (3) mutagenesis mechanisms resulting from binding, and (4) the relevance of adducts to the biological properties of the hydrocarbon.
Keywords: dna; benzopyrene; metabolism; carcinogenesis.

35148 Binding of Aromatic Hydrocarbons to Nucleic Acids. Rogan, E.G. (Univ. of Nebraska, 42nd and Dewey Ave., Omaha, NE, 68105). **Project number:** 1-CA-25176-1. **Contract:** R01-CA-25176-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(60); oil and gas(40) **R and D categories:** Biological effects of pollutants in experimental systems.

Binding of carcinogenic polycyclic aromatic hydrocarbons (PAH) to a cellular macromolecular target is hypothesized to be the first step in the tumorigenesis process. The research proposed here consists of comparing the binding of selected carcinogenic PAH to nucleic acids in several in vitro and in vivo systems. Binding of (14C) 6-methylbenzo(a)pyrene (BP-6-CH3) to DNA in nuclei isolated from Sprague-Dawley rat livers and to DNA and RNA in the skin of Swiss mice will be compared with that bound to calf thymus DNA by purified horseradish peroxidase, a possible model system for activation by one-electron oxidation. The adducts will be degraded to monomeric units enzymatically and chemically, and analyzed by chromatography on Sephadex LH20 and by high pressure liquid chromatography. Similarly, the binding of (14C)7-methylbenz(a)anthracene (BA-7-CH3) to skin nucleic acids will be analyzed and compared to the binding of the sulfate ester of (14C)Ba-7-CH20H (BA-7-CH20S03) to calf thymus DNA. Binding of BP-6-CH3 by peroxidase is expected to yield sufficient amounts of hydrocarbon-nucleic acid base or nucleoside adducts for chemical analysis. Use of the BA-7-CH20S03 also will enable chemical analysis and possibly identification of adducts. The structure of adducts from binding in nuclei or skin which co-chromatograph with the adducts will then be identified.
Keywords: polycyclic aromatic hydrocarbons; molecular structure; nucleic acids; toxicity.

35149 Arene Oxides and Their Analogues. Koreeda, M. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** 1-CA-25185-1. **Contract:** R01-CA-25185-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

The principal objectives of this renewal proposal are: (A) the development of an effective and sterochemically controlled synthesis of both racemic and optically active bay-region diol epoxides of phenanthrene, benz(a)anthracene, and 7,12-dimethyl benz(a)anthracene; (B) the study of the chemical properties and reactivities of the diol epoxide metabolites of carcinogenic aromatic hydrocarbons such as benz(a)anthracene and 7,12-dimethylbenz(a)anthracene and the elucidation of the structures of the reaction products of these hydrocarbons and their diol epoxide derivatives with nucleic acids in vivo and in vitro, respectively; and (C) the elucidation of the molecular mechanism of the epoxide hydrase reactions with arene oxides.
Keywords: phenanthrene; condensed aromatics; metabolism; hydrocarbons.

35150 Hydrocarbon Carcinoginses in Mouse and Human Cells. Fahl, W.E. (Northwestern Univ., 303 E. Chicago Ave., Chicago, IL, 60611). **Project number:** 1-CA-25189-1. **Contract:** R01-CA-25189-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to systematically characterize the key microsomal cytochrome, P-450, and conjugation components in an established, hydrocarbon-transformable cell line, C3H/10T1/2 fibroblasts, and compare them to clones of human embryo fibroblasts. More specifically, we will characterize and purify the benz(a)anthracene inducible cyt. P-450 species in the 10T1/2 fibroblasts and examine the site-specific oxidation of benzo(a)pyrene in these mouse and human cells. Factors effecting the subsequent oxidation of BP 7,8 diol to diastereoisomeric diol-oxides and interaction of these diol-oxides with nuclear DNA will also be investigated. The effect of both inhibition and allosteric stimulation of UDP-glucuronyl transferase will be examined in microsomal incubations and whole cells, in particular examining the potential role of this enzyme in controlling the modification of DNA by reactive benzo(a)pyrene derivatives. In order to monitor the effects of altering the cyt. P-450 or conjugation enzyme status in these cells, formation of specific BP-DNA base conjugates will be routinely examined. We hope to apply this fundamental information to future studies of chemical-induced mutation and transformation in both mouse and human cell lines.
Keywords: hydrocarbons; metabolism; toxicity; man; mice; animal cells; carcinogenesis.

36500 Mutagenesis and Genetic Repair. Waldren, C. (Univ. of Colorado, Denver, CO). **Project number:** HDP01-02080-14 (007). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Caffeine enhancement of x-ray lethality in cultured human and rodent cells is studied. Single cell survival curves are constructed for each cell type. Methods using mammalian cells in vitro for detection and quantitation of carcinogenesis and genetic damage produced by various agents, including x-ray, are being developed.
Keywords: mutagenesis; biological repair; caffeine; x radiation; radiosensitivity effects; animal cells; radiosensitivity.

36501 Pediatric Neurology. O'Tuama, L. (Univ. of North Carolina, Chapel Hill, NC, 27514). **Project number:** HDP30-03110-13 (003). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The study of two basic hypotheses is being investigated. The first is that selective accumulation of heavy metals by brain barrier systems may influence their distribution in the nervous system. The second states that metal induced dysfunction of the barrier systems may contribute to the neurotoxicity of heavy metals and related toxins.
Keywords: neurology; physiology; metals; toxicity; toxins; brain; biological accumulation.

36502 Neurobiology and Environmental Pollutants. Krigman, M.R. (Univ. of North Carolina, Chapel Hill, NC, 27514). **Project number:** HDP30-03110-13 (029). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The main goals of this subproject are to characterize neurobehavioral effects associated with low lead exposures and to understand the mechanisms whereby an increased body burden of lead may affect neural function and behavior. Possible lead induced structural and chemical changes within the CNS are also being assessed.
Keywords: neurology; physiology; lead; biological effects; toxicity; behavior; central nervous system; biological models.

36503 Functional Neuroanatomy. Grant, L. (Univ. of North Carolina, Chapel Hill, NC, 27514). **Project number:** HDP30-03110-13 (033). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The main goals of this subproject are to study the effects of lead on neural function and behavior in children and animal models. Research has focused on the effects of low level lead exposures early in development on later postnatal physical and behavioral development in the rat.
Keywords: neurology; juveniles; behavior; animals; man; lead; biological effects; physiology; rats; toxicity.

36504 Brain Tumors and Congenital Malformations. Workany, J. (Children's Hospital Research Foundation, Cincinnati, OH, 45201). **Project number:** HDP30-05221-10 (028). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The investigator is studying neurogenic tumors and congential central nervous system malformations. The oncogenic response of rats exposed to x-irradiation and ethylnitrosourea is being examined. It has been demonstrated that a dose relationship exists between reduction of tumor incidences and x-ray doses.
Keywords: brain; tumor cells; central nervous system; x radiation; organic nitrogen compounds; rats; biological radiation effects; toxicity; congenital malformations; teratogenesis.

36505 Psychomotor Behavior. Mullenix, P. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP30-06276-08 (009). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This subproject is concerned with the assessment of spontaneous locomotor activity of rats after prenatal or postnatal low-level lead exposure. Hyper- or hypoactivity, diurnal rhythmicity, social interactions, and sequential behavior patterns are analyzed using 24 hour residential mazes and time-lapse photography.
Keywords: behavior; lead; toxicity; daily variations; chronic exposure.

36506 Low Level Lead Intoxication. Averill, D.R. (Childern's Hospital Medical Center, Boston, MA). **Project number:** HDP30-06276-08 (017). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Using an animal model of low level lead intoxication, an inhibition of the rate of acquisition of cerebral cortical synaptogenesis has been shown. It has also been found that lead reduces the rate of basilar dendritic arborization of pyramidal neurons in the developing rat.
Keywords: lead; toxicity; chronic exposure; brain; behavior; rats.

36507 Lead Exposure and the Blood Brain Barrier. Lorenzo, A. (Children's Hosptial Medical Center, Boston, MA). **Project number:** HDP30-06276-08 (019). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

An animal model has been developed for overt and asymptomatic lead toxicity in which lead is fed orally to newborn rabbits rather than to the dam. Studies have investigated transport functions associated with the blood brain barrier in lead toxicity.
Keywords: lead; toxicity; metabolism; biochemical reaction kinetics; rabbits; blood; brain.

36508 Developmental Effects of Low Lead Exposure. Needleman, H.L. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP30-06276-08 (056). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim of this project is to compare the neuropsychological performance in asymptomatic school age children with elevated body lead burdens to control children with low lead burdens. The index of exposure is lead concentration in shed deciduous teeth.
Keywords: lead; chronic exposure; toxicity; neurology; behavior; teeth; body burden.

36509 Cortical Synaptogenesis. Averill, D.R. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP30-06276-08 (063). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Doses of lead below those which produce changes visible by light microscopy are administered to immature rats. Cortical slices are examined for synaptic maturity and dendritic complexity.
Keywords: lead; toxicity; rats; behavior.

36510 Neuropsychological Effects in School Age Children. Needleman, H.L. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP01-08945-04A1 (001). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this subproject is to measure the prevalence of a neuropsychological deficit due to undiagnosed lead intoxication in a sample of first and second grade school children in the Boston area. Lead levels are assessed by chemical examination of deciduous teeth. The levels are correlated with teacher ratings of nonadaptive behavior and with neuropsychological data including intelligence and language development.
Keywords: neurology; behavior; lead; toxicity; juveniles; brain.

36511 Animal Studies of Low Lead Exposure. Averill, D.R. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP01-08945-04A1 (003). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This subproject seeks to determine the effects of subhistotoxic burdens of lead upon neuronal growth measured by quantification of dendritic processes and synaptogenesis. Rats are studied anatomically and behaviorally.
Keywords: lead; toxicity; rats; behavior; morphological changes.

36512 Neuropsychological Effects of Lead: Infants and Children. Needleman, H.L. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP01-08945-04A1 (005). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this subproject is to determine the effect of exposure to lead during pregnancy on neonatal outcome and subsequent development during the first three years of life. The neuropsychological performance of children with mid-range dentine lead levels are also being compared to children with high and low dentine lead levels.
Keywords: lead; toxicity; juveniles; infants; man; neurology; behavior; brain.

36513 Analytical Laboratory and Environmental Studies. Peresie, H.J. (Children's Hospital Medical Center, Boston, MA). **Project number:** HDP01-08945-04A1 (006). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The goal of this subproject is the identification of environmental sources and pathways for human lead exposure in the environment. The interest is directed toward the lead from which large numbers of individuals receive a measurably increased body burden, as opposed to that which produces extremely elevated body burdens in a few individuals.
Keywords: lead; toxicity; man; body burden; ecological concentration.

36514 Interactions Among Trace Metals. Chisolm, J.J. Jr. (John F. Kennedy Inst., Baltimore, MD). **Project number:** HDP01-10981-02(005). **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The relationship between lead absorption and metabolic and neurological evidence of adverse effects in one-to-five-year-old children will be determined, as well as whether essential trace metals such as zinc and iron modify the effects of lead in these children. Other studies include determining whether the ratio of zinc bound to free protoporphyrin IX in erythrocytes might serve as a biochemical indicator of zinc deficiency.
Keywords: zinc compounds; lead compounds; elements; trace amounts; synergism; biological effects; children; metabolism; nutritional deficiency; biological indicators.

36515 Problems in Radiation Embryology. Brent, R.L. (Thomas Jefferson Univ., 1025 Walnut St., Philadelphia, PA, 19107). **Project number:** HDR01-11038-03. **Supported by:** National Inst. of Child Health and Human Development, Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of these research projects is to: (1) determine whether the mammalian embryo is more sensitive to the tumorogenic and life-shortening effects of x-irradiation than is the same organism when irradiated after parturition (mouse); (2) evaluate the importance of dose rate with regard to determining the rate of recovery of irradiated embryos; (3) evaluate the extent and persistence of radiation induced biochemical and physiological alterations in the adult animal following their production at specific times during gestation in the rat fetus; (4) continue studies concerned with variations in the response of the mouse and rat embryo; and (5) investigate the relative importance of irradiation non-embryonic tissues on embryonic development. Attempts have been initiated to irradiate the yolk sac without irradiating the embryo or chorioplacenta by utilizing radioactive labeled antiyolk sac antibodies. Rat zygotes irradiated on the first day of gestation will be studied in order to clarify what facters determine whether the embryo will die or survive. Many of these studies are directed toward determining the threshold level of irradiation for producing many known radiation effects (growth retardation, lethality, CNS defects, etc.) in the embryo and determining the recuperative powers of the embryo not

only as measured at term but also during the post-partum period. The nature of the recovery processes and the factors which influence these recovery processes will be investigated. Finally, the embryo culture technique will be utilized to evaluate the quantitative and qualitative aspects of reproductive hazards, using radiation as the initial agent in order to utilize our extensive in vivo experience.
Keywords: mammals; teratogenesis; genetic radiation effects; x radiation; mice; embryos.

36900 Relationships of Diet and Air Pollutants to Aging. Privett, O.S. (Univ. of Minnesota, 801 16th Avenue, NE, Austin, MN, 55912). **Project number:** 1-416007513-A4. **Contract:** 5R01-AG00174-05. **Supported by:** Department of Health, Education, and Welfare, Rockville, MD (USA). **Funding:** HEW.
Related energy source: medical applications(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective of this project is to gain an insight into metabolic-structural effects and interrelationships of dietary and environmental factors that influence lipid composition and underlying enzyme reactions associated with aging and related metabolic disorders. Goals of the current year are to investigate the formation of aging pigment in seven different tissues of rats fed diets containing fats of high, low, and medium degrees of unsaturation. Another objective is to define more clearly the influence of aging on the isoenzyme pattern of lactate dehydrogenase in serum and tissues. Preliminary studies were also conducted on the accelerating effects of x-irradiation on aging in the kidney and the relation of lipid oxidation to renal nephritis. A thin layer chromatographic technique of analysis was developed for detection and isolation of a fluorescent substance that appeared to be related specifically with the aging pigment. This technique was developed via studies of the fluorescent substances formed in model systems in which the reaction of products of lipid oxidation with glyycine were investigated.
Keywords: diet; air pollution; life cycle; biological radiation effects; biological effects; x radiation; age dependence.

37200 Protective Action Guides for Accidental Radioactive Contamination of Human Food and Animal Feeds. Shleien, B. (FDA, Bureau of Radiological Health, 12720 Twinbrook Parkway, Rockville, MD, 20857). **Project number:** 110. **Supported by:** Department of Health, Education, and Welfare, Rockville, MD (USA). **Funding:** HEW.
Related energy source: medical applications(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The proposed guidance, published in the Federal Register (43 FR 58790) on December 15, 1978, provides guidelines and recommendations for action to be taken in the event of a radiological incident resulting in the contamination of human food or animal feeds. These guidelines and recommendations are for use by state and local agencies responsible for constructing response plans in the event of a radiological incident. The proposal would establish a set of guidelines that can be used to determine whether or not levels of radiation encountered in food after a radiological incident warrant protective action and would suggest appropriate actions that may be taken if action is warranted. This proposal is being made because the Food and Drug Administration has a responsibility to issue guidance on appropriate planning actions necessary for evaluating and preventing contamination of foods and animal feeds and on the control and use of such products should they become contaminated.
Keywords: food; contamination; animal feeds; human populations; animals; radiation protection; radiation accidents; recommendations.

37201 Comparative Rat Thyroid Carcinogenesis from Iodine-131 and External Radiation. Lee, W.; Shleien, B. (FDA, Bureau of Radiological Health, 12720 Twinbrook Parkway, Rockville, MD, 20857). **Project number:** 273. **Supported by:** Department of Health, Education, and Welfare, Rockville, MD (USA). **Funding:** HEW.
Related energy source: medical applications(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this study is to evaluate the absolute and relative risks of thyroid carcinoma incidence in rats within the dose range of 0 to 1000 rad from both internal I-131 and x-irradiations. Also, the possible synergistic effects between the thyroid and the pituitary gland will be investigated when either one or both organs are x-irradiated. Three thousand six-week-old Long Evans female rats were divided into ten treatment groups. Four groups were irradiated with localized x-ray to the thyroids at approximately the same doses as those in the I-131 irradiated groups; and two groups were irradiated for 440 rad with localized x-ray to either the pituitary alone, or both the pituitary and the thyroid. Animals will be kept for a period of 24 months after the irradiations. Pathology of the thyroid and the pituitary will be examined under double-blinded conditions. Only those animals which survive at least six months after the irradiation will be counted for statistical analysis. As of December 1979, all animals have been sacrificed and histological slides prepared, initial pathological evaluation of thyroids and pituitary tissue has commenced, and comparative pathology study and analysis are in progress.
Keywords: rats; thyroid; carcinogenesis; iodine 131; biological radiation effects; irradiation; x radiation; pituitary gland.

37202 Potassium Iodide as a Thyroid Blocking Agent in a Radiation Emergency. Halperin, J.A.; Shleien, B. (FDA, Bureau of Drugs, 5600 Fishers Lane, Rockville, MD, 20857). **Project number:** 110. **Supported by:** Department of Health, Education, and Welfare, Rockville, MD (USA). **Funding:** HEW.
Related energy source: medical applications(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The Food and Drug Administration requested submissions of new drug applications (NDA's) for potassium iodide in oral dosage forms for use as a thyroid-blocking agent in a radiation emergency. The approval of such use would be one step in meeting the responsibilities of the Department of Health, Education, and Welfare to state and local governments for radiological emergency response planning. The agency encourages interested persons to submit NDA's in the interest of the public safety. The agency is also announcing the availability of labeling guidelines for potassium iodide for such use. An NDA was approved in the Fall of 1979.
Keywords: potassium iodides; radiation accidents; emergency plans; drugs; thyroid; radiation protection; radioprotective substances; uses; radiosensitivity effects; nuclear medicine; radioisotopes.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

40000 Residential Energy Efficiency Standards Study: Technical Analysis. Tato, J. (National Inst. of Building Sciences, 1015 15th St., NW, Washington, DC). **Project number:** H-5040. **Contract:** H-5040. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This contract will define the energy efficiency standards, estimate the retrofitting costs and potential energy savings from applying the energy efficiency standards, and estimate the resultant economic impacts on the building industry.
Keywords: houses; energy efficiency; energy conservation; standards; retrofitting; economic impact.

40001 Residential Energy Efficiency Standards Study: Policy Analysis. Yap, L. (Urban Inst., 2100 M. St. NW, Washington, DC). **Project number:** H-2882-T04. **Contract:** H-2882-T04. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This contract will provide technical assistance on the housing and policy-related issues involved in Section 253 includng identifying and analyzing program options for implementation, developing working papers on the impact of requirements on housing consumers and lenders, and developing program alternatives.
Keywords: houses; energy conservation; standards; energy policy.

40002 Evaluating the Effectiveness of Mobile Home Heating and Cooling Systems. Ross, D. (Science Applications, Inc., 1651 Old Meadow Rd., McLean, VA, 22101). **Project number:** H-2828. **Contract:** H-2828. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Since mobile homes comprise 20% of all new housing starts, about 30% of all new single family dwellings, and about 95% of all new single family dwellings priced under $15,000, there is a distinct need to determine energy conservation performance and develop reasonable standards. Title VI (Mobile Home Construction and Safety Standards Act) of P.L. 93-383 requires that the Secretary of HUD establish such appropriate standards. In addition, Title III (Energy Conservation Standards for New Buildings) of P.L. 94-385 imposes further requirements on all forms of buildings. During 1979, extensive research will be accomplished on the mobile home's thermal envelope (walls, floor, ceiling, windows, roof, etc.) as well as on the performance of various heating and cooling systems. The result to date has been to develop, for the first time, proposed standards based upon full scale field testing, laboratory analysis, and climatological modelling. In FY 1980 and 1981, further research will continue to investigate problems that result from condensation which causes sweating on interior walls, degradation of the structural envelope, improper ventilation, etc., and inadequate, sporadic or unbalanced cooling. Examination of non-conventional wall, floor and ceiling systems will also be carried out to determine their performance and fire-safety characteristics.

Keywords: mobile homes; heating systems; cooling systems; energy conservation; performance; standards.

40003 Public Housing Energy Conservation Demonstration. Finalson, F. (Aerospace Corp., P.O. Box 92957, Los Angeles, CA; 90009). **Project number:** H-2515. **Contract:** H-2515. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this contract are (1) to provide coordinated and comprehensive documentation of energy conservation demonstrations now being conducted by the Aerospace Corporation for four Local Housing Authorities (LHAs) - Atlanta, Hartford, Chicago, and Los Angeles; and (2) to obtain information from these demonstrations in a form usable to HUD and other LHAs as examples of the management techniques and the results of energy conservation measures.
Keywords: demonstration programs; houses; energy conservation; documentation.

40004 Demonstration and Evaluation of Energy Efficient Residential Structures: Optimum Value Engineered Energy Conservation Home. Lubes, D. (National Association of Home Builders of the United States, 15th and M St. NW, Washington, DC, 20005). **Project number:** H-2326. **Contract:** H-2326. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This contract is to present to the public cost effective ways to save energy based on an actual demonstration and comparison of energy-saving systems versus conventional systems in single-family construction. The contractor provided the information through the identification of all potentially value-effective energy conservation features currently available, and then designed and constructed a house using those features which appear to offer the greatest value. The contractor is then evaluating the results under actual conditions and is preparing a Builders' Technical Manual, brochures, and an audiovisual show in addition to a final report documenting all of the work. The manual will provide builders with instructions on how to build dwellings containing appropriate optimum value-engineered energy conservation features, including construction methods, design concepts and categories of products and equipment. Specific tasks include the research, review and identification of value-effective thermal features, builder and site selection, marketing and site engineering studies, dwelling design, construction, cost analysis, testing, measurements, acceptability evaluation, technical manual, and public information program.
Keywords: demonstration programs; energy conservation; residential buildings; construction; construction industry; site selection; marketing; economic analysis.

40006 Effect of Building Mass on Residential Energy Consumption. Kusuda, T. (National Bureau of Standards, Gaithersburg, MD, 20234). **Project number:** IAA-H-300-79. **Contract:** IAA-H-300-79. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The HUD Minimum Property Standards (MPS) Insulation Standards do not consider the effect of mass such as masonry or heavy wood in conserving energy. The MPS has been criticized as not being cost effective in this omission since massive construction may require less insulation to provide the same measure of energy consumption.
Keywords: thermal insulation; houses; wood; building materials; energy conservation; energy consumption; mass.

40007 Home Buyer's Guide to Energy Efficient Homes. Spain, F. (Technology and Economics, Inc., 2225 Massachusetts Ave., Cambridge, MA, 02410). **Project number:** H-2648R. **Contract:** H-2648R. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Under this contract, a manual to assist prospective home buyers to evaluate the energy conservation features of new and existing homes has been developed and will be disseminated.
Keywords: energy conservation; houses; evaluation; manuals.

40008 Modular Integrated Utility System (MIUS): Application and Transfer (Information Dissemination). Honick, J. (Group Management Associates, Inc., 15910 Ventura Blvd., Encino, CA, 91436). **Project number:** H-2896. **Contract:** H-2896. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

At a MIUS site, a total energy co-generation system provides, from a single on-site facility, all of the energy needs of the complex for electricity, heating and air conditioning, and domestic hot water, as well as waste water treatment and solid waste collection and disposal. On such a site, the heat byproduct from electric generation, normally wasted by discharge to water or air in the environment, is recovered and used for space heating, cooling, potable hot water, etc. The current MIUS activity consists of dissemination of MIUS information and concept application through workshops and seminars in 1979--1980 for relevant interest groups such as developers, architects, engineers and key institutional actors.
Keywords: mius; co-generation; heating systems; air conditioning; hot water; waste water; water treatment; solid wastes; waste disposal; waste heat utilization; electric power; communities; information systems.

40009 Technical Evaluation of Solar Hot Water Initative System. (Polytechnic Inst. of New York, Brooklyn, NY). **Project number:** H-8012. **Contract:** H-8012. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

One of the requirements for the hot water initiative was that HUD standards must be met by solar systems. The Solar Energy Applications Center of the Polytechnic Institute of New York (PINY) was selected to carry out this evaluation.
Keywords: us hud; solar water heaters; standards; evaluation; demonstration programs.

40010 Solar Hot Water Initiative Program. (Polytechnic Inst. of New York, Brooklyn, NY). **Project number:** H-8001. **Contract:** H-8001-H-8011. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This was a special incentive program initiated in the spring of 1977 to encourage the solar industry through a large number (10,867) of $400 grants to homeowners for solar water systems. The program was administered by the participating states.
Keywords: solar water heaters; financial incentives; grants; us hud.

40011 Technical Support to Residential Solar Demonstration. (National Bureau of Standards, Gaithersburg, MD). **Project number:** IAA-H-38-76-T15. **Contract:** IAA-H-38-76-T15. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Under this interagency agreement, the National Bureau of Standards utilizes demonstration program data to develop technical performance criteria and standards, and maintains the residential solar data files for HUD.
Keywords: demonstration programs; solar heating systems; solar cooling systems; residential sector; intergovernmental cooperation; performance; standards; data base management; us hud; us nbs; data analysis.

40012 Access to Sunlight for Solar Energy Systems. Entwiztel, E. (Environmental Law Inst., 1346 Connecticut Ave., NW, Washington, DC). **Project number:** H-8213. **Contract:** H-8213. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Under this grant, the grantee was charged with investigating the legal questions presented by the need for a solar system to receive sunlight from over a neighboring property. The project report documenting this research was published during the summer of 1979.
Keywords: solar rights; legal aspects; ownership; solar collectors.

40013 Information Dissemination on Solar Heating and Cooling. Bordner, K. (Franklin Research Center, Philadelphia, PA). **Project number:** H-2377. **Contract:** H-2377. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This contractor provides the prinicpal support in HUD's responsibility to disseminate information on solar heating and cooling to the building industry and its customers. The major activity is operation of the National Solar Heating and Cooling Information Center.

Keywords: us hud; solar space heating; solar air conditioning; information centers.

40014 Management Support to Solar Heating and Cooling Demonstration Programs. Beers, D. (Boeing Aerospace Co., P.O. Box 3999, Seattle, WA). **Project number:** H-2732. **Contract:** H-2732. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) maintain a control center overseeing all demonstration grants; (2) provide a field staff to provide technical assistance and management guidance to grantees; (3) furnish technical and market development consultation to the HUD program staff; (4) assist in evaluation of demonstration grant applications; and (5) collect data from demonstration projects.
Keywords: demonstration programs; management; grants; market; us hud; solar space heating; solar air conditioning.

40015 Solar Access for New Residential Developments. Mesana, D. (American Planning Association, E. 60th St., Chicago, IL). **Project number:** H-2573. **Contract:** H-2573. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is concerned with methods of assuring solar access in new developments through the use of various land use control techniques. Two reports, providing guidelines to public land use officials and to site planners, were published during the summer of 1979.
Keywords: solar rights; legal aspects; land use; recommendations; us hud; residential sector.

40017 Technical Assistance for HUD Solar Residential Demonstration Program. Royal, G. (American Inst. of Architects/Research Corp., 1735 New York Ave. NW, Washington, DC, 20006). **Project number:** H-2384. **Contract:** H-2384. **Supported by:** Department of Housing and Urban Development, Washington, DC (USA). Office of Policy Development and Research. **Funding:** HUD.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This contract provides support from the architectural profession in the selection of demonstration projects and in the management of the demonstration activities. The contract will not be extended past its current completion.
Keywords: solar architecture; demonstration programs; residential buildings; social impact; management; solar heating systems; us hud.

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51000 In-Seam Tested for Underground Coal Mines. Wisner, J.N. (Ingersoll-Rand Research, Inc., P.O. Box 301, Princeton, NJ, 08540). **Project number:** 05304. **Contract:** H0282030. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to develop and demonstrate a portable, quick, in-situ tester for determining drum-bit forces required to excavate coal from the face of an underground coal mine heading. To date the contractor has completed development and fabrication of a full-scale, semi-functional model of the in-seam tester; and complete drawings of the field model have been sent out for price and delivery quotes. A funcional in-seam tester is the expected product which can be used by the designers of continuous mining equipment to obtain bit-force data.
Keywords: coal seams; coal mining; underground mining; testing; mining equipment; design.

51001 Importance of Airborne Particulate Matter to the Transport of Radon in Mine Atmosphere. Hopke, P.K. (Univ. of Illinois, 1000 W. Western Avenue, Urbana, IL, 61801). **Contract:** G0264010. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this research program is to study in detail the interaction between the daughter nuclides of radon and airborne particulate matter. To date the contractor has determined that the mechanism of attachment of radon daughters to monodispersed particles varies with temperature and humidity, and with the square of the particle diameter and particle concentration. The significance of these results is that under the conditions of very low radon daughter concentration, the diffusion theory no longer applies and the attachmnet must be explained using the kinetic theory of gases.
Keywords: particles; aerosols; radon; environmental transport; adsorption; temperature dependence; humidity; particle size; uranium mines; sorptive properties; daughter products; radionuclide migration.

51002 Citrate Process Chemistry and Engineering. Nissen, W.I. (Bureau of Mines, Salt Lake City Research Center, 1600 East 1st South, Salt Lake City, UT, 84112). **Project number:** 9370-8. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to determine the process chemistry of the absorption of sulfur dioxide from waste gas streams by the Bureau of Mines developed citrate process and to improve the process efficiency, reliability, operations, and economics. Research is to determine reaction rates and products, side reactions, and to identify fate of all products in the process. Also to be investigated is the steam stripping of sulfur dioxide from loaded citrate solutions and the use of coal or coke for hydrogen sulfide production. Results will provide support for the citrate process demonstration plant.
Keywords: citrate process; absorption; sulfur dioxide; chemical reactions; plumes; gaseous wastes; optimization; steam; hydrogen sulfides; synthesis; waste processing; air pollution control; desulfurization.

51003 Citrate Process: Evaluation and Selection of Materials. Henry, J.L. (Bureau of Mines, Albany Research Center, P.O. Box 70, Albany, OR, 97321). **Project number:** 4555-1. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to recommend the best materials of construction for equipment to be used in the citrate process demonstration plant in order to minimize corrosion. Materials will be tested in sulfur vapor, in aqueous sodium citrate, and in H2O mixtures under operating conditions. Corrosion rates of materials of construction under simulated operating conditions will be determined.
Keywords: citrate process; evaluation; desulfurization; equipment; materials testing; sodium compounds; corrosion protection; fossil-fuel power plants; flue gas.

51004 Biomechanical Study of Work in Low Coal. Peay, J. (Texas Tech Univ., Lubbock, TX, 79409). **Project number:** 03018. **Contract:** H0387022. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The biomechanical study of work in low coal will generate data which can be utilized in optimal job and work station design. The project is primarily concerned with (1) the analysis of those jobs in underground, low coal which require significant energy expenditures or other physical demands; (2) the measurement of these jobs for the purpose of assessing the demands using biomechanics and work physiology methodologies; and (3) the comparison of the job demands to the low coal miner capacities (anthropometric, biomechanic, and physiological) to determine the degree of loading on the miners and make recommendations to improve these jobs to reduce occupational stress. Phase I has been completed and data has been collected on biomechanical, work physiology, and anthropometric problem areas.
Keywords: coal mining; underground mining; coal miners; performance; biological stress; physiology; evaluation.

51005 Development of Requisite Support for the Lincoln Training System. Wiehagen, W. (Massachusetts Inst. of Technology, Lexington, A, 02173). **Project number:** 03831. **Contract:** J0366078. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

This project will develop an expanded version of the Lincoln Training System (LTS-5X) which will provide the mechanism for generating lesson material. The LTS-5X will provide means for generating frame logic that goes with each audio/visual display, or check-out of lessons in notebook form before commitment to fiche, and for sorting and displaying student performance data gathered on the LTS-5X terminals to evaluate lessons and student performance. A unit for producing the microfiche in a routine fashion will be designed, fabricated, and tested on the current laboratory model. This unit will provide a turn-key means for routine fiche production that transcribes audio and data to the sound logic spirals which is unique to the LTS requirement. Lincoln personnel will also assist the Bureau in transferring this system to the mining industry. The final report is currently being written.
Keywords: education; educational tools; coal industry; coal miners; data processing; data analysis.

51006 Precalculation of the Effect of Fires on Mine Ventilation. Gruer, R. (Michigan Technological Univ., Houghton, MI, 49931). **Project number:** 03981. **Contract:** J0285002. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this contract is to calculate, in advance of their occurrence, the effect of transient mine fires on airflow, temperature, and mine atmosphere contamination in real mine fire ventilation networks. A steady-state computer program that calculates the distribution of combustion products and other contaminants has been developed. A real-time program that includes the build-up time for fume products to spread to any location in the mine is being developed.
Keywords: coal mines; fires; ventilation systems; mathematical models; combustion; contamination; occupational safety; forecasting; flow models; air; planning; safety engineering.

51007 Analysis of Fire Safety Tests and Standards. Winger, J. (National Bureau of Standards, Gaithersburg, MD, 20760). **Project number:** 03026. **Contract:** J0188042. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

Standard operating procedures for existing flammable test methods for conveyor belts and hydraulic fluids are prepared. Test specifications and criteria for certification of commercial testing laboratories are developed. New or revised fire test methods and procedures for conveyor belts, hydraulic fluids, brattice cloths, electrical cable, plastic container, and joints are designed.
Keywords: coal mining; safety; fire prevention; specifications; testing; mining equipment; conveyors; hydraulic mining; electric cables; containers; flammability.

51008 Remote Sealing System Upgrading. Monaghan, D. (Foster-Miller Associates, 350 Second Avenue, Waltham, MA, 02154). **Contract:** H0188066. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

A system for sealing off mine areas remotely, i.e. from the surface, has been designed, constructed, and successfully demonstrated. Components of the system include an inert gas generator and a generator for the froth foam that tops the fly ash seal. After field evaluation and before a full-scale public demonstration, these two components were modified to improve their performance. This contract supported that upgrading and, subsequently, a successful public demonstration occurred.
Keywords: coal mines; safety engineering; fires; remote control; seals; optimization.

51009 Instruments and Techniques for Dynamic Particle Size Measurements of Coal Dust. Marple, V.A. (Univ. of Minnesota, Minneapolis, MN, 55455). **Project number:** 05304. **Contract:** H0177026. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The contractor will develop and evaluate instruments and techniques for measuring airborne respirable dust. To date the contractor has developed two dust size measuring systems and has completed a thorough evaluation for accuracy of two dust monitors - one beta absorption and one photometric type. Study on virtual unfactors and development and fabrication of a test chamber for evaluation and calibration of dust measuring instruments have also been completed. The contractor will continue to develop a more compact, reliable, and permissible optical particle counter/multi channel analyzer (OPC/MCA) system to be used in coal mines.
Keywords: aerosols; particles; dusts; inhalation; particle size classifiers; coal mines; air pollution monitors; coal mining; underground mining; measuring methods; classification; cascade impactors; evaluation; design; monitoring.

51010 Field Trials of a Microseismic Roof Fall Warning System. Steblay, B.J. (Integrated Sciences Inc., 1134 Francis Street, Longmont, CO, 80501). **Project number:** H027009. **Contract:** H0272009. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

Prior work ranging from early experiments with commercial ultrasonic leak detectors to more recent work with units custom designed for the task have continued to show that microseismic anomalies do occur before roof falls. This contract stems from work done under a previously completed contract, which produced a prototype microseismic roof fall warning system. The objective of this contract is to obtain data for a large number of roof falls of different types using the prototype system to establish a comprehensive data base for improvement of the design and reliability of the system, and for further development of a commercially practical unit for use in underground coal mines. This project is scheduled for completion in February 1980, and the field test data will be presented in a final report.
Keywords: field tests; roofs; alarm systems; seismic waves; coal mines; underground mining; data compilation; safety; accidents; information centers.

51011 Evaluation of Mine Roof Bolter Components. Curtin, R. (Bendix Corp., 2582 S. Tejon Street, Englewood, CO, 80110). **Project number:** H0272044. **Contract:** H0272044. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to design a new generation roof bolting machine consisting of recently developed Bureau bolter components. The machine will provide safe, hands-off drilling/bolting.
Keywords: coal mines; safety; roofs; roof bolts; evaluation; mining equipment; design.

51012 Roof Failure Analysis. Moebs, N.N. (Morehead State Univ., Morehead, KY, 40351). **Project number:** 03032. **Contract:** J0188002. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

Roof failure will be studied at selected mines in eastern Kentucky, and state-required roof fall maps will be analyzed. Geologic hazards will be identified, classified, and compiled in a hazard potential map showing zones, trends, and projections into unmined areas. The use of photolineaments in tracing hazard zones will be evaluated.
Keywords: roofs; coal mines; failures; hazards; geology; maps; kentucky; risk assessment; safety.

51013 Safe Insulations and Fluids for Permissable Enclosures. Paciorek, K. (Ultrasystems, Inc., 2400 Michigan Drive, Irvine, CA, 92715). **Contract:** J0377075. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The permissible electrical enclosure is the prime safety device for preventing ignition in gassy areas in coal mines. Non-electrical hazards (e.g., hot bodies, flames) generated in these enclosures could possibly compromise the enclosure design or prevent the electronical devices from operating properly. The objectives of this contract are to identify organic insulator materials that easily degrade under low voltage stress, to determine the insulator characteristics that facilitate their degradation, and to determine safe conductor spacings for clean and moist insulator surfaces.
Keywords: electrical insulation; safety; coal mines; fire prevention; quality assurance; decomposition; testing; alarm systems.

51014 Control of Diesel Exhaust Emission in Underground Coal Mines. Stawsky, A. (Engelhard Minerals and Chemical Corp., 70 Wood Avenue South, Iselin, NJ, 08830). **Contract:** H0199021. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(80); oil shale(20) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective is to develop and evaluate effective onboard means of removing diesel exhaust contaminants. Filters, catalytic converters, venturi scrubbers and onboard additives will be investigated to assess their effectiveness in reducing harmful emissions. Contaminants to be investigated include particulate matter, NOx, SOx, CO, and HC. Control measures will be laboratory tested on diesel engines ranging in horsepower from 80 to 200.
Keywords: exhaust gases; diesel engines; coal mines; underground mining; air pollution control; filters; catalytic converters; scrubbers; comparative evaluations; nitrogen dioxide; sulfur dioxide; carbon monoxide; hydrocarbons; particles.

51015 Investigation of Direct Airborne Noise Generated During Coal Cutting. Robertson, J. (Wyle Labs., 7800 Governors Drive West, Huntsville, AL, 35807). **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective of this study is to conduct a preliminary investigation of noise generation associated with coal breakage during the removal of coal from the face for the purpose of defining a comprehensive research and development program to minimize such noise. The research will require the use of a linear cutting machine to be developed for laboratory use under this program. Cutting tool parameters are to be studied for their correlation to noise generated. The linear cutting apparatus has been developed and various coal samples including synthetic coal have been tested. Results are being correlated. Parameters investigated include bit

angle, bit velocity, and depth of cut. The ultimate goal of the program is to develop practical methods of abating airborne noise generated by the coal cutting process performed by continuous mining machines.
Keywords: noise pollution abatement; coal mining; mining equipment; design; continuous miners; cutter loaders; underground mining.

51016 Development of a Reduced-Noise Auger Miner Cutting Head. Burks, J.A. (Wyle Labs., 7800 Governors Drive West, Huntsville, AL, 35807). **Contract:** H0188065. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective is to develop noise control techniques and hardware for control of acoustic radiation from auger cutting heads. A combined field and laboratory effort is required to measure the acoustic radiation, to determine the modes of vibration and radiation, and to devise control techniques. Hardware development will be accomplished with participation of the Wilcon Division of Fairchild Corp., a manufacturer of augers for underground use. Mechanical auger, cutting-head excitation modes have been identified in the laboratory, and a low-noise, retrofit cutting-head has been designed and is to be tested in mine. The ultimate goal is to provide a redesigned cutter-head.
Keywords: coal mines; auger mining; noise pollution abatement; mining equipment; design; underground mining; continuous miners.

51017 Psychological Responses of Miners to Emergency. Kamon, E. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** 03531. **Contract:** G0155006. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will quantitatively evaluate (1) the physiologic responses of miners to the demands brought about by emergency conditions, (2) the biophysical interaction between the miner and the prevailing environmental conditions during emergency, and (3) physiologic metabolic responses of rescue team members, including studies of fatigue when working for longer than two hours, effect of weight and breathing resistance of breathing apparatus of men, effect of inhalation of hot air, and effectiveness of cooling garmets to relieve heat stress during rescue missions. A new series of 30 CFR 11H man tests will be developed and evaluated.
Keywords: coal mines; occupational safety; coal miners; behavior; accidents; performance; metabolism; biological stress; fatigue; temperature effects; mine rescue; physiology.

51018 Theoretical Investigation of Seismic Waves Generated in Coal Mines. Greenfield, R. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** 03529. **Contract:** G0155044. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

In some mine post-disaster situations, it is possible to place seismic monitoring equipment inside the mine. Inside mine monitoring may have significant advantages over surface seismic monitoring because of both lower noise levels and possible higher signal levels. Thus in-mine operation should allow, in appropriate situations, a higher probability of detecting a trapped miner than surface techniques permit. It is the objective of this work to study the feasibility of in-mine seismic monitoring and to cutline its application in detecting and locating trapped miners. To date, work in this contract has produced an optimized surface deployed geophone subarray. This subarray has proven to be superior to the present subarray in the trapped miner seismic location system and is presently being incorporated into the system. Future work will investigate signal detection by in-mine implanted geophones.
Keywords: seismic waves; coal mines; seismic detectors; feasibility studies; monitoring; underground mining; accidents; coal miners; occupational safety; detection; emergency plans; mine rescue.

51019 Statistical Survey of Miners. Wiehagen, W. (John Short and Associates, Salt Lake City, UT). **Project number:** 03753. **Contract:** J0375109. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The study of methodology proposed will provide a planning document for industry and government officials which will help them to: (1) gain better understanding of the training related characteristics of the mining profile; (2) determine the existing demand and need for safety and health training throughout the entire mining spectrum; (3) assess the future (1985 to 2000) extent, location, and workforce characeristics by mine type and product for which safety and health training will be either required or necessitated; (4) obtain a better understanding of workforce turnover components; and (5) determine the various implications of the above forecasts as they relate to MSHA's training mission. The final report is now being written.
Keywords: miners; planning; government policies; decision making; safety; education; evaluation; reviews; statistics; forecasting; occupational safety.

51020 Development of Improved Scrubbers for Coal Mine Applications. (Donaldson Co., Inc., Minneapolis, MN, 55440). **Project number:** 3304. **Contract:** H0199055. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: scrubbers; design; coal mines; air pollution abatement; occupational safety; mining equipment.

51021 Direct Indicating Respirable Dust Collectors. (GCA Corp., Burlington Road, Bedford, MA, 01730). **Project number:** 3222. **Contract:** J0395061. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: dust collectors; design; display devices; coal mines; aerosols; dusts; personnel; safety.

51022 Study of the Measurement and Control of Respirable Dust in Mines. (National Academy of Sciences, 2101 Constitution Ave. NW, Washington, DC, 20418). **Project number:** 6317. **Contract:** J0199002. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: dusts; mines; monitoring; air pollution control.

51023 Abatement of Noise of Continuous Mining Machines. (Bolt, Beranek, and Newman, Inc., 50 Moulton Street, Cambridge, MA, 02138). **Project number:** 3609. **Contract:** H0155113. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: noise pollution abatement; coal mines; continuous miners; occupational safety; mining equipment.

51024 Investigation of Direct Airborne Noise Generated During Coal Cutting. (Wyle Labs., 7800 Governors Drive West, Huntsville, AL, 35807). **Project number:** 3901. **Contract:** J0177060. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: noise; noise pollution; coal mines; coal mining; data analysis.

51025 Development of a Personal CO2 Detector and a CH4 Detector. (Andros, Inc., 2332 Fourth Street, Berkeley, CA, 94710). **Project number:** 3980. **Contract:** H0377096. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: coal mines; carbon dioxide; measuring instruments; hydrocarbons; design; personnel; safety.

51026 Monitoring of Mine Air Pollutions. (Michigan Technological Univ., Houghton, MI, 49931). **Project number:** 3664. **Contract:** J0199125. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: coal mines; air pollution; monitoring; carbon monoxide; hydrocarbons; occupational safety; exhaust gases; mining equipment; indoor air pollution.

51027 Control of Diesel Exhaust Emissions in Underground Coal Mines. (Southwest Research Inst., 6220 Culebra Road, San Antonio, TX, 78284). **Project number:** 5335. **Contract:** J0188157. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: diesel engines; mining equipment; exhaust gases; coal mines; underground mining; air pollution control; indoor air pollution.

51028 Reduction of Pollutants from Engines Operated Underground. (DOE, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 3679. **Contract:** J0166023. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.

Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: exhaust gases; mining equipment; underground mining; coal mines; air pollution control; occupational safety.

51029 Determination of the Products of Oxidative Thermal Degradation of Variously Treated Woods and Mine Materials. (Ultrasystems, Inc.; 2400 Michelson Drive, Irvine, CA, 92715). **Project number:** 3201. **Contract:** J0395008. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: coal mines; wood; mining equipment; thermal degradation; oxidation; carbon monoxide; hydrocarbons; occupational safety; gaseous wastes.

51030 Toxic Fumes from Explosives Tested in Underground Mines. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** 3422. **Contract:** H0395098. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: coal mines; underground mining; toxicity; aerosols; explosions; testing; health hazards; chemical explosives; sulfur compounds; nitrogen compounds; carbon monoxide; hydrocarbons; elements; trace amounts; safety; indoor air pollution.

51031 Analysis of the Economic Impact of Post-Accident Production Losses in Underground Coal Mines. (FMC Corp., 328 Brokow Road, Santa Clara, CA, 95052). **Project number:** 3157. **Contract:** J0387233. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: economic impact; accidents; underground mining; coal mining; production.

51032 Cost Benefit Analysis of Applied Health and Safety Research Development Projects in Coal and Metal and Nonmetal Mining. (Ketron, Inc., 530 Swedesford Rd., Wayne, PA, 19087). **Project number:** 3219. **Contract:** J0199042. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: cost benefit analysis; safety; coal mining; mining; minerals; metals; research programs.

51033 Improvement of Coal Mine Dust Incombustible Content Meter. (GCA Corp., Burlington Road, Bedford, MA, 01730). **Project number:** 3007. **Contract:** H0387001. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: coal mines; dusts; air pollution monitors; combustion properties; optimization; monitoring.

51034 Development of a Remote Readout Coal Dust Deposition Rate Monitor. (Ivor Hawkes Assoc., 14 Parkhurst Street, Lebanon, NH, 03766). **Project number:** 3044. **Contract:** J0188058. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
A remote readout for a coal dust deposition rate monitor will be developed.
Keywords: coal; dusts; readout systems; remote control; deposition; deposits; monitoring; aerosols.

51035 Analysis of Fire Safety Tests and Standards. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 3026. **Contract:** J0188042. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: fire prevention; standards.

51036 Improvement of Coal Mine Dust Incombustible Content Meter. (Nuclear Equipment Corp., 963 Industrial Road, San Carlos, CA, 94070). **Project number:** 3007. **Contract:** H0387021. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: coal mines; dusts; quantity ratio; measuring instruments; design; aerosols; fission products; monitoring.

51037 Salt Processes for Improvement of Health and Safety in Underground Coal Mining. (VPI and State Univ., Blacksburg, VA, 24061). **Project number:** 3683. **Contract:** J0155180. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: coal mining; underground mining; occupational safety; coal miners; optimization.

51038 Improving Surface Coal Refuse Disposal Site Inspections. (Chicago Aerial Survey, 2140 Wolf Road, Des Plaines, IL, 60018). **Project number:** 4300. **Contract:** J0188027. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: spoil banks; surface mining; coal mines; waste management; water pollution; land pollution; inspection.

51039 Coal Mine Hazard Detection Using Synthetic Pulse Radar. (Ensco, Inc., 5408A Port Royal Road, Springfield, VA, 22151). **Project number:** 2357. **Contract:** H0292025. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: coal mines; hazards; detection; radar; pulse techniques; underground mining; safety engineering.

51040 Application of Remote Sensing for Coal Waste Embankment Monitoring. (Shannon and Wilson, Inc., 1105 N. 38th Street, Seattle, WA, 98103). **Project number:** 4338. **Contract:** H0282041. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: remote sensing; coal mines; waste management; spoil banks; monitoring.

51041 Develop Deep-Penetrating Borehole Geophysical Technique for Prediction of Hazards Ahead of Coal Mining. (Southwest Research Inst., 6220 Culebra Road, San Antonio, TX, 78284). **Project number:** 2133. **Contract:** H0252033. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: borcholes; hazards; forecasting; coal mines; coal mining; occupational safety; safety engineering.

51042 Centrifue Modeling and Verification of Design Criteria of Mine Waste Embankments. (DOE, Albuquerque Operations Office, Albuquerque, NM, 87185). **Project number:** 4410. **Contract:** J0295038. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: spoil banks; coal mines; design; land reclamation; data analysis; waste management.

51043 Centrifuge Model Testing of Coal Waste Embankments. (Department of Defense, Waterways Experiment Station, Vicksburg, MS, 39180). **Project number:** 4289. **Contract:** H0282018. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: mathematical models; spoil banks; coal mines; waste management; solid wastes; land pollution; water pollution.

51044 Evaluation of Coal Deposits in the Narragansett Basin of Rhode Island and Massachusetts. (Boston College, Weston, MA, 02193). **Project number:** 5258. **Contract:** J0188022. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: coal deposits; exploration; rhode island; massachusetts; evaluation.

51045 Analysis of the Economic Feasibility for Development of Coal Resources in the Narragansett Basin of Rhode Island and Massachusetts. (Charles River Associates, Inc., 1050 Massachusetts Avenue, Cambridge, MA, 02138). **Project number:** 5259. **Contract:** J0188043. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: feasibility studies; coal reserves; energy source development; rhode island; massachusetts; economic analysis; coal deposits.

51046 Evaluation of Best Management Practices for Mining Solid Waste Storage, Disposal, and Treatment. (EPA, 401 M Street

SW, Washington, DC, 20460). **Project number:** 6326. **Contract:** J0199104. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: waste management; coal mines; waste storage; waste disposal; waste processing; evaluation; data analysis.

51047 Borehole Mining: an Environmentally Compatible Method for Mining Oil Sands. (Flow Industries, Inc., 21414 68th Avenue S., Kent, WA, 98031). **Project number:** 5338. **Contract:** J0295064. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.
Keywords: oil sands; boreholes; mining; oil sands; environment; oil sand deposits.

51048 Site Specific Investigation of Environmental Problems Associated with Surface Mining of Heavy Oils and Tar Sands. (Golder Associates, Inc., 10628 NE 38th Place, Kirkland, WA, 98033). **Project number:** 5321. **Contract:** J0295027. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.
Keywords: surface mining; oil sands; oil sand industry; environmental impacts; hydrocarbons.

51049 Monitoring and Modeling of Shallow Ground Water in the Powder River Basin. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** 2256. **Contract:** J0265050. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.
Keywords: ground water; monitoring; mathematical models; coal mining; waste water; water quality.

51050 Environmental Factors Affecting Surface Mining of Steeply Pitching Coal Seams. (Ketron, Inc., 530 E. Swedesford Rd., Wayne, PA, 19087). **Project number:** 4357. **Contract:** J0199006. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: surface mining; coal mining; coal seams; environmental impacts; hydrocarbons; elements; trace amounts; waste water.

51051 Technical and Economic Feasibility Study of Using Cemented Backfill in Active Underground Mines to Prevent Subsidence. (Micheal Baker Jr., Inc., 4301 Dutch Ridge Road, Beaver, PA, 15009). **Project number:** 5303. **Contract:** J0295001. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: technology assessment; feasibility studies; cements; backfilling; underground mining; coal mines; ground subsidence; prevention of significant deterioration.

51052 Inventory of Waste Embankments, Surface, and Underground Openings Metal/Nonmetal Active Mines. (Mountain States Research Development, Interstate 10 and Vail Road, Tucson, AZ, 85731). **Project number:** 4370. **Contract:** J0199054. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.
Keywords: coal mines; uranium mines; waste management; surface mining; underground mining; inventories; spoil banks; technology transfer; information.

51053 Impact of Surface Lignite Mining on Surface and Groundwater Quality in Texas. (Texas A and M Univ., Research Foundation, FE Box H, College Station, TX, 77843). **Project number:** 2405. **Contract:** J0295016. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: coal mining; surface mining; ground water; water quality; texas; environmental impacts.

51054 Continuation of Evaluation of Coal Deposits in the Narragansett Basin of Rhode Island and Massachusetts. (Department of Energy, Washington, DC, 20545). **Project number:** 6325. **Contract:** J0199061. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: coal deposits; rhode island; massachusetts; exploration; evaluation.

51055 Measurement of Seepage Beneath Tailing Ponds. (ASARCO, Inc., P.O. Box 5447, Tucson, AZ, 85703). **Project number:** 4399. **Contract:** S0261025. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: coal mines; leaching; tailings; ponds; waste management; ground water; water pollution.

51056 Evaluation of Lixiviation of Mine Wastes. (Calspan Corp., P.O. Box 400, Buffalo, NY, 14225). **Project number:** 4377. **Contract:** J0199057. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: leaching; coal mines; waste management; waste water; water pollution control.

51057 Field Test for Environmental Disposal of Mill Tailings in Surface Backfill. (Greater Shoshone County, Inc., Box 320, Wallace, ID, 83873). **Project number:** 4346. **Contract:** J0188146. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.
Keywords: mill tailings; feed materials plants; radioactive waste disposal; field tests; radioactive waste management.

51058 Assessment of Ground and Surface Water Effects Around Coal and Mineral Storage Areas. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** 5350. **Contract:** J0199076. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: ground water; surface waters; coal mines; waste water; water quality; environmental impacts.

51059 Effects of Subsidence from Thick-Seam Coal Mining on Hydrology. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** 2336. **Contract:** J0295012. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: ground subsidence; coal mines; hydrology; environmental effects; coal seams; coal mining.

51060 Technical and Economic Evaluation of Underground Disposal of Coal Mining Wastes. (HRB-Singer, Inc., P.O. Box 60, State College, PA, 16801). **Project number:** 2273. **Contract:** J0285008. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: coal mines; coal mining; underground mining; underground disposal; waste disposal; solid wastes; data analysis; waste management; technology assessment; economic analysis.

51061 Pilot Scale On-Site Evaluation of Activated Carbon for Rapid Oxidation of Ferrous Iron in Acid Mine Water. (Rhode Island Analytical Lab., Inc., 231 Elm Street, Warwick, RI, 02886). **Project number:** 3211. **Contract:** J0395036. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: acid mine drainage; activated carbon; waste water; waste processing; water treatment; iron compounds; cations; oxidation; evaluation; pilot plants; chemical reactions; waste management; coal mines.

51062 Analysis of Ground Water Criteria and Recent Restoration Attempts After In Situ Uranium Leaching. (Resource Engineering and Development, Inc., 3333 S. 900 E., Suite 240, Salt Lake City, UT, 84106). **Project number:** 5320. **Contract:** J0295019. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.
Keywords: ground water; leaching; uranium mines; radioactive wastes; radionuclide migration; soils; radioactive waste management.

51063 Developing a Slurry Fill for Modified In-Situ Oil Shale Mining. (Rio Blanco Oil Shale Co., 9725 E. Hampden Ave., Denver, CO, 80231). **Project number:** 4394. **Contract:** J0295046. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.

Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.
Keywords: oil shale deposits; oil shale mining; in-situ processing; slurries; backfilling; waste management.

51064 Effects of Coal Mine Subsidence on Ground Water Aquifers in Northern Appalachia. (Science Management Engineering, P.O. Box 190, King of Prussia, PA, 19406). **Project number:** 3231. **Contract:** J0199063. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: ground subsidence; coal mines; aquifers; appalachia; ground water; environmental effects.

51065 Water Handling Procedures for Reducing Acid Formation in Underground Coal Mines. (Skelly and Loy, 2601 N. Front Street, Harrisburg, PA, 17110). **Project number:** 3220. **Contract:** J0199027. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: coal mining; underground mining; waste water; acid mine drainage; water pollution control; water quality.

51066 Computer Analysis, Physical Analysis, Physical Properties, and Data on Spent Shale. (Department of Defense, Waterways Experiment Station, Vicksburg, MS, 39180). **Project number:** 6320. **Contract:** H0262064. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.
Keywords: computer calculations; data analysis; data; spent shales; oil shale industry; waste management; solid wastes; water pollution; land pollution.

51067 Contamination of Ground and Surface Waters by Uranium Mining and Milling. (Univ. of Colorado, 380 Willard, Boulder, CO, 80309). **Project number:** 5325. **Contract:** J0295033. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.
Keywords: ground water; surface waters; contamination; uranium mines; feed materials plants; environmental impacts; radionuclide migration.

51068 Fugitive Dust Study of an Open Pit Coal Mine. (Univ. of Minnesota, 2642 University Avenue, St. Paul, MN, 55114). **Project number:** 5367. **Contract:** J0295071. **Supported by:** Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: dusts; coal mines; surface mining; particles; air pollution control; air quality.

51069 Control of Water Pollution from Surface Mining Operations. (Wapora, Inc., 511 Old Lancaster Road, Berwyn, PA, 19312). **Project number:** 4404. **Contract:** J0199089. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: water pollution control; surface mining; waste water; coal mines; environment.

51070 Determination of the Optimum Topsoil Depth Requirements for Surface Coal Mined Areas Within the Northern Great Plains Coal Province. (Colorado School of Mines, Research Institute, P.O. Box 112, Golden, CO, 80401). **Project number:** 2250. **Contract:** J0265025. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: soils; depth; surface mining; land reclamation; coal mines; great plains; waste management.

51071 Environmental Effects of Slaking of Surface Mine Spoils. (D'Appolonia Consulting Engineers, Inc., 10 Duff Rd., Pittsburgh, PA, 15235). **Project number:** 2338. **Contract:** J0285024. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: environmental effects; surface mining; spoil banks; coal mines; leaching; waste management; water pollution; land pollution.

51072 Investigation of the Mechanics of Mine Acid Formation in Underground Coal Mine Drainage. (Eco-Control, Inc., 56 Rodgers St., Cambridge, MA, 02142). **Project number:** 3935. **Contract:** J0387215. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: acid mine drainage; underground mining; coal mines; waste water; mechanics.

51073 Development of Innovative Systems for Leveling and Recontouring Abandoned Spoil Banks. (Golder Associates, Inc., 10628 NE 38th Place, Kirkland, WA, 98033). **Project number:** 4390. **Contract:** J0295048. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: spoil banks; coal mines; abandoned sites; excavation; land reclamation.

51074 Minimization of Groundwater Contamination in Surface Mine Backfills. (Pennsylvania State Univ., University Park, PA, 16802). **Project number:** 4358. **Contract:** J0188136. **Supported by:** Bureau of Mines, Spokane, WA (USA). Spokane Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: ground water; water pollution control; contamination; waste water; surface mining; backfilling; coal mines; environmental impacts.

51075 Stability of Surface Mined Spoils at Central U.S. Coal Mines. (Shannon and Wilson, Inc., 1105 N. 38th St., Seattle, WA, 98103). **Project number:** 2297. **Contract:** J0275013. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: coal mines; surface mining; spoil banks; usa; waste management; solid wastes; stability.

51076 System Approach to the Reclamation of Strip-Mined Areas in North Dakota: Phase IV. (Univ. of North Dakota, Grand Forks, ND, 58202). **Project number:** 2321. **Contract:** J0295015. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: north dakota; surface mining; land reclamation; coal mines; abandoned sites; waste management.

51077 Design, Layout and Costing of a Prototype Underground Demonstration Mine in Oil Shale Deposits. (Cleveland-Cliffs Iron Co., P.O. Box 1211, Rifle, CO, 81650). **Project number:** 2257. **Contract:** J0265020. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: oil shales; technology assessment; design; cost; process development units; oil shale mining; underground mining.

51078 Underground Disposal of Spent Shale from the Paraho Retorting Process. (Cleveland-Cliffs Iron Co., P.O. Box 1211, Rifle, CO, 81650). **Project number:** 4214. **Contract:** J0265052. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: spent shales; waste disposal; underground disposal; retorts; oil shale industry; waste management.

51079 Evaluate the Fire and Explosive Hazards of Oil Shale Mining and Processing. (Tosco Research, Inc., 10100 Santa Monica Blvd., Los Angeles, CA, 90067). **Project number:** 3815. **Contract:** J0275001. **Supported by:** Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: fire hazards; explosions; hazards; oil shale mining; oil shale deposits; oil shale processing plants; occupational safety; evaluation; oil shale industry.

51080 Engineering Services Regarding Exploration Drilling Program in the Oil Shale Area of Northwestern Colorado. (DOE, Nevada Operations Office, P.O. Box 14100, Las Vegas, NV, 89114). **Project number:** 2230. **Contract:** H0252078. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: exploration; oil shale deposits; colorado; engineering; drilling.

51081 Preparation and Compilation of Geological and Hydrologic Information of the Oil Shale Deposits of the Piceance Creek Basin. (Geological Survey, Denver Federal Center, Denver, CO). **Project number:** 2183. **Contract:** H0252010. **Supported by:** Bureau of Mines, Denver, CO (USA). Denver Research Center. **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: oil shale deposits; colorado; geology; hydrology; exploration; data analysis.

51082 Anthracite Refuse Demonstration/Preparation Plant. (Anjomar, Inc., P.O. Box 702, Pittston, PA, 18640). **Project number:** 7088. **Contract:** J0177022. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.
Keywords: anthracite; coal preparation plants; solid wastes; waste management; water pollution; land pollution; pilot plants.

52000 Incorporating Fish and Wildlife Values into Decisions Regarding Electric Power Facilities. Johnson, R. (Fish and Wildlife Service, 2929 Plymouth Road, Ann Arbor, MI, 48105). **Project number:** Power Plants B.3. **Supported by:** Fish and Wildlife Service, Ann Arbor, MI (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The siting of power generation and transmission facilities is a very complex process involving economic, social, and environmental considerations. In part, past efforts to arrive at an acceptable siting procedure have had limited success due to (1) the inability to describe the effects of various options in terms which decisionmakers understood (e.g., direct financial costs/benefits to consumers versus environmental costs/benefits); and (2) the commonly-held opinion that additional detailed environmental data is necessary to adequately describe environmental effects for decisionmaking. In FY 79 a procedure for actually making siting decisions was developed using a multiple-objective programming model to provide predictions of economic, social, and environmental tradeoffs, and adaptive environmental assessment and management techniqes for resolution of conflicts. In addition, these techniques were used to develop a procedure to provide sufficient environmental information without resorting to on-site data collection.
Keywords: power plants; power transmission lines; site selection; decision making; environmental impacts; cost benefit analysis.

52001 Coastal Characterizations. (Fish and Wildlife Service, Washington, DC, 20240). **Project number:** Coastal 2.0. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is the structured synthesis of existing information and data into an information base identifying the functional relationships of natural processes and components of the ecosystem. This information base will reflect an ecosystem-level of understanding for the Texas Barrier Island ecosystem emphasizing OCS oil and gas, transportation, and fishing and hunting activities. This will be accomplished by development of a planning model, habitat mapping, collection of environmental information and data, and compilation of socioeconomic data (historic and present).
Keywords: texas; coastal regions; information systems; aquatic ecosystems; terrestrial ecosystems; habitat; data acquisition; data compilation.

52002 Ecological Interactions on Arid Lands. Jones, C. (Fish and Wildlife Service, National Fish and Wildlife Lab., Washington, DC). **Project number:** Coal 048-75. **Contract:** 14-16-0008-0936. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The study will determine the functional ecological relationships between seed production and seed depredators, and the resultant effects on vegetational succession in the arid southwest, with special reference to the implications to revegetation strategies on disturbed lands. Quantitative descriptions of important biotic components, specific management suggestions with respect to key plant and animal species, and a manual of investigative procedures for field personnel with sections on planning a study and analyzing data will be provided.
Keywords: revegetation; arid lands; seeds; land reclamation; predator-prey interactions.

52003 Surface Mining Effects and Stipulation Manuals. (Ecological Consultants, Inc., Ft. Collins, CO). **Project number:** Coal 010-76. **Contract:** 14-16-0009-77-008. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project will summarize mining technology and the associated physical, chemical, and biological disturbances. Three handbooks will be prepared containing recommended environmental protection/monitoring lease stipulations and a flow diagram of where and when control stipulations can be introduced to benefit fish and wildlife.
Keywords: surface mining; environmental impacts; recommendations; manuals; reviews; wild animals; fishes; management; us doi.

52004 Utilizing Approaches for Coal Conversion and Mine Waste Waters for Fish and Wildlife Habitat Enhancement and Development. (Skelly and Loy, 2601 N. Front St., Harrisburg, PA, 17110). **Project number:** Coal 028.1-77. **Contract:** 14-16-009-77-042. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project will develop a state-of-the-art manual for operational personnel detailing existing and promising methods and strategies related to the utilization of western coal mine and mine-mouth conversion plant waters for fish and wildlife habitat enhancement.
Keywords: waste water; coal mines; waste processing; water resources; arid lands; fishes; manuals; operation; waste product utilization.

52005 Application of the Western Energy and Land Use Model to Strip Mining Activities in an Ecological Test Area. Gross, J. (Fish and Wildlife Service, 2625 Redwing Road, Ft. Collins, CO, 80526). **Project number:** Coal 085-78. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The Western Energy and Land Use Model was initially developed to simulate significant time and space events in a developing oil shale mining operation. The system was improved and applied to coal problems in FY 78. This modeling effort has clearly shown application to coal-related problems and appears to be of significant value to regional and team aspects of the Coal Project, as well as to BLM and GS in testing criteria for lands unsuitable for mining and for reviewing mining plans. The impact assessment approach developed by SAG will be further tested on coal in the Montana/Wyoming Test Area. The goal is to identify areas suitable and unsuitable for mining development. The Test Area will be divided into geographic units, and information developed, impacts assessed and then the units will be ranked into a preferred sequence for development. An operating system/process will be delivered to WELUT and to the Billings Area Office. The related characterization and geographic information studies will be optimally integrated into this effort this fiscal year.
Keywords: coal mining; environmental impacts; mathematical models; montana; wyoming; land use.

52006 Effect of Peaking for Power on Wildlife Habitat. Giger, R. (Fish and Wildlife Service, 500 NE Multnomah Street, Portland, OR, 97232). **Project number:** Water 441.00Y78. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A coordinated study is conducted as a part of the ongoing inventory of riparian habitats and associated wildlife of the Columbia and Snake Rivers, Phase II study. The impact on riparian wildlife and habitat of diurnal water fluctuations and wave action of varying magnitudes is studied. An outdoor research facility is utilized to simulate the water fluctuations and wave actions.
Keywords: columbia river; wild animals; habitat; water waves; water supply; daily variations; shores; functional models; environmental impacts.

52007 Pilot Application of Regional Instream Flow Methodology in Water for Energy Assessments. Stalnaker, C. (Fish and Wildlife Service, 2625 Redwing Road, Ft. Collins, CO, 80526). **Project number:** Water 436.00Y78. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The chain of impacts on aquatic ecosystems of water for energy is assessed and described beginning with impacts of water withdrawal. Subsequent impacts on sediment yields, stream conditions, and eventually aquatic fauna are also described. Handbooks are prepared for biologists and developers describing potential problems and opportunities for cohesive action. In high-potential energy development areas, the relative ecological sensitivity of each stream is assessed, taking into account water withdrawals and present ecosystem integrity. Methods for creating aquatic habitats are identified, evaluated, and described as part of ongoing energy development and reclamation activities.
Keywords: manuals; streams; aquatic ecosystems; power generation; environmental impacts; water removal; habitat; land reclamation.

52008 Guide for Vegetating Surface Mined Lands for Wildlife. Vogel, W. (Forest Service, Berea, KY). **Project number:** Coal 250-77. **Contract:** 14-16-009-77-923. **Supported by:** Fish and Wildlife Service, Kearneysville, WV (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purpose of the agreement is to provide financial support to the U.S. Forest Service, NEFES, to summarize the current state-of-the-art for revegetating surface mined lands with plants of value to wildfauna. This information will be compiled in a guidebook titled A Guide for Vegetating Surface Mined Lands for Wildlife. The guidebook is intended for use by mine operators and a variety of land and resource managers, including Federal and state fish and wildlife personnel concerned with surface mining and reclamation activities and problems. This cooperative agreement will also (1) help the Forest Service and the Fish and Wildlife Service explore future research needs on this subject which are of mutual interest and benefit; (2) make possible the summarization, analysis, and publication of the diverse and scattered information on revegetation of strip-mined lands in the east with plants of value to wildfauna; and (3) expand ongoing research efforts on this subject.
Keywords: surface mining; spoil banks; revegetation; manuals; wild animals.

52009 Effects of Coal Extraction and Related Development on Wildlife Density. (Fish and Wildlife Service, Denver Wildlife Research Center, Denver, CO). **Project number:** Coal 045-76. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The study will determine the impact of strip mining coal on selected wildlife species (antelope, mule deer, white tail deer, and a number of raptors). For ungulates the primary tool used is radio telemetry. Habitat-species relationships will be analyzed. A quantitative report detailing habitat-wildlife relationships and how coal extraction and related development affects wildlife will be the end product of this study. Recommendations will be given on how mining plans can be altered to have the least detrimental effect on wildlife.
Keywords: coal mining; surface mining; environmental impacts; wild animals; habitat; population density.

52010 Synthesis and Evaluation of Avian Populations and Habitat: West Virginia and Alabama. Anderson, S. (Fish and Wildlife Service, Research Migratory Bird Lab., Laurel, MD). **Project number:** Coal 258-77. **Supported by:** Fish and Wildlife Service, Kearneysville, WV (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

In the breeding bird census data bank at Patuxent, data are available on bird populations and habitats for 83 plots located in, or adjacent to, counties in the West Virginia coal region. In addition, data are also available from 16 randomly distributed (50 stop) breeding bird survey routes within this region. Similar data, though in less quantity, are available for the coal region in Alabama. This effort will compile these data with data from other published sources and evaluate it to characterize avifauna and their habitats and impacts of coal development on changes in avifauna populations and habitats in West Virginia and Alabama.
Keywords: birds; west virginia; alabama; coal producing districts; populations; habitat; coal mining; environmental impacts.

52011 Predicting and Minimizing the Adverse Effects on Fish Associated with Intake and Discharge Structures. Fritz, E. (Fish and Wildlife Service, 2929 Plymouth Road, Ann Arbor, MI, 48105). **Project number:** Power B.2. **Supported by:** Fish and Wildlife Service, Ann Arbor, MI (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Activities in FY 1979 included the following: (1) the completion of a study on factors associated with accuracy in sampling fish eggs and larvae; (2) the refinement of a model for predicting entrainment and impingement; (3) the completion and verification of a density-dependent mortality model; (4) the development of methods for assessing impacts on fish and shellfish; (5) the determination of the effectiveness of existing intake designs in protecting fish and shellfish; and (6) the identification of fish behavioral and physiological parameters and data requirements for determining intake design criteria for minimizing entrainment and impingement.
Keywords: cooling systems; environmental impacts; fishes; eggs; sampling; mathematical models; entrainment; impingement; mortality; molluscs; intake structures; behavior; design.

52012 Threatened and Endangered Species and Significant Natural Features: Data Collection and System Development in West Virginia. Peluri, F. (Nature Conservancy, 1116 Quarter Street, Charlestown, WV, 25301). **Project number:** Coal 257-77. **Contract:** 14-16-0009-77-062. **Supported by:** Fish and Wildlife Service, Kearneysville, WV (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to develop a process, or method, for gathering, managing, analyzing, and utilizing information on threatened and endangered plant and animal species, and significant natural features in the Appalachian coal mining region and to test the utilization of the data management process by producing a report, with maps, for the coal producing areas of West Virginia and to prepare a guide describing the heritage program and how it can be used in aiding land use planning decision making.
Keywords: endangered species; appalachia; west virginia; land use; decision making; planning; information systems; coal producing districts; manuals.

52013 Marine Bird Study: Outer Continental Shelf. Lensink, C. (Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK, 99503). **Project number:** Coastal 2.7-8. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of the Marine Birds Studies is to develop an information base about pelagic and marine birds. The project will study population dynamics and trophic relationships of marine birds, effects of aircraft disturbances on seabird nesting colonies, and the biological and ecological aspects of marine birds that should be considered during an assessment of the possible impacts of oil and gas development.
Keywords: birds; marine surveys; alaska; population dynamics; baseline ecology; aircraft; environmental impacts; petroleum industry.

52014 Predicting and Minimizing the Adverse Effects of Fish and Wildlife and Their Habitats from Burning Coal for Electric Power Generation. Schreiber, R.K. (Fish and Wildlife Service, 2929 Plymouth Road, Ann Arbor, MI, 48105). **Project number:** Power B.1. **Supported by:** Fish and Wildlife Service, Ann Arbor, MI (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project seeks to document the state-of-knowledge regarding the ecological effects of burning coal for electric power generation and the means for minimizing adverse effects. Methods for predicting the effects of SO2 on fish and wildlife were advanced by development of a mathematical model for predicting the effects of SO2 on selected types of habitat.
Keywords: coal; combustion products; power generation; wild animals; fishes; mathematical models; sulfur dioxide; habitat; environmental impacts; forecasting.

52015 In-Situ Uranium Mining. Martinka, R. (Montana Dept. of Fish and Game, Helena, MT). **Project number:** Minerals 509-76. **Contract:** 14-16-0008-2124. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Various energy companies are planning to test the feasibility of uranium solution mining on the Long Pines Area of eastern Montana. This study will monitor the ecosystem effects of solution mining techniques and wildlife populations, and develop guidelines for reducing these conflicts. Studies will be conducted to furnish the baseline data needed to monitor the effects of solution mining. Long Pines will be used as a model demonstration site for researching the compatiblity of wildlife, vegetation and solution mining. The project will also review Montana's environmental protection statutes in terms of protection to the environment.
Keywords: solution mining; uranium deposits; environmental effects; wild animals; terrestrial ecosystems; montana; pollution laws; uranium mines; uranium ores.

52016 Utilization of Geothermal Effluents to Create Waterfowl Wetlands. (Fish and Wildlife Service, 2625 Redwind Road, Ft. Collins, CO, 80526). **Project number:** Minerals 521-79. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to determine the feasibility of utilizing geothermal effluent to create waterfowl wetlands at Brady Hot Springs, Nevada. Feasibility will be determined in two phases: Phase I - preparation of a state-of-the-art analysis of the ecological, engineering design, legal/institutional, and socio-economic factors and constraint affecting project feasibility; and Phase II - work plan development, site selection, and implementation of a pilot waterfowl wetland geothermal disposal project.
Keywords: geothermal power plants; thermal effluents; waste management; feasibility studies; marshes; land use; birds.

52017 Plant Information Network. Bryant, G. (Colorado State Univ., Botany and Plant Pathology Dept., Ft. Collins, CO, 80523). **Project number:** 005-76. **Contract:** 14-16-0008-2058. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI. **Related energy source:** Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

An existing information system, RAPIC, has been modified, adapted, and tested to catalog taxonomic, geographic, ecologic, biologic, and economic information on plant species found in Colorado, Montana, and Wyoming. The PIN is an operational system used to aid in vegetation inventories, impact assessments, land-use planning, and reclamation planning. In FY 79 PIN was expanded to include North and South Dakota. The tasks included: (1) decisions on the taxonomy of plant species in North and South Dakota, (2) information entry, (3) training, (4) consultants, (5) interdisciplinary advisory committee, (6) modifications and additions, (7) operation of PIN data bank and selected interactive terminals, and (8) publication of a handbook of southwestern North Dakota.

Keywords: information systems; plants; colorado; montana; wyoming; north dakota; south dakota; taxonomy; ecology; economics; us doi.

52018 Fish and Wildlife Impact of Energy Development in the Four Corners. Parker, A. (Univ. of New Mexico, Dept. of Economics, Albuquerque, NM). **Project number:** Minerals E3. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** EPA.

Related energy source: Coal(20); solar(20); geothermal(20); hydroelectric(20); conservation(20) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project examines the impact to fish and wildlife resources in the Four Corners region from demographic changes associated with energy development. Conclusions are based upon energy development scenarios and recreation dispersion models which evaluate alternative scenarios of energy development, recreation, land use, and regulation.

Keywords: fossil-fuel power plants; arizona; new mexico; utah; colorado; environmental impacts; fishes; wild animals; human populations.

52019 Mitigation Goals for Oil Shale. Russell, K. (Colorado State Univ., Fort Collins, CO). **Project number:** Minerals 051-75. **Contract:** 14-16-0008-2016. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.

Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study identifies the most significant fish and wildlife population reductions that will result from environmental changes caused by oil shale development, formulates a list of candidate mitigation goal alternatives, and evaluates the effectiveness of a sample of previous attempts to mitigate wildlife population reductions. The study's work activity is centered at the Cooperative Wildlife Research Unit at Colorado State University and focuses on assembly of presently existing data. Evaluation of earlier mitigation efforts requires field data collection. Extensive communication with persons possessing specialized knowledge of specific topics in the area of ecology, oil shale development, land-use planning, and systems modeling is necessary. No collection of quantitative data in the field is anticipated.

Keywords: oil shales; mining; environmental impacts; terrestrial ecosystems; data compilation; oil shale industry; population dynamics.

52020 Atlantic Coast Ecological Inventory: Refinery Siting Study. (Dames and Moore, 7101 Wisconsin Avenue, Washington, DC, 20014). **Project number:** Coastal 2.18. **Supported by:** Fish and Wildlife Service, NSTL Station, MS (USA). **Funding:** DOI.

Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The major purpose of this study is to identify areas of the Atlantic Coast that are unsuitable environmentally for siting oil and gas processing and manufacturing facilities by locating and mapping areas of high natural resource value. Important coastal fish and wildlife species and habitats as well as special land use designations will be inventoried and described. This will be used on available information.

Keywords: atlantic ocean; shores; coastal regions; site selection; petroleum industry; industrial plants; fishes; wild animals; habitat; inventories.

52021 Trace Substances in Wildlife Food Chains. Nagy, J.G. (Colorado State Univ., Fort Collins, CO). **Project number:** Minerals 41-76. **Contract:** 14-16-0008-2111. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.

Related energy source: oil shale(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study is focused on the trace substances that occupy the food chains related to wildlife in the Piceance Basin. Information will be compiled on elements which might be potentially hazardous materials in the environment, and an investigation of wildlife food habits will be conducted to obtain data on possible hazards of trace elements for the fauna of the region. Data will be collected on trace element concentrations in animal tissues and in selected plant materials and on actual or likely sources of trace mineral contaminations.

Keywords: elements; trace amounts; food chains; colorado; tissues; plants; animals; ecological concentration; environmental impacts; oil shales.

52022 Developing Methods for Managing Land and Water Affected by Electric Power Generation and Transmission for Fish and Wildlife Habitat. Hoover, K. (Fish and Wildlife Service, 2929 Plymouth Road, Ann Arbor, MI, 48105). **Project number:** Power Plants B.4. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** DOI.

Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Private and public utilities control large amounts of land, much of which is suitable for fish and wildlife habitat. This study is to develop methods for managing transmission line rights-of-way, ash and sludge disposal areas, and cooling lakes and ponds, for fish and wildlife habitat.

Keywords: power transmission lines; rights-of-way; sanitary landfills; cooling ponds; wild animals; land use; management.

52023 Determine the Distribution and Habitat Requirements of Aquatic Endangered Species in High Potential Energy Development Areas. Armour, C. (Fish and Wildlife Service, 2625 Redwing Road, Ft. Collins, CO, 80526). **Project number:** Water 443.00Y78. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** DOI.

Related energy source: Coal(20); oil and gas(20); oil shale(20); conservation(40) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Mechanisms are being developed to identify, locate, and monitor endangered species in regions under stress from energy development. The habitat requirements of Colorado squawfish are being identified, and the impact on Colorado squawfish of modifying stream temperatures below Flaming Gorge Dam is being determined.

Keywords: endangered species; fishes; utah; streams; dams; temperature effects; biological effects; habitat; modifications.

53000 U.S. Lineaments. Carter, W.D. (USGS, EROS Program, Stop 730, Reston, VA, 22092). **Project number:** E-6. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$35,000.

Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Lineaments of the conterminous United States derived by analysis of Landsat mosaics have been completed at scales of 1:10,000,000, 1:5,000,000, and 1:1,000,000 to determine the structural fabric of the nation. The 1:1,000,000 map has been reduced to a scale of 1:2,500,000 to fit and compare with the Geologic and Tectonic Maps of the United States. These comparisons have identified many areas where faults are not shown on the existing maps and indicate areas where further field work may be necessary. More recently, as part of the Intergovernmental Affairs Fellowship Program of the U.S. Civil Service Commission a lineament map of the State of Maine was compiled at 1:250,000 scale and reduced to 1:500,000 to fit and compare with the geologic map of the state. Field work suggests that strike-slip faults may be the cause of major offsets in the drainage pattern of the Penobscot and Kennebec Rivers. Seasat synthetic aperture radar (SAR) covering a swath from Pecos, Texas, to Bozeman, Montana, is now being evaluated in several intervening areas to compare lineaments derived from radar and Landsat data.

Keywords: hydroelectric power plants; geology; topography; usa; maine; site selection; rivers; maps; earth planet; radar; remote sensing; satellites.

53001 Arctic Environmental Studies Program. Ferrains, O.J. Jr. (USGS, 345 Middlefield Road, Menlo Park, CA, 94025). **Project number:** 9310-01546. **Supported by:** Geological Survey, Menlo Park, CA (USA). **Funding:** DOI-$410,000.

Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to investigate energy-related transportation corridors and other areas of development in Alaska in order to obtain base-line geotechnical data needed to aid in (1) planning, designing, operating, and maintaining engineering structures, (2) minimizing adverse environmental impacts of construction and operation of engineering projects, and (3) evaluating the feasibility of proposed engineering projects. The methods employed are to: (1) map and study the major surficial geologic units in transportation corridors and make interpretations of the potential engineering problems and availability of construction materials; (2) collect and synthesize seismic data; (3) study geologic processes that are especially active in Alaska; and (4) observe environmental problems that arise during construction and operation of the TransAlaska oil pipeline in order to evaluate methods for controlling adverse environmental impacts.

Keywords: petroleum; natural gas; pipelines; alaska; environmental impacts; baseline ecology; transport; permafrost; arctic regions.

53002 Oil Shale Hydrology. Hudson, H.H. (USGS, Denver Federal Center, Box 25046, MS 406, Lakewood, CO, 80225). **Project number:** CO-75-060. **Supported by:** Geological Survey, Lakewood, CO (USA). **Funding:** DOI-$2,311,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

A program is being conducted to predict, evaluate and assess the environmental impacts of oil shale development by: (1) establishing a baseline water monitoring network in oil shale areas of Colorado, Utah, and Wyoming; and (2) modeling the hydrologic systems to be impacted by oil shale development to permit simulation of possible impacts. The project is to be accomplished by establishing and operating numerous water monitoring stations to measure the surface and ground water systems and by constructing and calibrating hydrologic models of the hydrologic systems to permit simulation and prediction of impacts. Results will be models of the hydrologic systems and pre-development baseline data against which impacts can be assessed.
Keywords: oil shale mining; environmental impacts; colorado; utah; wyoming; ground water; surface waters; water resources; hydrology.

53003 Hydrology of the Madison Limestone in North Dakota, South Dakota and Wyoming. Cushing, E.M. (USGS, Denver Federal Center, MS 412, Box 25046, Lakewood, CO, 80225). **Project number:** CR-76-192. **Supported by:** Geological Survey, Lakewood, CO (USA). **Funding:** DOI-$2,335,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Major development of coal within this area will place a heavy demand on the area's limited water resources. Surface water is poorly distributed in time and space. It is fully appropriated in part of the area, and in the rest its use will require storage reservoirs and distribution systems. Preliminary studies indicate that the Madison limestone and associated rocks might provide a significant percentage of the total water requirements for coal development. However, the effects of large sustained withdrawals of water from these rocks on the hydrologic system are not known. The program is designed to evaluate quantity of water that may be available from the Madison, define chemical and physical properties of the water, determine effects of existing developments on potentiometric head, storage, recharge and discharge, spring flow and streamflow, and pattern of ground-water flow, and to predict possible hydrologic effects of proposed withdrawals of water for large-scale developments at selected rates and locations, and to determine the better locations for wells and the type of construction and development of deep wells to obtain optimum yields. A network of observation wells and streamflow gages to monitor effects of additional developments on the hydrologic system is planned. The approach is to assemble, review, and assess available geologic and hydrologic data, prior studies, and oil company information. Borehole and surface geophysical information and other pertinent data are to be purchased from oil companies. The program also includes defining structure and stratigraphy and determining aquifer boundaries and geologic parameters that control permeability. These parameters are transferred into hydrologic terms. A test-drilling program is to be designed to test aquifer. Preliminary digital simulation model of system is planned along with a monitoring network.
Keywords: north dakota; south dakota; wyoming; limestone; hydrology; water resources; evaluation.

53004 Coal Hydrology. Kilpatrick, F.A. (USGS, Reston, VA, 22092). **Project number:** WD-75-040. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$1,318,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to assess the impacts of existing mining on water resources due to mine drainage, sediment movement, mine dewatering and consumptive water use. Impacts on hydrologic systems at or in proximity to active coal mining and reclamation sites will be evaluated via: (1) water quality measurements, both surface water and ground water; (2) sediment yields from mining areas; (3) changes in ground water levels in coal mining areas; and (4) laboratory studies on coal geochemistry and coal--water--sediment interactions.
Keywords: coal mining; acid mine drainage; sediments; water removal; hydrology; land reclamation; ground water; surface waters; water quality; sulfates; nitrates; hydrocarbons; organic compounds; geology; environmental impacts; water resources.

53005 Low Level Waste Hydrology. DeBuchananne, G. (USGS, National Center, MS 410, Reston, VA, 22092). **Project number:** WD-75-046. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$1,826,000.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the research is to determine the processes and principals that control migration of radioactive waste in different hydrological environments. An understanding of processes and principles will provide a sound basis for the development of geologic and hydrologic criteria that can be used to select, develop, and monitor future low-level solid radioactive waste disposal sites. The understanding of the controlling parameters of waste migration will also provide the basis for designing monitoring systems at existing low-level waste burial sites. Hydrogeological field observations are being made at five NRC licensed, state-owned, privately operated, solid low-level waste disposal sites. Each of these existing sites is located in a different hydrogeological environment. The field data will be correlated with theoretical geochemical and kinetic laboratory data obtained by using rock materials and waste solution from the existing burial sites. The information generated will be used to design waste solute transport models to better predict the migration and/or fate of waste nuclides. The results of the waste transport models from the different environments will be used to identify hydrogeological criteria for use in the selection of future low-level waste sites and to design an adequate monitoring network at existing disposal sites.
Keywords: low-level radioactive wastes; hydrology; radionuclide migration; solid wastes; radioactive waste disposal; ground water; cesium; mathematical models.

53006 Heat Transfer Across an Air-Water Interface. Jobson, H.E. (USGS, Gulf Coast Hydroscience Center, Bay St. Louis, MS, 39529). **Project number:** SR-73-033. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$180,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

It is desired to obtain a better understanding for predicting evaporation. The objective of this project is to improve current methods for prediction of water temperature and evaporation under both natural and altered conditions. Models will be developed for the following categories: (1) cases where the vertical temperature stratification is an important factor; (2) cases where the lateral temperature gradient dominates the process; and (3) cases where the water is mixed. In developing these models, studies will be conducted on energy transfer processes such as evaporation, conduction and radiation. Sensitivity analysis will be performed on model parameters such as net absorbed radiation, air temperature, and wind speed.
Keywords: heat transfer; water; air; mathematical models; evaporation; numerical solution; temperature measurement; interfaces.

53007 Energy Lands. Maberry, J.O. (USGS, Office of Environmental Geology, USGS National Center, Stop 9081, Reston, VA, 22092). **Project number:** 9530-01931. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$2,929,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to acquire, interpret, and disseminate geologic, hydrologic, geochemical, and related information that will assist in analyzing and solving environmental problems associated with energy resource extraction and utilization, and planning, siting, and construction of energy conversion and distribution facilities. The programs assemble basic geologic, geochemical, engineering, and interpretive earth-science investigations into the environmental aspects of energy resource recovery, transmission, and conversion. Maps and reports characterizing environmental earth-science aspects are being prepared for areas of Montana, North Dakota, Wyoming, Utah, Colorado, New Mexico, Arizona, Oklahoma, Kansas, and Texas.
Keywords: montana; north dakota; wyoming; utah; colorado; new mexico; arizona; oklahoma; kansas; texas; data acquisition; mapping; geochemical surveys; geological surveys; hydrology; energy source development; environmental impacts; planning.

53008 Water Monitoring in Coal Lease Areas. Hudson, H.H. (USGS, Denver Federal Center, Mail Stop 406, Box 25046, Lakewood, CO, 80225). **Project number:** CR-77-222. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$1,895,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives of this program are to assess baseline hydrologic conditions in actual or probable coal mining areas with emphasis on public lands. A regional network of hydrologic monitoring stations will be established on public lands where coal leasing is likely. New monitoring stations are in operation in North Dakota, Montana, Wyoming, Colorado, New Mexico, Utah, Oklahoma, and Alabama.
Keywords: coal deposits; leasing; ground water; surface waters; monitoring; hydrology; hydrocarbons; public lands; usa.

53009 Remote Sensing of High Temperature Geothermal Areas of Iceland. Williams, R.S. Jr. (USGS, Land Information and Analysis Office, EROS Program, MS 730, Reston, VA, 22092). **Project**

number: USGS/LIA E-0003. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI; INEA.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

The overall objective of the binational cooperative research project in Iceland is to determine the scientific and operational use of aerial and satellite photography and/or imagery to monitor and to study the dynamic geological and geophysical environment of Iceland, with particular reference to geologic hazards and geologic and geomorphic processes. The geothermal studies, a task of the project, involve the preparation of a professional paper on aerial photographic, aerial thermographic, and satellite imagery studies of the 27 high-temperature areas of Iceland. The primary product will be a comprehensive monograph on the use of remotely-sensed data in the analysis of high-temperature geothermal areas in Iceland. Aerial photography and thermography will be correlated with ground-based geological and geophysical data to provide a complete reference work to Iceland's high-temperature geothermal areas. A comprehensive bibliography and index of the extant scientific literature of the geothermal areas of Iceland will be an important part of the monograph. During the past year research emphasis has been directed at field work in Iceland, distribution of aerial photos, aerial thermographs, and maps to the chapter authors, and to the compilation of the bibliography and index of the 27 confirmed and potential high-temperature geothermal areas of Iceland. Over 4000 bibliographic citations on the geology and geophysics of Iceland have now been indexed and typed, including references to most of the geothermal literature. A comprehensive outline has been prepared for the USGS professional paper, and 3 editors and 15 chapter authors have been selected. The monograph should aid in the exploration for exploitable high-temperature geothermal areas in the U.S. and other areas.
Keywords: iceland; remote sensing; geothermal fields; kgra; infrared surveys; aerial surveying; geology; geophysics; photography; geothermal exploration; bibliographies; thermography.

53010 National Environmental Overview Program. Epstein, J.B. (USGS National Center, Reston, VA, 22092). **Project number:** 9510-01593. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$587,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives are to summarize many of the characteristics and geographic distribution of earth materials, nature and extent of geologic processes and hazards, and to inventory many of man's activities related to resource extraction in the United States on maps that are generally 1:7,500,000, although more detailed maps and reports have been prepared. The maps and reports will provide a geologic and hydrologic data base useful to the understanding of environmental problems on a national scale and will be useful for generalized decision-making on land-use, energy- and mineral-resource development and their environmental impact, and public health. The products are prepared by combining the talents of many regional experts, by literature research, by new technique development, and by limited field investigations. Future products will include maps and reports concerning geology of nuclear reactor sites, bedrock lithology, radioactive waste management sites, coal strip mines, strippable coal, carbonates for SO2 scrubbing, limestone resources, swelling clays, geologic hazards, solution-mine subsidence, quaternary dating applications, sand and gravel resources, karst lands and caverns, regional Btu values for coal and lignite, volcanic hazards, permafrost, bedrock excavability, and others.
Keywords: usa; mapping; geological surveys; hydrology; data acquisition; reactors; lithology; radioactive waste management; scrubbing; landslides; mathematical models; geologic faults; site selection; energy source development; minerals; environmental impacts; sulfur dioxide; surface mining; coal mining.

53011 Energy-Related Environmental Studies. Edgar, N.T. (USGS, National Center, MS 915, Reston, VA, 22092). **Project number:** 9450-9460. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$4,217,000; BLM-$3,285,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

Marine environmental research studies are focused primarily on identifying and mapping, regionally, the marine geologic hazards to offshore development. All information gathered in these studies forms a common base of understanding for the safe leasing and development of resources on the OCS and is made available to other Federal agencies, the petroleum industry, and the concerned public. Features commonly identified as environmental hazards include submarine landslides, seafloor faults, earthquakes, seafloor ice scours, shallow gas charged sediments, extreme wave conditions, and floating sea ice. Studies conducted in the course of these investigations are tailored to the regional geology and oceanography of each OCS lease area. Program priorities initially are determined by the Department of Interior's lease sale schedule, but within a given OCS area, program emphasis is re-evaluated after each field season because newly gathered information may reduce a formerly assumed hazard to a mundane problem and elevate a relatively unknown process to the level of a substantial environmental risk. An analysis of the environmental geology is prepared for inclusion in the pre-call for nominations summary reports which are submitted to BLM for their consideration in tract selection. Later, regional environmental geology reports are submitted to BLM for incorporation in Environmental Impact Statements. Newly identified features that are recognized after EIS preparation to be potential hazards to offshore development are considered for tract withdrawal or stipulations prior to a lease sale. The USGS also conducts environmental geology studies cooperatively to meet program requirements of other agencies and prepares reports for BLM and NOAA.
Keywords: offshore operations; geology; geologic faults; leasing; hazards; earthquakes; sediments; maps; oceanography.

53012 Marine Geology Investigations. Edgar, N.T. (USGS, National Center, MS 915, Reston, VA, 22092). **Project number:** 9460-9450. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$1,246,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Research on marine sediments has been conducted on the continental shelves off New England, California, and Alaska, and phosphorite deposits have been studied in the South Georgia embayment and off southern California. Sediment instability studies, a decision prerequisite for offshore structures and pipelines, have been carried out in the Gulf of Mexico and Gulf of Alaska and will continue in support of the USGS's platform verification program. Studies related to factors controlling the strength of sediments on the ocean floor, such as gas content are being conducted with several Gulf Coast universities. Research on the engineering properties of marine sediments and on the effect of storm waves on these properties is based on in situ measurements made from offshore petroleum platforms. Combined geologic and hydrologic studies in San Francisco Bay and Willapa Bay (Oregon) are providing an understanding of estuarine environments and the sensitivity of these environments to natural and man-induced changes. In addition, these studies provide significant insight into the interpretation and prediction of distributions of ancient rock bodies as investigated in other elements of the USGS programs. Coastal processes are being studied off Texas and Massachusetts in cooperation with State Government agencies. An offshore sand resource investigation is being conducted cooperatively with the Government of the Virgin Islands. In certain areas, deep-sea sediments overlying the oceanic crust are enriched in economically valuable minerals, and preliminary investigations are underway to determine the source and process of mineral enrichment. This work, together with a study of the effect of disturbed marine sediments on the ocean water column and biota, are done in cooperation with NOAA. For FY 80, the studies described above will be continued, as will research on the relationship between deep-sea minerals and the marine sediments in which they occur.
Keywords: usa; continental shelf; sediments; offshore platforms; phosphorites; stability; sea bed; geological surveys; marine surveys; pipelines.

53013 Geothermal Investigations--Subsurface Environmental Impact. Christiansen, R.L. (USGS, 345 Middlefield Road, Menlo Park, CA, 94025). **Project number:** 9700-01522. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$552,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The project objective is to assess the impact of geothermal development and utilization on the subsurface environment in terms of the possibilities of increased seismic activity, and subsidence, and changes in ground water flow and quality. The approaches are to: (1) establish vertical and horizontal control nets for monitoring subsidence associated with subsurface fluid withdrawal; (2) establish seismic nets for monitoring induced microearthquake activity; and (3) collect hydrologic data in order to establish baseline standards for the quality and flow of ground water. The results expected include: (1) reports of land subsidence and earthquake activity in the Imperial Valley and The Geysers, California; (2) preliminary assessments of ground deformation in the Long Valley, California; (3) hydrologic data from Long Valley, Imperial Valley, and Raft River area; and (4) environmental research related to geothermal systems.
Keywords: geothermal resources; energy source development; environmental impacts; ground subsidence; seismic events; water quality; monitoring; hydrology; imperial valley; geysers geothermal field; long valley; raft river valley; microearthquakes; ground water; risk assessment.

53014 Sulfur in Coal and Lignite. Bodenlos, A.J. (USGS, National Center, MS 956, Reston, VA, 22092). **Project number:** 9420-01092. **Contract:** 9420-01092. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$56,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A program is reported that is designed to collate sulfur content of coal and lignite with paleoenvironments of deposition and

to establish hypotheses on the genesis of sulfur in those fuels. The aim is to determine possible changes in S content of coals as they mature and to apply the findings in predicting S content of unexplored coals. The methods employed are to: (1) review the literature on the geology of coal, stratigraphy of coal-bearing basins, and the sulfur content of coal; (2) study the available analyses of organic and inorganic sulfur in coal of various ranks and geologic basins; (3) determine the paleoenvironments that led to variations in the sulfur content of coal; and (4) prepare a USGS report on the findings.
Keywords: coal; lignite; sulfur; forecasting; quantity ratio; chemical composition; paleontology; maturation; natural occurrence.

53015 Reactor Hazard Research Program. Morris, R.H. (USGS, National Center, 12201 Sunrise Valley Drive, MS 908, Reston, VA, 22092). **Project number:** 9500-10010. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$2,655,000; NRC-$750,000.
Related energy source: nuclear fission(90); conservation(10) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The Reactor Hazards Research Program is designed to provide basic research of geologic and tectonic features which are significant in determining the seismic engineering parameters of nuclear power plants. About 50 research projects have been implemented which will lead to a better understanding of geologic processes such as faulting and earthquake generation and how these may be related to construction of large engineering facilities.
Keywords: nuclear power plants; power reactors; reactor sites; engineering geology.

53016 Fraunhofer Luminescence. Watson, R.D. (USGS, EROS Program, 2255 North Gemini Drive, Flagstaff, AZ, 86001). **Project number:** 7030-24110. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$80,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to identify and discriminate selected natural resources and environmental pollutants through the use of an airborne Fraunhofer line discriminator (FLD) which measures solar stimulated luminescence. A supporting laboratory program uses a fluorescence spectrometer to quantify the luminescence of materials of interest and to predict the detectivity of such materials with the FLD. The luminescence of oils (crude and refined), oil shales, industrial and residential wastes (including phosphate plant and paper mill effluent), phosphate and gypsum outcrops, and geochemically stressed vegetation was quantified in terms of a known standard rhodamine WT. Results were used to predict the detectivity of these materials with an airborne FLD. Measurements of luminescence with the FLD proved the validity of the predictive technique. Application of the FLD measurements to the environmental impact of phosphate plant effluent at Lakeland, FL, and paper mill effluent at Perry, FL, were made in cooperation with the Environmental Protection Agency. In addition, geochemically stressed vegetation was detected at Malachite Mine, CO, and Pine Mt., NV. The FLD was also used in cooperation with the Army Corps of Engineers to measure longshore currents in Lake Michigan by using fluorescent dyes at tracers. The instrument is now operating in an imaging mode from a fixed-wing aircraft. Marked success has been shown in imaging oil seeps in the Santa Barbara Channel, CA, and fluorescent rocks associated with uranium mineralization in New Mexico and Utah.
Keywords: fraunhofer lines; luminescence; discriminators; fluorescence spectroscopy; oils; oil shales; industrial wastes; municipal wastes; phosphates; aerial monitoring; plants; contamination; oil spills; uranium ores; mineral resources; gypsum; aerial prospecting; new mexico; utah.

53017 Chemical Analysis and Geologic Evaluation of Coal in Western United States. Hatch, J.R. (USGS, Denver Federal Center, P.O. Box 25046, Stop 972, Denver, CO, 80225). **Project number:** 9420-01980. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$150,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project will characterize U.S. coal resources west of the Mississippi River as to their elemental, and mineralogic composition. In cooperation with state geological surveys, about 3200 to 3300 coal samples will be collected and analyzed chemically and about 1650 analyzed mineralogically over the next five years. Approximately 600 coal samples will be analyzed chemically for 60 to 70 major, minor, and trace elements, proximate analysis, ultimate analysis, forms of sulfur, Btu, free swelling index, and ash fusibility. Low temperature ash mineralogy will be determined for approximately 250 selected samples. All analyses will be incorporaed in the USGS NCRDS. An EPA summary report of all analytical data obtained during the fiscal year will be prepared. U.S. Geological Survey open-file reports on the analyzed samples will be prepared.
Keywords: usa; coal deposits; geology; coal; chemical composition; minerals; chemical analysis; sulfur; calorific value; ashes; melting.

53018 Oilspill Trajectory Analysis. Lanfear, K.J. (USGS, 760 National Center, Reston, VA, 22092). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Oilspill risk analyses will be conducted to determine the relative environmental hazards of developing oil in different regions of the U.S. outer continental shelf. These studies will employ a large mathematical model to analyze the probability of spill occurrences, likely paths of spilled oil, and locations of resources vulnerable to spilled oil. The combined results will yield estimates of the overall oilspill risks associated with development of proposed lease areas. In FY 1980, oilspill risks analyses are scheduled to be completed for the Kodiak Island, central and northern California, South Atlantic, Cook Inlet and Shelikof Strait, Mid-Atlantic and Gulf of Mexico outer continental shelf leasing areas.
Keywords: oil spills; trajectories; mathematical models; continental shelf; california; gulf of alaska; gulf of mexico; mid-atlantic region; risk assessment; leasing.

53019 Assessment of Western Coal Mining Reclamation. Narten, P.F. (USGS, 760 National Center, Reston, VA, 22092). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

An assessment is made of the potentials for establishing productive diverse plant communities, composed primarily of native plants, in western coal mining areas. The study combines reconnaissance examinations of natural and planned reclamation results at western coal mines with literature reviews. Climatic, landform, overburden, soil, and biological (including vegetation) parameters are examined together with techniques available to reduce the impacts detrimental to reclamation. Variances in mining company approaches are discussed. Twenty-two coal mines from North Dakota to Arizona are tabularly compared. Although there are no long-term examples of mine reclamation that would meet the Office of Surface Mining's regulations, current data suggests that desirable reclamation can mostly be achieved with strict planning and implementation practices based on existing technology and specific mine site characteristics. The results are to be presented for lay-reader comprehension in a Geological Survey publication.
Keywords: coal mining; land reclamation; revegetation; north dakota; south dakota; arizona; utah.

53020 Comparative Study of Change and Disorganization in Energy Development Communities of the Great Plains. Thompson, J. (Univ. of Wyoming, University Station, Laramie, WY, 82071). **Contract:** 7060-30011. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI; UWY; PSU.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purpose of this study is to develop testable hypotheses concerning the effects of rapid community change associated with energy development on the social well-being of local populations. To this point, statements concerning these effects made on the basis of limited evidence and analysis are having substantial influence on policy action in several areas where rapid change associated with energy development is occurring. Many of the impact studies to date have drawn largely negative conclusions about development. Critical analysis of the situation will proceed via the following steps: (1) explication of the theoretical meaning and implications of the assertion that rapid community change associated with energy development has social consequences which on the whole can be regarded as negative, including negative conclusions regarding the social organization of affected communities and attendant citizen effects--such as alleged high rates of divorce, welfare dependence, crime, mental illness, etc. (assertions will be refined to produce general hypotheses for empirical study); (2) the testing process, including examination of empircal trends in a selected set of localities, specifically in the Old West states, which have experienced varying degrees and rates of change apparently associated with energy development in recent years; (3) specification of alternative (competing) hypotheses derived from previous research and from general theories of social and community change; and (4) multivatiate analyses to assess the level of support provided the principal hypothesis and the major competing hypotheses. The results of this analysis and theory refinement will be applied to developing improved socioeconomic analyses for environmental impact statements.
Keywords: communities; energy source development; social impact; energy policy; sociology.

53021 Council on Environmental Quality: Environmental Statistics and Indicators. Smith, E.T. (USGS, 750 National Center, Reston, VA, 22092). **Project number:** R11. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are compilation of a directory of national environmental statistics to cover such areas as air/water quality,

land use, mineral resources, energy, food/fiber, and others; and presentation of these statistics in graphical form in a publication on environmental indicators and one on trends indicated by the statistics. Statistics will be assembled largely from federal sources, e.g., land use and minerals data from USGS, food/fiber data from USDA, etc., for each statistical area. Interpretive analyses will be prepared to evaluate the data for significance and probable trends in each subject area. A contract will be let by CEQ with CEQ, GS, and EPA, the sponsors of the activity, providing program direction, guidance, and review. In addition, the Federal project managers will arrange for advice and review by experts in the various categories covered. The statistics will be periodically updated and published when significant changes warrant. In addition to the report, Environmental Statistics (published in 1979), a report entitled Presenatation of Environmental Indicators, will be prepared. Selected tables and graphs were used in the CEQ annual report. Portions of the report were U.S. contributions to the International State of the Environmental report published by the Organization for Economic Cooperation and Development.
Keywords: biological indicators; environmental effects; statistics; directories; air quality; water quality; land use; resources; mineral resources; environment.

53022 Cavitating Water Jet Cleaning Nozzle. Thiruvengadam, A.P. (Springlake Research Center, 15110 Frederick Rd., Woodbine, MD, 21797). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to harness the destructive forces of cavitation erosion in a water jet nozzle for cleaning underwater structural joints. A hand-held gun-like device has been tested by divers on an offshore structure. Cleaning rate to bright metal on 6-year marine growth was 1 square foot per minute. No back thrust from the jet was experienced, nor was there much turbulence in the water to obscure the divers' view.
Keywords: nozzles; offshore platforms; cavitation; erosion; cleaning; underwater; turbulence; performance.

53023 Blowout Prevention Procedures for Offshore Drilling. Bourgoyne, T. (Louisiana State Univ., Baton Rouge, LA). **Contract:** 14-08-0001-17225. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to develop improved well control procedures by obtaining in-situ experimental data to evaluate mathematical analyses and rule of thumb assumptions used in controlling the flow of drill muds. The project will study the transient conditions of well kicks, start up, and shut down. An experimental well for modeling deepwater drilling operations, together with surface support equipment, has been designed. The university's training facility well is being used to study flow characteristics of adjustable chokes and blowout preventers.
Keywords: offshore drilling; pressure control; blowouts; blowout preventers; oil wells; natural gas wells.

53024 Detecting Incipient Structural Failure Using Randomdec. Yang, J.A. (Univ. of Maryland, College Park, MD). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI; DOD.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A method is being developed of nondestructive evaluation of a structure by periodic recording and filtering of its natural vibration response signature to obtain changes in structural damping. Experimentation is being conducted on a model offshore structure which is being tested in air and water, and on solid and sand footings.
Keywords: offshore platforms; cracks; nondestructive testing; mechanical vibrations; functional models.

53025 Underwater Acoustic Telemetry. Softley, E. (Ocean Electronics Applications, 245 Ridgewood Rd., Key Biscayne, FL, 33149). **Contract:** 14-08-0001-17520. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

A technique is being developed for transmitting underwater information by means of digital acoustic telemetry between a transmitter and receiver, which determine by signal and feedback the optimum frequency, data rate and power level. An optical imaging mission has been devised for the system. It will acquire an image, convert it to digital data and transmit the data to the surface. Equipment has been developed, and is being evaluated at sea.
Keywords: underwater operations; telemetry.

53026 Fluidic Sensor for Hydrocarbon and Hydrogen Sulfide Gas. Funke, M. (Tri Tec, Inc., P.O. Box 56, Columbia, MD, 21045). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a technology for sensing H2S and hydrocarbon gas on an offshore structure by means of a fluidic gas concentration sensor.
Keywords: hydrogen sulfides; hydrocarbons; gases; offshore platforms; fluidic devices; monitoring.

53027 Dynamic Response of Offshore Structures. Vandiver, J.K. (Massachusetts Inst. of Technology, Cambridge, MA, 02139). **Contract:** 14-08-0001-17202. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objectives of this project are: the prediction of the dynamic response of structures to wave excitation; the development of a design estimator for predicting structural life; and the investigation of artificial damping of structures to increase fatigue life. First year efforts procured and set up spectral analysis equipment and determined mathematical and statistical approach as well as sources of response data for use in the program. Two high resolution spectral estimators are being applied to assess the degree of structural damping: maximum likelihood spectral analysis (to locate frequency bands of energy), and maximum entropy analysis (to assess energy levels in the various bands). Results to date indicate substantially lower damping than commonly believed. The maximum likelihood spectral analysis is the subject of R.B. Campbell's PhD thesis and is soon to be published.
Keywords: offshore platforms; oceanography; fatigue; wave forces; water waves; dynamic loads.

53028 Toxic Effects of Drill Mud on Coral. Shinn, G. (USGS, Fisher Island Station, Miami Beach, FL, 33139). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is the quantification of the effects of whole drilling muds on corals and the quantification of the extensiveness and chemical consistencies of mud plumes. Tests indicate no more toxic than standard mud (CaCo3). Work on corals has been completed, and mud plume data acquired from several drilling platforms are now being analyzed.
Keywords: toxicity; drilling fluids; corals; tolerance; hydrocarbons.

53029 Underwater Free Swimming Robot Inspection Vehicle Technology. Heckman, P. (Naval Ocean System Center, Code 5211, San Diego, CA, 92152). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objectives of this project are to develop and evaluate the technology for navigation, data sensing, storage, and telemetry for a free swimming robot submersible which would be programmed to inspect underwater pipelines and structures. Existing vehicles are being used as test beds, e.g., NOSC has built a torpedo-shaped open frame vehicle and the University of New Hampshire (under contract to them) has developed a highly maneuverable, though slower speed vehicle. Testing of the propulsion and control systems has been accomplished for both vehicles. A development plan has been prepared for this combined NOSC-UNH program. NOSC is concentrating on magnetic navigation and fiber optics telemetry. UNH is investigating acoustic navigation and acoustic telemetry of information.
Keywords: underwater operations; navigational instruments; telemetry; data acquisition; remote handling equipment; submarines; underwater facilities; pipelines; inspection; technology assessment.

53030 Incipient Crack Detection in Offshore Structures. Hochrein, A.G. (Springlake Research Center, 15110 Frederick Road, Woodbine, MD, 21797). **Contract:** 77-C-0567. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

A nondestructive evaluation (NDE) technique for detecting incipient cracking by means of monitoring the internal damping characteristics of a metal is being developed. The application is being applied to offshore structures as a means for locating joints which are fatiguing and for monitoring and predicting structural life without putting personnel in the water. ONR Structures Program is funding a computer-assisted NDE adjunct to this program. A four-legged, 14-foot high model offshore structure has been fabricated. The NDE technique has been applied to the model and data have been processed through a computer. Results on the model, in air, show that the technique indicates both incipient failures of joints as well as broken members.
Keywords: offshore platforms; cracks; nondestructive testing; fatigue; mathematical models.

53031 Overpressured Marine Sediments. Thompson, L.J. (Texas A and M Univ., College Station, TX, 77843). **Contract:** 14-08-0001-G444. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is to explain the occurrence of overpressured marine sediments in order to predict their locations when planning drilling operations. TAMU contends that established theories are not correct and do not account for the total pressure; they are reviewing the theory and performing experiments.
Keywords: sediments; offshore sites; hydrocarbons; offshore drilling; site selection; oceanography.

53032 Fluidic Pulser for Mud Pulse Telemetry. Homes, A. (Harry Diamond Labs., 2800 Powder Mill Road, Adelphi, MD, 20783). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is the development of technology for using fluidic controlled flow for mud pulse telemetry. The valve would have no moving parts and promises high reliability and high pulse rate. Mud pulse telemetry is a system of obtaining drill bit data, while drilling, by pulsing through the drill mud. The characteristics of drilling mud as well as the geometry down-hole and the needed rates of mud circulation have been determined adequate for fluidic control hardware. Several configurations of fluidic control valves are being tested using both water and drill muds. Results to date show encouraging pulse signal strength and telemetry rate. Arrangements are being made with industry to evaluate the pulser down-hole.
Keywords: telemetry; drilling fluids; boreholes; mwd systems; drill bits; well drilling; oil wells; natural gas wells.

53033 Attenuating Surface Waves in a Localized Region of the Open Ocean. Hires, R.I. (Stevens Inst. of Technology, 711 Hudson Street, Hoboken, NJ, 07030). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

This project consists of an experimental investigation of the refraction of surface waves from a localized area of the open ocean for purposes of launching and retrieving divers and submersibles as well as smoothing water where divers are working. Towing tank experiments have been conducted in regular, oblique, and random waves using towed turbulence grids. For regular waves, dramatic wave attenuation can be obtained at modest power requirements for wave periods up to 6 seconds. Results for oblique and random seas require considerably more power, but are still encouraging. Quarter-scale trials have just been conducted in New York Bay. Full scale trials are planned for January 1980.
Keywords: oceanography; surface waters; refraction; diving operations; safety; turbulence; seas.

53034 Offshore Pile Design Assessment. Sangrey, D. (Cornell Univ., Ithaca, NY, 14853). **Contract:** 6100-1140. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

A determination and assessment of the state of the art and practice for predicting pile capacity and performance including effective stress technology will be conducted.
Keywords: offshore platforms; foundations; design; performance; stress analysis.

53035 Wellhead Fire Suppression. O'Neill, J. (National Bureau of Standards, Washington, DC, 20234). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The Center for Fire Research of NBS will examine fire phenomena resulting from blowouts on offshore drilling platforms and investigate technologies for detecting and suppressing ignitions.
Keywords: offshore platforms; oil wells; natural gas wells; wellheads; fires; blowouts; fire prevention.

53036 Environmental Effects from Blasting Off Wellheads. Phillips, D. (Naval Surface Weapons Center, Silver Spring, MD, 20910). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

This study involves the quantification of the environmental effects of blowing off wellheads by use of shaped charges. Theoretical and experimental analyses will be made of the overpressures created by detonating shaped charges fifteen feet below the mud line on given wellheads.
Keywords: wellheads; environmental effects; shaped charges; removal; noise pollution; oil wells; natural gas wells; offshore sites.

53037 Cementing Technology for Shallow Casings. McDonald, W. (Maurer Engineering, 10301 N.W. Freeway, Houston, TX, 77092). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

A study is conducted of the cementing practices applied to shallow casings in offshore oil and gas wells.
Keywords: offshore sites; oil wells; natural gas wells; well completion; well casings; cements.

53038 Estimating Hydrocarbons Lost During a Blowout. Hawkins, M. (Coastal Petroleum Associates, Baton Rouge, LA). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Methods used and recommendations for new technology to assess the hydrocarbons lost during blowouts are surveyed. Work on volumes of gas escaping has been completed.
Keywords: oil wells; blowouts; hydrocarbons; volume; water pollution; offshore sites.

53039 Oil Recapture from Blowing Wells. Milgram, J. (Massachusetts Inst. of Technology, Cambridge, MA, 02139). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

This study consists of a theoretical and experimental hydrodynamic investigation into the collection of oil from a blowing wellhead.
Keywords: oil wells; blowouts; petroleum; recovery; water pollution; offshore sites.

53040 Water Monitoring in Coal Areas. Kilpatrick, F.A. (USGS, National Center, MS 410, Reston, VA, 22092). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of this project is to design and implement a hydrologic data network in the coal areas of the United States. The program was initiated because existing data collection systems were inadequate to address hydrologic information needs associated with coal mining. Information generated from this system will be available to public and private coal mining interests for use in preparing environmental assessments, monitoring mining and reclamation activities, and other water-related purposes. The data network includes both permanent stations which measure continuously and synoptic locations which extend spatial coverage. included in the continuous record stations are sites downstream from major mining activities and sites located in areas unlikely to be influenced by mining. Parameters which are being measured include, but are not limited to, discharge, temperature, conductivity, pH, alkalinity/acidity, macroinvertebrates, dissolved oxygen, common ions, metals, suspended sediment, iron, manganese, and bottom materials.
Keywords: surface waters; ground water; hydrology; water quality; coal mining; environmental impacts; water pollution.

53041 High Level Radioactive Waste Hydrology. DeBuchananne, G.D. (USGS, National Center, MS 410, Reston, VA, 22092). **Project number:** WD-79-079. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

Research addresses the hydrologic and geologic problems of storing high-level nuclear wastes in rock. Safe storage requires detailed knowledge of hydrologic systems, waste/rock interactions, geologic structures, and dynamic geologic processes that might cause a breach in the repository. Objectives of the survey program are to: (1) provide hydrologic and geologic data to the federal agencies responsible for developing repository site criteria; (2) provide data needed for predictive models of waste behavior after emplacement; (3) develop field techniques for site evaluation; and (4) develop techniques for monitoring a repository during and after waste emplacement. The research encompasses a broad range of studies with special emphasis placed on laboratory studies to evaluate the effects of heat-generating wastes on the containing rock media as well as to evaluate significant changes in the mechanical, thermal, and fluid regimen within the host rock that might occur during the critical early period of storage. The survey is developing and improving methods of water dating, borehole-to-borehole geophysical techniques, and methods for monitoring the transport of radioactive substances by water, gas, and suspended solids. Chemical processes controlling the transport of radionuclides such as ion exchange, mineral solution-precipitation, sorption-desorption and ion filtration processes are being evaluated for use in waste transport models.

Keywords: radioactive waste disposal; geologic structures; high-level radioactive wastes; hydrology; geology; rocks; radionuclide migration; ground water; chemical reactions; mathematical models; radioactive waste facilities; site selection.

53042 Development and Application of a Methodology for Siting Onshore Facilities Associated with OCS Development. Waitsman, I. (New England River Basins Commission, 53 State Street, Boston, MA, 02108). **Project number:** R1. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to prepare a methodological guidebook to assist planners in preparing for the impacts of Outer Continental Shelf (OCS) oil and gas development, optimizing the benefits for minimizing the negative aspects, through formulation of guidelines for the siting of onshore facilities associated with OCS development.
Keywords: site selection; continental shelf; planning; environmental impacts; natural gas deposits; petroleum deposits; onshore sites; energy facilities; exploration; exploitation; north atlantic region.

53043 Outer Continental Shelf Oil and Gas Information Program. Golden, F. (Rogers and Golden, 1427 Vine Street, Philadelphia, PA, 19102). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to prepare a series of regional summary reports to assist coastal state planners in preparing for the impacts of outer continental shelf oil and gas development, focusing on: (1) updating oil and gas resource and reserve estimates; (2) projecting the magnitude and timing of development; (3) discussing the methods of transportation; and (4) presenting the general location and nature of near-shore and onshore facilities.
Keywords: natural gas deposits; petroleum deposits; continental shelf; environmental impacts; planning; transport; exploitation; socio-economic factors; exploration; natural gas; petroleum; reserves; information.

53044 Power Plant Siting Task Force. Thomas, H. (New England River Basins Commission, 55 State Street, Boston, MA, 02108). **Project number:** R0015. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI; EPA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to convene a task force composed of federal and state officials, utility representatives, and public interest group leaders to improve the power plant siting process and the related land siting criteria required to evaluate alternative sites. The task force is operated collaboratively and meetings are run by a neutral facilitator. The task force has met three times and is presently evaluating alternative solutions to the above problems. The significance of the project is to provide a non-adversarial forum where traditional adversaries can work cooperatively. The report product will be a set of recommendations and a plan for their implementation.
Keywords: thermal power plants; site selection; meetings; research programs; land use.

53045 Western Coal Planning Assistance Project. Greenberg, A. (Missouri River Basin Commission, 208 North 29th Street, Billings, MT, 59101). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This project consists of two phases. Phase I, completed in October 1979, consisted of the generation of necessary data to compile a planning reference system comprised of four major publications to assist local planners and decisionmakers in coping with the impacts of coal development. Phase II will include developing and holding a series of workshops within the project area states (WY, MT, ND) to acquaint potential users with the planning reference system and provide instructions in the use of this system.
Keywords: coal mining; environmental impacts; planning; decision making; wyoming; montana; north dakota; land use.

53046 Land Cover Mapping in the National Petroleum Reserve: Alaska (NPR-A). Gaydos, L. (NASA, Ames Research Center, Mountain View, Moffett Field, CA, 94043). **Project number:** G-24. **Contract:** 7010-49109. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

This project consists of the mapping of vegetation and land cover in the NPR-A on the North Slope of Alaska as part of the basis for assessment of environmental impact of projected exploration for petroleum and natural gas. Mapping is conducted by computer-assisted analysis of multispectral data acquired by Landsat. Expected products include maps of land cover classes, digital tapes, area measurement of and cover classes, and reports describing methods used.
Keywords: petroleum; alaska; maps; ground cover; environmental impacts; baseline ecology; plants; inventories; natural gas; reserves.

53047 Computer-Plotted Map of Land Use and Land Cover, Three Mile Island and Vicinity. Chief, Geography Program. (USGS, 710 National Center, Reston, VA, 22092). **Project number:** G-1;G-3. **Contract:** 7010-31001. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

Following the accident at Three Mile Island nuclear power station near Harrisburg, PA, in March 1979, the USGS provided a current land use and land cover map of the vicinity. It was generated by computer from a statewide data base jointly completed by federal and state efforts in 1978. The map combines political units and census statistical areas and overlies a topographic map. By correlating land use information with other data sets, the system provides a tool for power plant and power line site selection, planning of wastewater treatment facilities assessing the impact of natural or man-made hazards, and preparing for emergencies and disaster relief. The map graphically portrays these needs and also a capability to fulfill them. A preliminary map overlay showing radioactive dose per person can also be plotted by computer. The Nuclear Regulatory Commission is considering requesting similar maps of other plant sites.
Keywords: land use; radiation accidents; three mile island-1 reactor; three mile island-2 reactor; maps; plants; site selection; risk assessment; radiation doses; geography; pennsylvania; computer graphics; pwr type reactors.

53048 Socioeconomic Assessment of the East Gillette and North Antelop Mines. Thompson, J. (Wyoming Research Corp., 1050 North 3rd Street, Laramie, WY, 82070). **Contract:** 7060-45301. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This project provides the basic social and economic description and analysis necessary for writing a site-specific environmental impact statement designed to assess the impacts of coal production on Campbell County and the service base community of Gillette, Wyoming. The assessment includes a description of the environment, assessment of impacts of the proposed mining activity on the social and economic environment, specification of unavoidable adverse effects, and specification of irreversible social and economic effects. In contrast to previous EIS-related socioeconomic studies, a social disorganization perspective of the energy-impacted base community is not assumed. Instead, a social change theoretical perspective is applied to the analysis of various data sets. This helps to reveal both positive and negative impacts on the well-being of various segments of the public at different points in time. The studies also reveal that a popularly-held conclusion regarding so-called boom communities does not necessarily apply. For example, an examination of Wyoming data reveals no significant relationship between rapid growth in Campbell and similar counties and the rate of divorce, welfare dependency, and certain types of crime. The studies also discuss potential measures for mitigating negative consequences of development. For example, negatively affected segments of the public such as the elderly or dislocated ranchers are discussed as candidates for certain special assistance programs.
Keywords: wyoming; coal mines; environmental impacts; social impact; economic impact; coal mining; socio-economic factors.

54000 Population, Economy, and Fiscal Forecasts: Lower Cook Inlet Sale 60. Gorsuch, L. (Inst. of Social and Economic Research, 707 A Street, Anchorage, AK, 99501). **Project number:** CT6-61-9CA. **Contract:** AA550-CT6-61-9CA. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

This study is designed to analyze potential impacts and changes to the population and economic structures for the state and involved communities resulting from OCS activities in Cook Inlet. Information on population growth and structural changes in the local economies is needed to assess impact of onshore activity associated with exploration activity, siting of onshore pipeline and transport facilities and development of transportation plans and development and production plans.
Keywords: transport; pipelines; site selection; social impact; economic impact; continental shelf; petroleum deposits; leasing; resource development; alaska; human populations; communities.

54001 Local Socioeconomic Impacts: Lower Cook Inlet Sale 60. Smythe, J. (Alaska Consultants,Inc., 704 West 2nd Avenue, Anchorage, AK, 99501). **Project number:** CT6-61-9CC. **Contract:** AA550-CT6-61-9CC. **Supported by:** Bureau of Land Management, Anchor-

age, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

This study includes a field and synthesis effort to analyze the impacts and changes resulting from OCS activities on local socioeconomic and physical systems (i.e., utilities, housing, and services). Information is needed to evaluate the increased burden of OCS-related development on local availability of social service facilities, housing, and utility services.
Keywords: continental shelf; petroleum deposits; leasing; social impact; economic impact; social services; communities; alaska; resource development.

54002 Marine Mammal Inventory. Winn, H. (Univ. of Rhode Island, Kingston, RI, 02881). **Project number:** CT8-48. **Contract:** CT8-48. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Field observations and literature review of marine mammal and turtles in the North Middle Atlantic regions will be conducted to: (1) determine which species inhabit and/or migrate through the regions; (2) estimate size and extent of populations; (3) determine their temporal and spatial distribution; (4) identify, delineate, and describe areas of importance for feeding and calving; and (5) determine behavioral characteristics.
Keywords: aquatic organisms; mammals; inventories; turtles; habitat; behavior; north atlantic region; mid-atlantic region; baseline ecology.

54003 Effects of Oil on Marine Mammals. Geraci, J. (Univ. of Guelph, Guelph, Ontario). **Project number:** CT9-29. **Contract:** CT9-29. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Literature review, laboratory experiment and field survey will be conducted to determine: (1) the behavioral and physiologic responses of cetaceans with emphasis on their ability to detect and avoid oil slicks; (2) the effects of oil on their integument, and on their ocular, respiratory, reproductive, digestive, and excretory systems; (3) the long-term impact of oil effects on their survival and behavior, such as feeding, breeding, calving, and migration; (4) their potential for bioaccumulation of petroleum hydrocarbons and metabolites, and where practical, determining the toxic threshold levels; and (5) identifying a range of mitigating measures which could eliminate or minimize the effects of oil pollution on their responses.
Keywords: petroleum; toxicity; crustaceans; physiology; avoidance; behavior; hydrocarbons; water pollution.

54004 OCS Space Use Conflicts. Ingram, B.S. (Centaur Associates, Inc., 1120 Connecticut Avenue NW, Washington, DC, 20036). **Project number:** CT9-26. **Contract:** CT9-26. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to conduct a literature review and field survey to develop general equations for quantifying probable dollar: (1) losses to commercial and recreational sport fishing revenue likely to be sustained through decreased catches or lost and damaged gear, when the presence of OCS development-related structures either restrict certain areas of the ocean bottom or water column to fishing, or makes them hazardous to fishing operations; and (2) increases in commercial and recreational fishing operating costs caused by intensified competition for labor, berthing, marine supplies and equipment, boat services, and financing. Other objectives are to identify ways in which revenue losses and operating cost increases can be optimally minimized, and to analyze the cost benefit value of proposed mitigating measures.
Keywords: continental shelf; petroleum deposits; land use; recreational areas; fishing industry; operating cost; income; profits; economic impact; alaska; leasing.

54005 Geohazards Analysis. Knebel, H. (Geological Survey, Quissit Campus, Woods Hole, MA, 02543). **Project number:** MU9-4. **Contract:** MU9-4. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

A field survey will be conducted in areas where existing information is insufficient to delineate shelf-edge slump areas, to determine extent and age of slump activity, and if of recent action, to quantify sediment movement down slope. Information is required to permit: (1) deletion of tracts in unstable areas; (2) approval of exploration permits; and (3) assurance of proper location and engineering in oil development platforms.
Keywords: offshore sites; continental shelf; petroleum deposits; exploration; site selection; hazards.

54006 Climatological and Oceanographic Analysis of Georges Bank. Godshall, F. (National Oceanic and Atmospheric Administration, Washington, DC, 20235). **Project number:** IA8-14. **Contract:** IA8-14. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Analysis of the historical data base maintained in the National Environmental Data Archive to identify the characteristics of water masses, the geograhic positions of ocean fronts, and the surface circulation pattern on the Georges Bank region of the OCS. Characterization is by the statistical and analytical Asymptotic Singular Decomposition method developed by EDS.
Keywords: georges bank; climates; oceanography; baseline ecology.

54007 Benthic Recolonization. Burreson, E. (Virginia Inst. of Marine Science, Gloucester, VA, 23062). **Project number:** CT8-32. **Contract:** CT8-32. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

This project represents a field and laboratory effort to determine the rate at which an area, impacted by an oil spill, will recover and the sequence of benthic recolonizaton. Oiled and control (clear) boxes of sediment are placed at three strategic ridge and swale locations. Boxes are recovered seasonally over a twelve month period and examined biologicaly for macrobenthos, meiobenthos, foraminifera, bacteria, and histopathology; chemically for hydrocarbons, trace metals, and total organic carbon; and textually for bioturbation.
Keywords: benthos; population dynamics; oil spills; biological recovery; toxicity; petroleum.

54008 Population Economy and Fiscal Impacts: Bering Norton Sale 57. Gorsuch, L. (Univ. of Alaska, Inst. of Social and Economic Research, 707 A Street, Anchorage, AK, 99501). **Contract:** AA550-CT6-61-9CA. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

This one-year field study and synthesis is designed to analyze potential impacts and changes to the populations and economy structures of the state and local communities resulting from OCS activities in Norton Sound. Information is needed on population growth and economic changes to assess impacts of Sale 57 on local communities and to develop plans to minimize the identified impacts.
Keywords: human populations; population dynamics; communities; alaska; continental shelf; petroleum deposits; leasing; resource development; social impact; economic impact.

54009 Texas Barrier Island Ecosystem Characterization. Johnson, J.B. (Fish and Wildlife Service, NSTL Station, MS, 39529). **Contract:** AA551-MU9-14. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to assemble, review, and synthesize existing biological, physical, and socioeconomic information for the Texas Barrier Island Ecosystem; (2) to identify and describe subsystems and their communities within the Texas Barrier Island Ecosystem; (3) to identify and describe physical and biological processes that relate to components of the Texas Barrier Island Ecosystems; (4) to relate ecosystem responses to natural and man-induced changes; and (5) to identify major information deficiencies and research priorities needed for greater understanding of the Texas Barrier Island Ecosystem.
Keywords: baseline ecology; texas; biological models; terrestrial ecosystems; information needs.

54010 Pilot Study of the Seasonal Distribution and Abundance of Marine Birds, Mammals, and Turtles and the Endangered Manatee of the South Atlantic and Gulf of Mexico. Smith, D.M. (Fish and Wildlife Service, National Coastal Ecosystems Team, Slidell, LA). **Contract:** AA551-MU9-18. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) collect and analyze field data about the distribution and abundance of the organisms named herein; (2) develop software for analysis and archival storage of field data; (3) identify and describe areas of special biological significance; (4) obtain and synthesize available data and literature about marine

mammals, turtles, and manatees in the entire study area; and (5) develop a comprehensive study plan for expanding the field studies from the initial two subunits of the study area to the area from Cape Hatteras, North Carolina, around the southern tip of Florida and westward along the OCS to Brownsville, Texas. The subunits in which field data will be collected during the pilot study are: (1) from Tarpon Springs, Florida, south to Cape Sable, Florida, and (2) from Matagorda Island, Texas, south to Brownsville, Texas. The seaward extension of the subunits is approximately the 200 m isobath.
Keywords: coastal waters; florida; texas; spatial distribution; populations; turtles; manatees; mammals; data analysis; seasonal variations; atlantic ocean; gulf of mexico; birds; endangered species.

54011 Marine Geological Survey and Mapping in Support of Gulf of Mexico Environmental Studies. Berryhill, H. (Geological Survey, Office of Marine Geology, Corpus Christi, TX). **Contract:** AA551-MU9-10. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The general objectives are an interpretation of the geologic framework and history of the northern Gulf of Mexico, with the identification of potential geologic hazards and their mapping, and a detailed map of geologic hazards on the Mississippi River Delta. These maps and interpretations will prove invaluable in all future decisions involving tract selection, actual sales, exploration, development plans, and pipeline permits.
Keywords: gulf of mexico; geology; hazards; mapping.

54012 Gulf of Mexico OCS Area Study of Effects of OCS Oil and Gas Activities on Reef Fish Populations. Gettleson, D. (Continental Shelf Associates, Inc., Tequesta, FL). **Contract:** AA551-CT9-36. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

During the first year of this two-year study, field and laboratory studies will be conducted to determine the quantities of noxious substances that may be injurious to reef fish and to determine appropriate mitigating measures. Existing information on this subject is scanty. Results from this study will be available by March 1981 and will be used in development plan approvals. Sales affected include 45, 51, 58, 58A, 62, 65, and 66.
Keywords: gulf of mexico; continental shelf; environmental effects; petroleum deposits; natural gas deposits; fishes; toxicity; dose-response relationships; leasing.

54013 Collection and Interpretation Pertaining to the Migration, Distribution, Feeding Habits, Ecology, Habitats of the Endangered Bowhead, Gray, Pacific Right Whales in the Beaufort Sea. Kelley, J. (Naval Arctic Research Lab., Barrow, AK, 99723). **Project number:** IA9-17. **Contract:** AA551-IA9-17. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Research objective is to obtain scientific data on the migration, distribution, ecology, behavior, habitats, and effects of oil and gas activities on the endangered bowhead, gray, ingutuk and Pacific Right whales in the Beaufort Sea lease area. Field and laboratory studies will provide an understanding of the biology of the bowhead whale: (1) effects of oil on the feeding mechanism of the bowhead whale; and (2) use of the Beaufort Sea lease area by endangered whales. These results will provide information on the potential impact of oil and gas activities on the endangered whale populations.
Keywords: fishes; endangered species; baseline ecology; pacific ocean; seas; petroleum; biological effects.

54014 Subsea Permafrost Hazards: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Contract:** AA51-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Regional information on the Prudhoe Bay area demonstrates the widespread extent of subsea permafrost and the problems associated with it when placing structures in or on the permafrost. The studies proposed for FY 1979 will attempt to evaluate a larger portion of the lease area. Canadian exploratory drilling in the Arctic has encountered serious problems associated with permafrost in eight wells to date. The presence of hydrocarbons in these wells would have led to serious oil pollution. Current knowledge of the extent, geotechnical properties, and the problems associated with gas hydrates is limited.
Keywords: permafrost; prudhoe bay; environmental effects; sea bed; leasing; drilling; hydrocarbons; petroleum industry; natural gas industry; environmental impacts; continental shelf; baseline ecology; beaufort sea.

54015 Receptors (Birds and Mammals): Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Important bird and mammal populations exist in Lower Cook Inlet. During FY 1979, the final year of a continuing study, all existing information for Lower Cook Inlet will be synthesized in order to determine key species, the location of critical habitats for these species, and the degrees of risk to these speices and habitats from OCS exploration and development.
Keywords: alaska; baseline ecology; inventories; birds; animals; habitat.

54016 Sea Bottom Geohazards: Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Movement of large sand waves as large as 10 meters high on the ocean bottom is a major potential hazard in Lower Cook Inlet. This continuing study will resurvey the sand wave field over previous tracklines to determine how much movement is occurring.
Keywords: gulf of alaska; sediments; hazards; travelling waves.

54017 Receptors in Cook Inlet: Fish, Plankton, and Benthos. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The commercial fishery which consists of fish (salmon, halibut, herring, etc.) and benthos (tanner crab, king crab, shrimp) is an extremely important resource in Lower Cook Inlet. This FY 1979 study consists of a synthesis of information on fish, plankton, and benthos and related organisms in Cook Inlet to identify key species, the location of important habitats, and the degree of risk to these species and habitats that exists from OCS exploration and development.
Keywords: receptors; fishes; plankton; benthos; gulf of alaska; fishing industry; habitat; continental shelf; exploration; petroleum; economic development; environmental impacts.

54018 Geohazards (Seismic): Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The continuation of this long-term monitoring of seismic and volcanic activity is essential for determining risks and improving capabilities for predicting catastrophic events during OCS exploration and development. The Lower Cook Inlet lease area has high earthquake potential and is adjacent to active volcanoes. Continued monitoring during FY 1979 will allow significant improvement of the risk analysis which is essential as input to design criteria and for evaluation of development plans.
Keywords: gulf of alaska; seismic events; volcanism; monitoring.

54019 Receptors (Littoral): Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The littoral communities (intertidal and shallow subtidal) are the areas of greatest risk from both acute oil spills from drilling rigs and from onshore development. This FY 1979 study consists of a synthesis of information on nearshore areas in Cook Inlet including their vulnerability to oil, microbial degradation rates of oil, location of important habitats for key species, and the degree of risk to the littoral zone that exists from OCS exploration and development.
Keywords: gulf of alaska; habitat; coastal waters; aquatic ecosystems; oil spills; offshore drilling; offshore operations; baseline ecology; shores; risk assessment; communities; petroleum; biodegradation.

54020 Effects of Existing Rigs: Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project**

number: AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI. **Related energy source:** oil and gas(100) **R and D categories:** Environmental effects assessment.

This investigation of the effects of existing rigs in Cook Inlet is being conducted to monitor and document: (1) the release of hydrocarbons from rig sites to the water column, (2) the processes involved in incorporation of contaminants into the sediments and the biota, and (3) the factors which determine areas of influence surrounding the site. The history of the rig sites at which these studies are being conducted suggests that the resulting information can be used to provide an estimate of the levels of contaminants to be expected at future drilling sites in Lower Cook Inlet.
Keywords: gulf of alaska; offshore drilling; environmental effects; oil spills; environmental transport; petroleum.

54021 Winter Studies: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This study will focus on identifying and describing the winter biologic populations and habitats of the Beaufort Sea with respect to productivity and behavior.
Keywords: beaufort sea, habitat; aquatic organisms; populations; productivity; behavior; seasons.

54022 Vulnerable Populations/Key Species: Chukchi Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Limited field work during the past years has produced a survey of the distribution, abundance and biology of some key species in the area. This allocation provides for a synthesis of the studies to be completed in FY 1979. The impact of accidents caused by offshore petroleum development must be measured with respect to its consequences to these key biological species, particularly those vulnerable to such accidents.
Keywords: beaufort sea; aquatic organisms; ecology; spatial distribution; data analysis.

54023 Transport of Pollutants: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

During the ice-free season in the Beaufort Sea spilled oil is transported by winds and ocean currents. Offshore and inshore circulations have been examined, but the exchange between these two areas remains to be determined by this continuing study. Pollution trajectories (pathways and rates) are important in determining whether pollutants might enter critical habitats, such as lagoons, estuaries, and salt marshes, which are particularly vulnerable to impacts.
Keywords: beaufort sea; coastal waters; water currents; environmental exposure pathway; oil spills; environmental transport.

54024 Information Synthesis: St. George Basin. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This synthesis presents the results of OCSEA Program in the St. George Basin to the Department of Interior decisionmakers in an organized manner that allows its effective use in the oil and gas decisionmaking process. The synthesis includes: (1) a series of Lease Area Synthesis Reports, (2) an information base of verified environmental data, (3) an archive of biological voucher specimens, and (4) maps and visual displays to support environmental impact analyses.
Keywords: gulf of alaska; offshore sites; leases; data compilation; environment; maps.

54025 Receptors (Marine Birds and Mammals): Bristol Bay. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Bristol Bay is one of the richest and most consistently productive areas in the world. Some of the coastal habitats are vital to migrating song birds, shore birds, and waterfowl populations. Seals are important species in the area and serve as indicators of the overall level of biotic productivity. This FY 1979 program completes a series of studies and provides a synthesis of results. These bird and mammal studies provide input data for an ecosystem model.
Keywords: gulf of alaska; birds; mammals; ecology.

54026 Information Synthesis: Bristol Bay. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This synthesis effort presents the results of the OCSEA Program in Bristol Bay to the Department of Interior decisionmakers in an organized manner that allows its effective use in the OCS oil and gas decisionmaking process. The synthesis includes: (1) a series of Lease Area Synthesis Reports, (2) a data base of verified environmental information, (3) an archive of biological voucher specimens, and (4) special reports and visual display to support environmental impact analysis.
Keywords: gulf of alaska; offshore sites; leases; data compilation; environment.

54027 Information Synthesis: Bering Norton. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This synthesis presents the results of the OCSEA Program for Norton Sound to the Department of Interior decisionmakers in an organized manner that allows its effective use in the oil and gas decisionmaking process. The synthesis includes: (1) a series of Lease Area Synthesis Reports, (2) a data base of verified environmental information, (3) an archive of biological voucher specimens, and (4) maps and special reports to support environmental impact analysis.
Keywords: bering sea; offshore sites; leases; data compilation; environment; maps.

54028 Transport of Pollutants: Bering Norton. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Information is required for the prediction of coastal currents in both open water and under winter ice cover. The studies included in this research unit are designed to meet these objectives. The results of field studies being synthesized in FY 1979 will provide the circulation patterns in the Norton Sound area and input data to a high resolution numerical transport model designed to compute pollutant trajectories and dispersion characteristics both in open water and under ice.
Keywords: bering sea; coastal waters; water currents; water pollution; environmental transport; mathematical models.

54029 Receptors (Marine Birds and Mammals): St. George Basin. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

During the final year of this continuing study, information from previous field surveys of marine birds and mammals in the St. George Basin will be synthesized. The sea bird colonies of this lease are of international significance. Some species migrate to the area from as far away as Australia. They represent a significant tourist related economic resource, and their populations affect the nutrient cycling of the sea and especially the available food resources for other high trophic levels such as mammals. The mammals occupy an important niche in the marine ecosystem and some of them have recently been considered as threatened populations. The vulnerability of these living resources to OCS activities is being assessed in this study.
Keywords: gulf of alaska; birds; mammals; ecology.

54030 Transport of Pollutants: St. George Basin. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** Na-

tional Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Information from this continuing study is needed for prediction of coastal currents, the trajectories of potential oil spills, and the design of future studies. Since the region is subject to ice cover during a significant part of the part, a predictive capability, along with verified field data, is needed for the appropriate assessment of oil movement in open water and under ice cover. The projects in this study are designed to meet this objective. The results of previous field studies are being synthesized during FY 1979 and are providing the first quantitative information available on seasonal circulation patterns in the St. George Basin. These studies are also providing input data to a high-resolution numerical transport model designed to predict pollutant trajectories and dispersion characteristics.
Keywords: gulf of alaska; water currents; coastal waters; water pollution; environmental transport; mathematical models; seasonal variations.

54031 Microbial Responses: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The microbial community is an important link between phytoplankton, detritus, and the higher trophic components in the food web supporting fish, birds, and mammals. The taxonomy, distribution, and response to contaminants of these biota are being determined by continuing field work and analysis. The microbiological populations are an essential part of the biological system of the Beaufort Sea. Response to contaminants, which in the cold waters of the Beaufort Sea is apparently quite different from other areas, may affect the entire biological system of the area. The ability of some of the microbiological species to consume oil is also being investigated.
Keywords: beaufort sea; microorganisms; taxonomy; spatial distribution; water pollution; biological effects.

54032 Information Synthesis: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This synthesis effort presents the results of the OCSEA Program on the Beaufort Sea to the Department of Interior decision-makers in an organized manner that allows it effective use in the oil and gas decision process. This synthesis includes (1) a series of Lease Area Synthesis Reports, (2) a data base of verified environmental information, and (3) maps and special repors to support environmental impact analysis.
Keywords: beaufort sea; leases; offshore sites; environment; data compilation; maps; energy source development; environmental impacts.

54033 Other Hazards - Ice Gouging, Seismicity, and Coastal Erosion: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Ice gouging, seismicity, and coastal erosion are problems associated with the safe design of offshore structures and pipelines. Only reconnaissance information is presently available on these phenomena, and these continuing studies will quantify some of this information. The deep gouging of the sea floor by the keels of sea-ice pressure ridges, the rapid erosion of the Beaufort Sea coast, and the recent discovery that the Beaufort Sea offshore area is seismically active demonstrate the need for assessing the hazards these processes pose to offshore structures.
Keywords: beaufort sea; ice; seismicity; erosion; shores; hazards; risk assessment; offshore platforms.

54034 Monitoring the Movements of Whales in and Adjacent to OCS Lease Areas. Mate, B. (Oregon State Univ., Newport, OR, 97365). **Project number:** CT9-34. **Contract:** CT9-34. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Research objective is to develop a safe and reliable system (tag) for monitoring the movements of whales by field testing two types of radio tags on gray whales in Baja, California. Tests will provide tag evaluation, effect of tags on whale tissue, and behavior of untagged and tagged whales.
Keywords: continental shelf; fishes; behavior; habitat; tracer techniques; endangered species; alaska; baseline ecology.

54035 Investigation of the Occurrence, Population Density, and Behavior Patterns of Endangered Whales in the Vicinity of the Beaufort Sea Lease Area. Ljungblad, D. (Naval Ocean Systems Center, San Diego, CA, 92152). **Project number:** AA551-IA9-9;AA551-IA9-20. **Contract:** AA551-IA9-9. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the distribution, abundance, and population density of endangered bowhead and gray whales in the Beaufort Sea lease area. Aerial surveys in and about the Beaufort Sea lease area will be conducted. The effort to date is one year of data. An additional two years of data are necessary to predict the impact of oil and gas activity on the bowhead whale population.
Keywords: beaufort sea; mammals; populations; spatial distribution; endangered species.

54036 Study of Crude Oil Effects to Development Stages of the American Lobster. Ryther, J.H.; Capuzzo, J.M. (Woods Hole Oceanographic Inst., Woods Hole, MA, 02543). **Project number:** AA551-CT9-5. **Contract:** AA551-CT9-5. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) examine the long-term chronic effects to maturing lobsters previously exposed, as larvae, to different concentrations of crude oil; (2) test the mating, spawning, and reproductive success of these animals exposed as planktonic larvae to crude oil/sea water mixtures; (3) determine the hatching success and larval development of offshore ripe (egg-bearing) female lobsters exposed to realistic concentrations (ppM) of soluble crude oil fractions in seawater; (4) determine the acute toxicity of water soluble crude oil fractions to first through fourth-stage lobster larvae utilizing newly developed flow-through methodologies; (5) examine and define causative factors resulting from exposure to petroleum which result in chronic and sublethal effects on maturing lobsters which make them vulnerable to predation or disease; (6) examine the histologic condition of various life stages of lobsters exposed to low level concentrations of water-accommodated crude oil; and (7) establish depuration rates for lobsters exposed to water-accommodated crude oils in flow-through bioassay experiments.
Keywords: petroleum; toxicity; lobsters; sensitivity; juveniles.

54037 Production of a Climatology and Oceanographic Analysis of the California Pacific Outer Continental Shelf Region. Williams, R. (NOAA, Center for Environmental Assessment Services, Washington, DC, 20235). **Project number:** AA551-IA9-2. **Contract:** AA551-IA9-2. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this study is to assemble, interpret and summarize historical meteorological and physical oceanographic data necessary to characterize the physical oceanograhic structure, the water quality (as defined by archived nutrient and dissolved oxygen data), and the transport of atmospheric and oceanic pollutans in the California OCS region. This study includes summaries and analyses of government archived and private institution data on water circulation, climatology, water mass movements, and advection and diffusion phenomena in the water and atmosphere of the California OCS. The results from this study will be used to predict the probable path, fate, and impact of spilled oil in ocean and marine area pollutant trajectory modeling efforts. This study also supports air quality and air pollutant trajectory studies on the California OCS.
Keywords: california; coastal waters; oceanography; water quality; meteorology; pollution; atmospheric chemistry; environmental transport; water currents; oil spills; forecasting; data compilation; data analysis.

54038 Ecological Characterization of Central and Northern California Coastal Region. Watson, J. (Fish and Wildlife Service, 500 NE Multnomah St., Lloyd 500 Bldg., Suite 1692, Portland, OR, 97232). **Project number:** AA551-MU9-12. **Contract:** AA551-MU9-12. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the study are: (1) to obtain and synthesize environmental and socioeconomic data for the Central and Northern California Coastal Region which identify and describe important resources, ecological processes, and their interrelationships within the study area; and (2) to provide an analysis of their functional

relationship. This effort will provide an ecosystem-level understanding of the Central and Northern California Coastal Region emphasizing OCS oil and gas, forestry, fisheries, recreation, transportation, agriculture, and fish and wildlife resources. The products are an ecosystem model, narrative report, an information base and atlas. Study information will be used in the decisionmaking process involving OCS oil and gas activities off Central and Northern California.
Keywords: california; baseline ecology; coastal regions; socio-economic factors; environmental impacts; land use; petroleum; natural gas; data acquisition; decision making; offshore operations.

54039 Seabird Nesting and Seasonal Use Survey for the Central and Northern California Coastal Region. DeGange, A.R.; Sowls, A.L. (Fish and Wildlife Service, 500 NE Multnomah Street, Lloyd 500 Building, Suite 1692, Portland, OR, 97232). **Project number:** AA551-MU9-13. **Contract:** AA551-MU9-13. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This study consists of field surveys of seabird nesting and seasonal use at selected sites from Pt. Conception north to the Oregon/California border. The survey area includes all nesting seabird habitats, i.e., coastal headlands and offshore rocks and stacks within the above area. The Farallon Islands are not covered because this area is and has been studied. The field effort is being accomplished by ground and aerial surveys. The nesting surveys were done in the period of April 1979 to August 1979. The seasonal use surveys started in September 1979 and will run to March 1980.
Keywords: california; birds; coastal regions; land use; habitat.

54040 Geological Hazards Assessment for Proposed Lease Areas of Sale 53: Central and Northern California. McCulloch, D.; Greene, G.; Rubin, D. (Geological Survey, Pacific-Arctic Branch of Marine Geology, 345 Middlefield Road, Menlo Park, CA, 94025). **Project number:** AA551-MU9-19. **Contract:** AA551-MU9-19. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The study is designed to gather information needed to fill gaps in the geologic data base and to assess by seismic reflection data the potential geologic hazards to oil and gas development, consisting principally of: tectonic activity; unstable sea floor conditions; active bedforms; and other hazards (gas seeps). Some past work off California has been done. This study will have three seismic reflections cruises conducted by the U.S. Geological Survey in Arena/Bodega Basins, Outer Santa Cruz Basin and Santa Maria Basin. The three surveys have been completed and preliminary maps have been sent to the Pacific OCS Office. Final products will consist of seafloor geologic map, hazards maps, stability maps, briefings, and interpretive reports.
Keywords: natural gas; petroleum; exploration; risk assessment; seismicity; geology; maps; sea bed; california; continental shelf.

54041 Air Quality Assessment of the Potential Impact of Offshore Oil and Gas Development in Northern and Central California. Kahane, S. (Environmental Resources Group, 6380 Wilshire Blvd., Los Angeles, CA, 90048). **Project number:** AA551-CT9-23. **Contract:** AA551-CT9-23. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The purpose of this study is to describe and assess the impact upon air quality due to primary, secondary, and tertiary effects of offshore oil and gas development as proposed in Sale 53. The information will reflect existing air quality laws, regulations, and statues on a local, State, and Federal level and assess effects of proposed offshore lease Sale No. 53. The study will enable BLM to evaluate the impact of such development and provide evaluations of mitigating requirements or measures to minimize potentially adverse impacts. The study shall be done by a review of the literature and regulations, air pollution modeling, and agency coordination.
Keywords: offshore operations; energy source development; environmental impacts; air quality; california; leases.

54042 Formation Water Dispersion Study. Dickey, T. (Univ. of Southern California, Los Angeles, CA). **Project number:** YN010-CT9-002. **Contract:** YN010-CT9-002. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The Pacific OCS Office awarded a contract on July 1979 to Dr. Tom Dickey, University of Southern California, to model the dispersion of formation water discharged from an offshore rig. The model was completed in September and successful test runs were performed. A final report is anticipated in February 1980.
Keywords: interstitial water; spatial distribution; flow models; offshore sites; drilling rigs; continental shelf; petroleum deposits; water pollution.

54043 Marine Mammal and Seabird Study of Central and Northern California. Dohl, T. (Univ. of California, Center for Coastal Marine Studies, Santa Cruz, CA, 95064). **Project number:** AA551-CT9-33. **Contract:** AA551-CT9-33. **Supported by:** Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The study will determine the composition, distribution, abundance, and areas of special biological importance of marine mammals and seabirds of central and northern California. The objectives of this study are as follows: (1) determine seabird and marine mammal species and habitats in the area; (2) determine the distribution and abundance of seabird and marine mammal populations in the area; (3) determine the seasonal variations of seabird and marine mammal populations and habitat use in the area; (4) identify and describe areas of special biological importance (e.g., feeding, breeding, and haul-out areas); and (5) describe the size, abundance, and location of oil slicks observed.
Keywords: california; coastal waters; mammals; birds; spatial distribution; populations; habitat; seasonal variations; oil spills.

54044 New England OCS Physical Oceanography/Processes. Scarlet, R.T. (EG and G, 151 Bear Hill Road, Waltham, MA, 02154). **Project number:** CT8-46. **Contract:** CT8-46. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project is a multidisciplinary data collection effort on Georges Bank including hydrographic, current, and meteorological measurements to: (1) permit an improved capability for predicting the immediate or short-term dispersion fate of contaminating substances which might be introduced into the environment of Georges Bank as the result of offshore hydrocarbon exploration and production; and (2) permit an understanding of the dynamics of the physically driven nutrient cycle which makes Georges Bank one of the most valuable of the world's fishing grounds in order to mitigate the affect of hydrocarbon operations on these processes.
Keywords: north atlantic region; oceanography; georges bank; petroleum; offshore operations; exploration; baseline ecology; continental shelf; nutrients.

54045 Transportation System Impacts: Lower Cook Inlet Sale 60. Eakland, P. (Peter Eakland and Associates, P.O. Box 610, Douglas, AK, 99824). **Project number:** AA550-CT6-61. **Contract:** AA550-CT6-61-9CB. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This study is designed to analyze impacts and changes to existing transportation networks resulting from potential OCS petroleum development activities. The study will address impacts to social infrastructure and shipping conflicts. Information is needed to evaluate the burden of development on existing transport networks and to assess the severity of space use conflicts, especially those related to ocean shipping.
Keywords: transportation systems; leasing; continental shelf; petroleum deposits; alaska; social impact; economic impact; resource development; maritime transport; natural gas deposits.

54046 Petroleum Development Scenarios: Bering Norton Sale 57. Hanley, P.T. (Dames and Moore, 510 L Street, Suite 310, Anchorage, AK, 99501). **Project number:** AA550-CT6-61. **Contract:** AA550-CT6-61-9CG. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Scenarios describing potential OCS oil and gas development events will be developed for estimated potential petroleum resources levels and present potential onshore and offshore development activities. Technology options will also be considered for their impacts on onshore populations and communities. Development scenarios will provide an assessment of all activity types and levels associated with oil and gas development. The information will then be used in other impact studies to allow estimates of impacts on labor, economics, social systems, transportation, and burden of use on facilities.
Keywords: petroleum deposits; resource development; alaska; continental shelf; leasing; social impact; technology assessment; economic impact; transportation systems.

54047 Seafloor Hazards: Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported**

by: National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI. **Related energy source:** oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Potential hazards related to surface faulting and sediment instability have been identified along the NEGOA shelf. The new lease area between Cape Fairweather and Yakutat Bay required one more field season of geological reconnaissance surveys to ascertain the presence of potential seafloor hazards for use in tract selection. **Keywords:** gulf of alaska; continental shelf; geologic faults; sediments; physical properties; hazards.

54048 Marine Birds and Mammals: Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

These continuing studies provide information on seasonal abundances, distributions, breeding locations, natural histories, and habitats of dominant species of marine bird and mammal species in the NEGOA region. This study is designed to identify critical habitats and periods of vulnerability of biota to OCS activities. This information is used for tract selection, stipulation development, and other management decisions. The emphasis of the program during FY 1979 will be on the completion of analyses of previous year's field studies. The only field work will consist of long-term monitoring of sealion movements and periodic counts of morbid marine mammals.
Keywords: gulf of alaska; birds; mammals; ecology.

54050 Receptors (Fish, Benthos, Littoral): Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

These continuing studies are designed to furnish information on distributions and abundances of biota and general features of marine communities. This information forms the basis for identification of vulnerable populations and critical habitats which will be used in tract selection and subsequent OCS decisions. The emphasis of the FY 1979 work will be on the analysis of previous field efforts. **Keywords:** gulf of alaska; aquatic ecosystems; baseline ecology; fishes; benthos.

54051 Geohazards (Faulting): Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Potential geological hazards due to nearsurface faulting and sediment instability have been identified previously in some areas of the Kodiak Shelf. Geological reconnaissance surveys will continue to identify and locate zones of faulting on the Kodiak Shelf.
Keywords: gulf of alaska; continental shelf; geologic faults; sediments; hazards.

54052 Coastal Oil Spill Vulnerability: Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

In this extension of an existing study the potential effects of petroleum development on the NEGOA beaches will be qualitatively determined by the application of the oil spill vulnerability index. This impact assessment will be based on the geological and geomorphological characteristics that were identified for NEGOA beaches in the earlier OCSEAP study. This study addresses probable oil residence times and the susceptibility of beaches to long-term oil spill pollution.
Keywords: gulf of alaska; shores; oil spills; environmental impacts.

4053 Marine Mammals: Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

In the Kodiak area, sea lions are abundant and these localities are also major breeding rookeries, supplying the majority of pups to other areas in the Gulf of Alaska. This study is designed to synthesize the large amount of data from previous studies to provide a status of knowledge on the distribution and population dynamics of harbor seals and sea lions in the area. Statistics on causes of natural mortality of mammals will also be provided.
Keywords: gulf of alaska; mammals; population dynamics; spatial distribution; mortality; statistics.

54054 Geohazards (Seismicity): Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Long-term continuous monitoring of seismic and volcanic activity is needed to determine risks and to improve capabilities for predicting catastrophic events during development in the Kodiak sale area. This is especially true in the Kodiak shelf area because of its extremely high earthquake potential. Continuation of the basic monitoring network in FY 1979 will allow significant improvement of the seismic risk analysis, which is needed as input to design criteria and for evaluation of development plans.
Keywords: gulf of alaska; seismicity; volcanism; monitoring.

54055 Commercial Fisheries: Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A significant portion of FY 1979 effort will be devoted to synthesis of previously collected data. Information from these studies will be necessary to formulate lease stipulations and regulations to protect areas of abundance, spawning, and larval development of important fish and shellfish species, and to minimize resource use conflicts with the regional fishing industry.
Keywords: gulf of alaska; fishing industry; fishes; ecology.

54056 Marine and Coastal Birds: Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Birds exhibit the most obvious impact from environmental disturbance - physical, biological, or chemical. Much of the OCSEAP biological effort has been to determine the seasonality of bird abundance, the influence of marine birds on the coastal ecosystem, and the reproductive ecology of selected colonies. During the final year of this study, the large amount of OCSEAP data will be synthesized into reports on bird distributions and population ecology, and into a population--energetics model.
Keywords: gulf of alaska; birds; ecology; population dynamics.

54057 Information Synthesis: Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This synthesis effort presents OCSEAP results from NEGOA studies to the Department of Interior decisionmakers in an organized manner that facilitates its effective use in the OCS oil and gas decision process. The presentation includes (1) a series of Lease Area Synthesis Reports which contain a complete description of the environmental factors affecting oil and gas developments, (2) an information base of verified environmental data collected as part of OCSEAP and pertinent non-OCSEAP data, (3) an archive of biological voucher specimens for future reference, and (4) maps, special reports, and visual displays to support environmental impact analysis.
Keywords: gulf of alaska; data compilation; environment; leases; offshore sites; energy source development; environmental impacts; maps.

54058 Seismic Activity: Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Long-term continuous monitoring of seismic activity is essential for predicting seismic risks and for improving the capability to predict catastrophic events during OCS development. Some seismic information is already available and the seismic network has been established. Continuation of the monitoring network in FY 1979 will allow significant improvement of seismic risk analysis for the NEGOA region.
Keywords: gulf of alaska; seismic events; monitoring; risk assessment; energy source development; offshore sites.

54059 Transport: Northeast Gulf of Alaska. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

These continuing studies include (1) direct observations of coastal currents and water masses, (2) field observations and numerical studies of local winds, and (3) numerical simulations of pollutant trajectories which include inputs from the other studies. This study will also include a synthesis of earlier field information.
Keywords: gulf of alaska; coastal waters; water currents; wind; pollution; environmental transport; mathematical models.

54060 Information Synthesis: Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This synthesis is designed to present OCSEAP results from studies of the Kodiak lease area to the Department of Interior decisionmakers in an organized manner that allows its effective use in the oil and gas decision process. The presentation includes: (1) a series of Lease Area Synthesis Reports, (2) a data base of verified environmental information, (3) an archive of biological voucher specimens, and (4) maps, special reports, and visual displays to support environmental impact analysis.
Keywords: gulf of alaska; data compilation; leases; offshore sites; environment; maps; energy source development; environmental impacts.

54061 Spill Trajectories: Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Continuing studies on diagnostic modeling and contaminant trajectory analysis are designed to define and predict the distribution and movement of hydrocarbon contaminants on the sea surface near Kodiak. These studies are supplemented by data on local winds.
Keywords: gulf of alaska; oil spills; environmental transport; mathematical models; wind.

54062 Oil Spill Trajectory Analysis: Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The continuing study in Lower Cook Inlet consists of evaluations of ocean currents and winds to support predictions of oil spill trajectories, and a study of ocean bottom sediment transport for use in assessment of sea bottom hazards and movements of sediment-borne pollutants. In FY 1979, the primary effort will be an analysis and intrpretation of FY 1978 field data, identification of data gaps, and prediction of trajectories and sediment flux.
Keywords: gulf of alaska; coastal waters; water currents; wind; sediments; environmental transport; oil spills; forecasting.

54063 Shelf Circulation: Kodiak. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Previously collected physical oceanographic data will be analyzed and synthesis of this information will be initiated. This study will result in a comprehensive description of circulation on the Kodiak Shelf and the principal mechanism that govern it. This information is necessary to identify residence times of shelf waters, describe mechanisms of dispersion of contaminant plumes, and provide input to trajectory-simulation modelling.
Keywords: gulf of alaska; continental shelf; coastal waters; water currents; data analysis.

54064 Information Synthesis: Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This synthesis effort presents the results of the OCSEA Program for Cook Inlet to the Department of Interior decisionmakers in an organized manner that facilitates its effective use in the oil and gas decision process. The final report includes a series of lease area synthesis reports, an information base of verified environmental data collected as part of the OCSEAP and pertinent non-OCSEAP data, an archive of biological voucher specimens, and maps, special reports, and visual displays to support environmental impact analysis.
Keywords: gulf of alaska; offshore sites; leases; data compilation; environment; energy source development; environmental impacts; maps.

54065 Effects: Cook Inlet. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The English Bay lawsuit required BLM to document petroleum effects on local biota and to minimize the information gaps and unquantified threats to the environment which act to delay or stop leasing. Only effects studies demonstrate whether the impact of oil impinging on key species will be severe enough that (1) tracts should be deleted, (2) movement of oil through the area should be prohibited or restricted during certain times of the year, and (3) at what levels allowable discharges should be set. The study continues previous research on the uptake, metabolism, depuration, and sublethal behavioral, respiratory, and histopathological effects of petroleum by ecologically and commercially important species found in Cook Inlet, Kodiak, and NEGOA.
Keywords: gulf of alaska; petroleum; environmental effects; oil spills; aquatic organisms; behavior; respiration; pathological changes.

54066 Receptors (Marine Mammals): Bering Norton. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Bearded and ringed seals are important species for subsitence hunters of the Norton Sound area. These studies provide data necessary to predict possible impacts of OCS development on migration routes and timing, ice habitat dependency and use, natality, mortality, growth, population structures, longevity, age-specific reproduction, and trophodynamics. FY 1979 funding will permit limited sampling of seal stomachs taken by native hunters, and synthesis and integration of an extensive data base derived during two previous years of field work.
Keywords: bering sea; mammals; energy source development; environmental impacts; ecology.

54067 Geohazards: Bering Norton. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Complex surface processes in the Yukon-Kuskokwim Delta region pose potential hazards to nearshore and onshore development. These hazards include rapidly shifting coastlines and stream channels, permafrost, flooding associated with ice breakup, storm-surge erosion, and faulting. Sufficient data were collected by the end of FY 1978 field season to define the general nature and distribution of these hazards. Data analysis and interpretation will be completed during FY 1979 to evaluate hazards to siting of facilities.
Keywords: gulf of alaska; offshore sites; hazards; evaluation; site selection; geologic faults; ice; erosion; floods; data analysis; energy source development.

54068 Transport of Pollutant: Bristol Bay. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.

Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Information is needed for the prediction of coastal currents, the trajectories of potential oil spills in both open water and under winter ice cover, and for the design of future studies. The projects included in this continuing study were designed to satisfy these objectives. The results of field studies are being synthesized in FY 1979 and are providing seasonal circulation patterns and input data for a high-resolution numerical transport model designed to predict pollutant trajectories and dispersion.

Keywords: gulf of alaska; coastal waters; water currents; oil spills; environmental transport; mathematical models; data analysis.

54069 Receptors (Birds): Bering Norton. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Norton Sound supports large populations of sea birds which are an integral part of the ecology of the area and are greatly influenced by sea ice conditions. They are also very sensitive to disturbance and habitat alterations which could accompany OCS oil and gas development. Considerable data on their population dynamics have been collected by earlier OCSEAP studies and by other groups and agencies. FY 1979 funding will permit investigators to analyze, interpret, and synthesize the existing information and data and will provide selected field studies to supply additional data.
Keywords: bering sea; birds; ecology; population dynamics; data analysis.

54070 Vulnerable Populations/Key Species: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Field work during the past years has provided a survey of the distribution, abundance, habitats and feeding dependencies of key mammals, birds, benthos, fish, and plankton. This FY 1979 effort is a synthesis of previous studies. The impact of accidents caused by offshore petroleum development will be evaluated in terms of its impacts upon these key biological species, particularly those vulnerable to such accidents.

Keywords: beaufort sea; baseline ecology; habitat; spatial distribution; populations; birds; mammals; benthos; fishes; plankton; oil spills; environmental impacts.

54071 Seafloor Hazards: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

During the second year of this continuing study, sediment regimes, sediment transport and coastal changes due to sediment erosion and deposition are being investigated in relation to hazards and pollution transport. The sediment regime of the seafloor is important in both biological and physical processes. It also determines the geotechnical properties of the substrate which is subject to erosion and deposition.

Keywords: beaufort sea; shores; geomorphology; sediments; environmental transport; erosion; sedimentation.

54072 Effects: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Environmental effects studies indicate whether the impact of oil on key species will be severe enough (1) that tracts should be deleted, (2) movement of oil through the area should be prohibited or restricted during certain times of the year, and/or (3) at what level regulations regarding pollutant discharges should be established.

Keywords: prudhoe bay; beaufort sea; petroleum; oil spills; water pollution; toxicity; environmental impacts; decision making.

54073 Lagoon Ecosystem Analysis: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Assessment of a barrier island-lagoon ecosystem's response to offshore oil development is the purpose of this study. Final data analysis and synthesis of the study will be completed during this final year of this study. By demonstrating interrelationships between biological and physical processes in a typical arctic barrier island-lagoon ecosystem, this project is assessing the total impact of disturbance of this system by offshore oil development.

Keywords: beaufort sea; offshore operations; energy source development; environmental impacts; shores; aquatic ecosystems.

54074 Alaska OCS Environmental Studies Program: Logistics and Management. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Management and logistics costs are determined for those studies that were conducted by NOAA for BLM.

Keywords: continental shelf; alaska; management; environment; baseline ecology.

54075 Oil--Ice Interactions: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Oil spilled in the Arctic will be contained, dispersed, and transported for 9 to 10 months each year by sea ice. Oil cleanup in sea ice is presently not possible because no suitable technology exists, either to detect the oil remotely under the ice or to remove it effectively. These studies provide information on oil behavior and trajectories in ice.

Keywords: oil spills; arctic regions; spatial distribution; environmental transport; water pollution; trajectories; ice.

54076 Spilled Oil Research Teams. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This continuing effort (1) identifies research needs that can be satisfied at the time of a spill of opportunity; (2) provides for the experimental design and logistics planning; (3) trains a small group of scientists and technicians in these specialized field operations; and (4) supports a limited amount of field activities in the event of a spill. Emphasis is placed on spills in the Alaskan OCS or analogous cold-water environments.

Keywords: oil spills; information needs; experiment planning; professional personnel; alaska; continental shelf; arctic regions; research programs; water pollution control.

54077 Receptors (Marine Birds): Aleutians. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A very extensive data base has resulted from OCSEAP studies on seasonal distribution and abundance of marine birds. Data are currently being synthesized to provide final documents and an atlas describing major nesting areas, breeding colonies, and foraging areas of principal bird species in the Gulf of Alaska and the eastern Bering Sea. Current synthesis efforts incorporate information on marine birds in the Aleutian area.

Keywords: aleutian islands; birds; ecology; spatial distribution; data analysis.

54078 Information Synthesis: Aleutians. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This syntheis presents the results of the OCSEA Program on the Aleutians to the Department of Interior decisionmakers in an organized manner that allows its effective use in the oil and gas decisionmaking process. The synthesis includes (1) a series of Lease Area Synthesis Reports for each lease area, (2) a data base of verified environmental information collected as part of the OCSEAP and

pertinent non-OCSEAP data, (3) an archive of biological voucher specimens, and (4) maps, special reports, and visual displays to support environmental impact analysis.
Keywords: aleutian islands; offshore sites; leases; environment; data compilation; energy source development; environmental impacts.

54079 Physical Oceanography: Aleutians. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A limited amount of physical oceanography data has been obtained in this area to assess water transport and mixing processes as related to probable contaminant distribution. Synthesis of this data is planned in FY 1979 to design contaminant transport studies in the future when required. Synthesis of Aleutian data will also be used to evaluate the distribution and dispersion of contaminants transported by currents from other Gulf of Alaska lease areas.
Keywords: aleutian islands; oceanography; data analysis.

54080 Chemistry Quality Assurance. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Juneau, AK (USA). Bering Sea-Gulf of Alaska Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This continuing study is designed to: (1) provide interlaboratory comparison of analytical techniques for heavy hydrocarbons; (2) establish the level of confidence to be placed on reported data; (3) provide a framework for documenting improvements in methodology; and (4) verify the utility of new analytical methods. This study is a prerequisite to effective field hydrocarbon chemistry programs and to studies of the effects of petroleum on biota. The study supports the entire BLM chemistry effort.
Keywords: hydrocarbons; chemical analysis; quality control; chemistry.

54081 Sea Ice Hazards: Beaufort Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Analysis of data collected on shorefast ice movement during the last two winter seasons will be analyzed as part of this study. Data collection on the mechanisms by which ice can be deformed into ridges and hummocks will continue. The ability to predict the average and worst possible occurrence of ridging in the nearshore area is significant to the location of pipeline landfalls and nearshore structures. Field studies will continue to define the strength properties of sea ice. These data, when synthesized, are needed to predict the stresses which moving ice can exert against fixed structures.
Keywords: beaufort sea; ice; shores; environmental transport; mechanical properties.

54082 Damage Function Assessment Utilizing Monte Carlo Techniques. Watkins, E. (Pacific Consultants, 2020 K St. NW, Suite 410, Washington, DC, 20006). **Project number:** AA551-IA9-7. **Contract:** AA551-CT9-28. **Supported by:** Bureau of Land Management, Washington, DC (USA). Div. of Offshore Resources. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This is the first phase of a multi-phase study analyzing the direct economic effects of oil spills on commercial fisheries. The first phase will determine the practicability of using existing information to assess these effects via Monte Carlo simulation techniques. Work tasks include a literature review, detailed review of existing models and a priority ranking of these models. The final report will be available in July 1980.
Keywords: oil spills; economic impact; fishing industry; monte carlo method; simulation; petroleum.

54083 Central Gulf of Mexico Ecological Study of Petroleum Production Platforms. Bedinger, C.A. (Southwest Research Inst., 3600 Yoakum Blvd., Houston, TX, 77006). **Project number:** AA551-CT8-17. **Contract:** AA551-CT8-17. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to investigate the long-term fate and persistence of petroleum related contaminants around platforms with varying durations and production histories. In addition, the artificial reef phenomena around these platforms was studied. Samples of resident biota and sediments were taken at carefully selected stations around twenty platforms and four control sites.
Keywords: gulf of mexico; offshore platforms; ecology; water pollution; petroleum; environmental effects.

54084 South Atlantic OCS Area Living Marine Resources Study. Van Dolah, R.F. (Marine Resources Research Inst., P.O. Box 12559, Charleston, SC, 29412). **Project number:** AA551-CT9-7. **Contract:** AA551-CT9-27. **Supported by:** Columbia Univ., New York (USA). Dept. of Mathematical Statistics. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this study are to: (1) determine the potential for impact (both detrimental and beneficial) by OCS oil and gas offshore activities on live bottom habitats and communities, with emphasis on fishery resources; and (2) characterize the habitats and associated biologic communities at the selected study sites. A total of nine live bottom areas has been selected for study during two seasons: winter (January/February) and summer (August/September). Field sampling and laboratory analysis efforts will be performed for a variety of biological, hydrographic, and physical habitat parameters, including: (1) meteorological observations; (2) salinity, temperature, dissolved oxygen, transmissivity, and illumination with depth; (3) characterization of physical live bottom habitat; and (4) assessments of epifaunal, macroalgal, and associated ichthyofaunal communities. Major data interpretation and synthesis tasks include: (1) characterizations of the individual study sites; (2) intersite comparisons and general characterizations of live bottom areas; (3) assessment of the potential for impact or enhancement of live bottom areas as a result of OCS oil and gas activities; (4) evaluations of methods used; and (5) recommendations for future studies.
Keywords: continental shelf; fishing industry; offshore operations; exploration; petroleum industry; natural gas industry; environmental impacts; fishes; habitat; southeast region.

54085 South Atlantic and Gulf of Mexico Pilot Study of the Seasonal Distribution and Abundance of Marine Birds, Mammals, Turtles, and the Endangered Manatee. Smith, D.M. (Fish and Wildlife Service, National Coastal Ecosystems Team, NASA/Slidell Computer Complex, Slidell, LA, 70458). **Project number:** AA551-MU9-18. **Contract:** AA551-MU9-18. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this study are to: (1) obtain and synthesize available data and literature about marine mammals, turtles, and manatees in the entire Gulf of Mexico and South Atlantic OCS Areas; (2) identify and describe areas of special biological significance; (3) develop software for analysis and archival of field data; (4) develop a comprehensive study plan for expanding the field studies from the initial study areas to the areas from Cape Hatteras, NC, around the southern tip of Florida and westward along the OCS to Brownsville, TX; and (5) collect and analyze field data about manatee in two areas (from Tarpon Springs, Fl, south to Cape Sable, FL, and from Matagorda Island, TX, south to Brownsville, TX). The approach of this study includes synthesis of available information and conduct of aerial and shipboard inventories.
Keywords: atlantic ocean; gulf of mexico; birds; mammals; turtles; manatees; spatial distribution; data compilation; data analysis; endangered species.

54086 Marine Habitat Mapping and Pipeline Hazard Assessment of the South Atlantic OCS. Popenoe, P. (Geological Survey, Office of Marine Geology, Woods Hole, MA, 02543). **Project number:** AA551-MU9-8. **Contract:** AA551-MU9-8. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this study are to determine: (1) the types of geologic features that exist on the Southeast Georgia Embayment, (2) those features which are sensitive biologic areas, and (3) whether any of the features could constitute a hazard to production, pipeline transportation, or installation of barge-loading facilities. Geophysical and bathymetric surveys utilizing side-scan sonar, high resolution seismic reflection system (Uniboom), precision depth render (3.5 kHz) and towed underwater television are conducted.
Keywords: atlantic ocean; coastal regions; georgia; geology; hazards; offshore operations.

54087 Application of a Coastal Circulation Model to the South Atlantic OCS. Herring, H.J. (Dynalysis of Princeton, 20 Nassau Street, Princeton, NJ, 08540). **Project number:** AA551-CT9-32. **Contract:** AA551-CT9-32. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this effort are to: (1) adapt the model specified by the BLM to the South Atlantic OCS region; (2) test the model with appropriate existing data; (3) document the model for the BLM's use; (4) provide recommendations for type, quantity, and quality of additional data needed to improve the model's effectiveness; and (5) provide quantitative values of the seasonal surface circulation for use in the Department of Interior oil spill risk analysis model. The approach to achieving those objectives consists of three phases: model preparation, data base assembly and formatting, and test runs, evaluation, and model revision. The principal products will be a magnetic tape with all computer codes including the mainprogram, subroutines and procedures, and a final report which will be primarily dedicated to a step-by-step description of the use of the model (a user's manual).
Keywords: atlantic ocean; coastal waters; water currents; mathematical models; surface waters.

54088 Archiving and Curating of Bureau of Land Management OCS Biological Specimens by Smithsonian Institution. Jones, M.L. (Smithsonian Inst., National Museum of Natural History, Washington, DC, 20560). **Project number:** AA551-CT9-37. **Contract:** AA551-CT9-37. **Supported by:** Bureau of Land Management, Washington, DC (USA). **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Through this contract the Smithsonian Institution, National Museum of Natural History will archive and curate voucher and other biological specimens from the Bureau of Land Management's (BLM) Outer Continental Shelf (OCS) Environmental Studies Program. The Smithsonian will make these specimens part of its collection and will manage them in accordance with its standards of specimen management. To date, all biological specimens collected under the BLM South Atlantic OCS Benchmark Program have been submitted to the Smithsonian. The Smithsonian will report to BLM semiannually on its progress in archiving the OCS biological specimens.
Keywords: plants; animals; inventories; continental shelf; baseline ecology; classification; aquatic ecosystems; southeast region.

54089 South Atlantic OCS Physical Oceanographic Data Collection. Saunders, G. (DOE, MS E-201, Germantown, MD, 20545). **Project number:** AA551-IA9-24. **Contract:** AA551-IA9-24. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this interagency agreement is to provide ship support for the collection of physical oceanographic data on joint Bureau of Land Management (BLM)--Department of Energy (DOE) cruises in 1980. This effort is planned for the winter--spring period of 1980 and is called the Georgia Bight Experiment I (GABEX I).
Keywords: continental shelf; southeast region; atlantic ocean; oceanography; baseline ecology; georgia.

54090 Northern Gulf of Mexico Topographic Features Study. Rezak, R.E.; Bright, T.J. (Texas A and M Univ., Research Foundation, College Station, TX, 77843). **Project number:** AA551-CT8-35. **Contract:** AA551-CT8-35. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The fourth year of this continuing study includes a field survey to monitor effects of OCS development on features of high ecological value and to determine if other currently unexamined features have equivalent ecological value. Although monitoring of the East Flower Garden Bank has been conducted for 3 years, more OCS development is expected in the vicinity of this site. Results from this study will be available by December 1979 and will be used in development plan approval, marine sanctuary decisions, and NPDES permitting. Sales affected include 45, 51, 58, 58A, 62, 65, and 66.
Keywords: gulf of mexico; topography; offshore sites; energy source development; environmental impacts; monitoring.

54091 Mississippi Deltaic Plain Ecological Characterization. Johnston, J.B. (Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA, 70458). **Project number:** AA551-MU8-28. **Contract:** AA551-MU8-28. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives of this study, which primarily synthesizes existing information, are to: (1) provide an ecological description of the area for comprehensive coastal resource use planning; (2) develop tools for environmental assessment and gather information for environmental impact analysis; (3) identify information gaps and research priorities; and (4) provide an assessment of the state of knowledge for this particularly rich and diverse ecosystem, which may be affected by OCS petroleum development.
Keywords: mississippi river; gulf of mexico; louisiana; coastal regions; ecology; land use; planning; energy source development; environmental impacts; offshore sites.

54092 Identification of Benthic Polychaetous Annelids from the Gulf of Mexico. Vittor, B.A. (Barry A. Vittor and Associates, 8100 Cottage Hill Road, Mobile, AL, 36609). **Project number:** AA551-CT9-35. **Contract:** AA551-CT9-35. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Monitoring of impacts of existing and future oil exploration activities in the Gulf of Mexico should rely heavily on abundance and diversity of benthic polychaetous annelids. Previous studies (MAFLA and West Texas) have stressed the importance of the polychaetes as indicators of possible habitat changes. The proposed study will standardize identification of polychaetes for the Gulf of Mexico so that future monitoring can be based upon adequate taxonomic data. The principal product of this program will be a key to the polychaetes of the Gulf of Mexico.
Keywords: gulf of mexico; benthos; taxonomy; biological indicators.

54093 Sabine Area Cultural Resources Evaluation. Ruppe, R. (Arizona State Univ., Tempe, AZ, 85200). **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this study is to establish broad probability zones for the existence of submerged archaeological and historical cultural resources on the OCS. The intent is to further refine those broad probability zones based on existing geophysical survey data. Expected products are seminars by qualified marine archaeologists on the location of these resources, an assessment of the ability of the present survey techniques to detect these resources, and an assessment of the efficacy of present lease stipulations in preventing damage to these resources by OCS oil and gas operations.
Keywords: archaeological sites; continental shelf; cultural resources; geophysical surveys; gulf of mexico; probability.

54094 Biogeochemistry of Petroleum Components at the Sediment--Water Interface. Farrington, J. (Woods Hole Oceanographic Institution, Woods Hole, MA, 02543). **Project number:** IA7-20. **Contract:** IA7-20. **Supported by:** Bureau of Land Management, Washington, DC (USA). **Funding:** DOI; DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

Research is oriented towards elucidation of the following mechanisms in the distribution of hydrocarbons in sediments: diffusion between pore waters and overlying waters, physical mixing of water and sediment, and biological activities. A prototype chamber for benthic biogeochemistry research was fabricated in 1977 and has been used in the laboratory and marine environment. Through the use of the chamber, parameters including current velocity, hydrocarbon concentration, sediment type, type and number of organisms can be controlled and varied to determine their effect on hydrocarbon distributions. In situ and laboratory experiments have been completed and preliminary results indicate that the polychaete Nepthys accumulated greater amounts of higher molecular weight hydrocarbons (e.g. pyrene) relative to the lower molecular weight hydrocarbons (e.g. fluorene). Narrative progress reports are scheduled for April of each year.
Keywords: sediments; water chemistry; oceanography; petroleum; hydrocarbons.

54095 Distribution and Fate of Biogenic and Petroleum Derived Substances in Marine Sediments. Kaplan, I.R. (Univ. of California, Inst. of Geophysics and Planetary Physics, Los Angeles, CA, 90024). **Project number:** IA6-34. **Contract:** EY-76-3-03-0034. **Supported by:** Bureau of Land Management, Washington, DC (USA). **Funding:** DOI; DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This program is intended to investigate and characterize the distribution and stability of organic and inorganic pollutants on the California outer continental shelf and nearshore. Hydrocarbons, pesticide, and trace metal analyses are performed on sediment samples collected in unpolluted areas and compared with those collected in polluted areas. Concentrations and speciation will be interpreted to determine transformation mechanisms. The distribution and types of hydrocarbons will be compared in the continental shelf, slope and rise sediments to determine the mechanism by which hydrocarbons may be transported from the OCS to deep water. The long term contamination of Southern California OCS sediments by petroleum has been confirmed using the presence of a series of extended

triterpanes-hopanes. Annual reports are available in June of each year.
Keywords: petroleum; environmental transport; sediments; continental shelf; california; hydrocarbons; metals; pesticides; mathematical models.

54096 Commercial Fishing Industries Impacts Lower Cook Inlet Sale 60. Terry, J. (Univ. of Alaska, Fairbanks, AK, 99701). **Project number:** CT6-61. **Contract:** AA550-CT6-61-9CE. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This extended study is designed to analyze impacts and changes in the fishing industries resulting from potential OCS development and to assess the linkages and potential conflicts between the fishing industry and the oil industry. Fishing is a major industry in Alaska, and information from this study is needed to assess the impacts of OCS development on the fishing industries, competition for labor, wage effects, and employment levels.
Keywords: fishing industry; petroleum industry; environmental impacts; alaska; economic impact.

54097 Sociocultural Impacts: Lower Cook Inlet Sale 60. Braund, S.R. (Stephen R. Braund, 2658 Northrup Place, Anchorage, AK, 99504). **Project number:** AA550-CT6-61-9CD. **Contract:** AA550-CT6-61-9CD. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This study is designed to analyze potential impacts and changes in the social organizations of the predominantly native communities and to develop an understanding of the social system linkages between these communties and higher levels of government. Information is needed to assess effects of OCS exploration and development on native populations and their life styles and to estimate impacts of OCS activities on the stability of small non-native communities.
Keywords: alaska; offshore sites; continental shelf; leasing; petroleum deposits; communities; social impact; human populations; eskimos; life styles.

54098 Local Socioeconomic Systems Impacts: Bering Norton Sale 57. Ender, R.L. (Policy Analysts Ltd., 5139 East 42nd Avenue, Anchorage, AK, 99504). **Project number:** C76-61. **Contract:** AA-550-CT6-61-9CH. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This one-year field and synthesis study is designed to analyze the impacts and changes from OCS activities on community infrastructures such as utilities, housing, and other services. Information is needed to evaluate the increased burden of development on local availability of social service facilities, housing, and utilities.
Keywords: petroleum deposits; natural gas deposits; alaska; economic impact; social impact; communities; public utilities; houses; leases.

54099 Socioeconomic Impacts on Anchorage: Bering Norton Sale 57. Ender, R.L. (Policy Analysts Ltd., 5139 East 42nd Avenue, Anchorage, AK, 99504). **Project number:** CT6-61. **Contract:** AA-550-CT6-61-9CF. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this study is to estimate the potential changes in economic activity and structure, social systems, and manmade physical systems in Anchorage as a result of the proposed Bering Norton OCS lease sale. The information will be used to assess the demographic, economic, and fiscal effects on Anchorage of the leasing proposal.
Keywords: petroleum deposits; natural gas deposits; alaska; socioeconomic factors; human populations; leases.

54100 Local Sociocultural Systems Impacts: Bering Norton Sale 57. Ellanna, L.J. (Linda Ellanna, P.O. Box 1538, Nome, AK, 99762). **Project number:** AA550-CT6-61-9CJ. **Contract:** AA550-CT6-61-9CJ. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This one-year study is designed to analyze potential impacts and changes in the social organization of the predominantly native communities in the Norton Sound area and to assess the social system linkages between these communities and higher levels of government. Information is needed to evaluate effects of exploration and development on native populations and their life styles as well as to estimate impacts on the stability of small white communities.
Keywords: alaska; continental shelf; petroleum deposits; leasing; eskimos; social impact; communities; social services; local government; state government; exploration; resource development; life styles.

54101 Transportation System Impacts: Bering Norton Sale 57. Schmidt, R.W. (Peat, Marwick, Mitchell and Co., 601 West 5th Avenue, Anchorage, AK, 99501). **Project number:** AA550-CT6-61-9CB. **Contract:** AA550-CT6-61-9CB. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This study is designed to analyze the impacts and changes to existing transportation networks resulting from potential OCS development. The study will also address impacts to social infrastructure and shipping conflicts. The information is needed to evaluate the burden of development on the existing transport network and to assess the severity of space-use conflicts, especially those related to ocean shipping.
Keywords: transportation systems; economic impact; continental shelf; alaska; petroleum deposits; resource development; leasing; maritime transport.

54102 Commercial Fishing Industries Impacts: Bering Norton Sale 57. Terry, J. (Univ. of Alaska, Fairbanks, AK, 99701). **Contract:** AA550-CT6-61-9CK. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

Fishing is a major industry in Norton Sound. The extension of this existing study is designed to assess potential changes in the fishing industries resulting from OCS development and to define the linkages and potential conflicts between the fishing industries and the oil industry. The information is needed to assess the impact of OCS development on the fishing industries, competition for labor, wage effects, and employment levels.
Keywords: fishing industry; economic impact; leasing; continental shelf; petroleum deposits; offshore sites; alaska; competition.

54103 Information Synthesis: Chukchi Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This synthesis presents the results of the OCSEA Program on the Chukchi Sea to the Department of the Interior decisionmakers in an organized manner that allows its effective use in the oil and gas decision process. This synthesis includes: (1) a series of Lease Area Synthesis Reports, (2) a data base of verified environmental information, (3) an archive of biological voucher specimens, and (4) special reports and visual displays to support environmental impact analysis.
Keywords: petroleum industry; natural gas industry; decision making; leasing; environmental impacts; seas; land use.

54104 Oil-Ice Interactions: Chukchi Sea. (NOAA, Office of Marine Pollution and Monitoring, Boulder, CO, 80303). **Project number:** AA551-IA9-7. **Contract:** AA551-IA9-7. **Supported by:** National Oceanic and Atmospheric Administration, Fairbanks, AK (USA). Arctic Project Office. **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

Oil spilled in the Arctic will be contained, dispersed, and transported for 9 to 10 months each year by sea ice. Oil cleanup in sea ice is presently not possible because no suitable technology exists, either to detect the oil remotely under the ice or to remove it effectively once it is detected. The behavior of oil spilled in or under ice is generally unknown. This continuing study provides tentative information on the transport of ice and any spilled oil through Bering Strait and compliments the oil-ice program in the Beaufort Sea.
Keywords: oil spills; arctic regions; cleaning; beaufort sea; environmental impacts.

55000 Ecological-Limnological Impact of Pumped Storage. La Bounty, J.F. (Water and Power Resources Service, Denver Federal Center, P.O. Box 25007, Denver, CO, 80225). **Project number:** DR-331. **Supported by:** Water and Power Resources Service, Denver, CO (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to deterime ecological impact of pumped-storage on Twin Lakes, includng Lake Trout Fishery. Data are collected at Twin Lakes before operation and will be collected after

operation begins. The expected product will be data and reports, some of which will be applicable to other pumped-storage projects. **Keywords:** colorado; lakes; pumped storage power plants; limnology; baseline ecology; aquatic ecosystems; environmental impacts; fishing industry.

56000 Effect of Water Pollution Control Regulations on Input Substitution Elasticities in Electric Power Production. Deyak, T.A. (Auburn Univ., Dept. of Economics, Auburn, AL, 36830). **Contract:** A-062-ALA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this study are to obtain an empirical description of electric power production and to determine the impact of water quality regulations on electric power generation and their effect on higher costs and output prices. The approach was to: (1) estimate transcendental logarithmic cost functions; (2) determine effects of water pollution control regulations on input substitution elasticities; (3) calculate relevant input substitution elasticities; (4) disseminate results of research in water pollution control and regulatory personnel; and (5) provide information in journals regarding efficiency and economic consequence of water pollution control. **Keywords:** power generation; pollution regulations; cost; water pollution control; thermal power plants; water quality.

56001 Economic Consequences of Allocating Groundwater to Competing Interests in the Santa Cruz Basin, Pima County, Arizona. Wade, J.C. (Univ. of Arizona, School of Agriculture, Tucson, AZ, 85721). **Contract:** A-087-ARIZ. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to evaluate short- and long-run economic consequences of using groundwater in the Santa Cruz Basin where demands for supplies are competitive. The approach is to: (1) collect data to assess consequences of using Basin water and Tucson's sewage treatment plant effluent for agriculture, mining, municipal, and domestic demands; (2) develop models to simulate consequences of allocation schemes for groundwater and reuse water; (3) examine demands by users; (4) determine elasticities; and (5) access alternative allocation schemes.
Keywords: arizona; ground water; agriculture; mining; waste water; economic impact; allocations; rivers; water resources.

56002 Decision Framework for Evaluating Costs of Water Application in Production Agriculture. Altobello, M.A. (Univ. of Arizona, School of Agriculture, Tucson, AZ, 85721). **Contract:** A-089-ARIZ. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this study are to develop a decision framework for evaluating water application costs in production agriculture, and specifically: (1) to identify potential water-saving irrigation systems or techniques availabile in the West, given specific sets of agronomic parameters (soil type, topography, climate, crop mix, etc,); (2) to determine total investment and operating costs for each system; and (3) to develop Bayesian decision framework, incorporating information on predicted energy price increases to minimize ion-run costs of irrigation.
Keywords: crops; farms; cost; water supply; soils; climates; energy consumption; topography; investment; irrigation.

56003 Hydrologic Variability: Complying with Regulatory Enforcement Standards for the Rehabilations of Surface-Mined Coal Lands. Hekman, L.H. (Univ. of Arizona, School of Agriculture, Tucson, AZ, 85721). **Contract:** B-073-ARIZ. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); conservation(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this program are: (1) to characterize hydrologic uncertainties affecting reclamation efforts on surface-mined coal lands in economic terms; and (2) to develop methodology for incorporating uncertainties into reclamation standards. Stochastic models of precipitation and temperature are with hydrologic models and soil/water/plant establishment relationships to generate probability distributions of precipitation, temperature, mositure, run-off, sediment and vegetative cover densities. Data are from western coal mining regions with emphasis on Black Mesa of Arizona. Simulation techniques are used to model and assess dynamic interactions of total system overtime. The overall approach will determine the performance standards that will meet the intent of the law and minimize the performance losses that are the results of hydrologic variability. **Keywords:** coal mining; surface mining; hydrology; land reclamation; regulations; economics; arizona; simulation.

56004 Hydrogeologic and Geochemical Investigation of the Boone Limestone Aquifer in Benton County, Arkansas. Ogden, A.E. (Univ. of Arkansas, School of Arts and Sciences, Fayetteville, AR, 72701). **Contract:** A-044-ARK. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is a thorough study of shallow Boone limestone aquifer of Benton Co., Arkansas. The approach will be to: (1) evaluate capacity; (2) correlate well yields with photo-lineaments mapped from low altitude BXW (1:20,000) and U-2 color photography; (3) recharge and discharge areas to be determined from piezometric surface map and areas of groundwater mining; (4) monitor water levels to predict seasonal effects to piezometric surface; (5) determine water quality of aquifer and measure major ions and bacteria; (6) locate pollution sources by geostatistical methods; and (7) correlate water quality to photo-lineament (fracture) proximity. **Keywords:** aquifers; coal mines; ground water; recharge; arkansas; monitoring; water quality; water pollution; environmental impacts.

56005 Water Quality Considerations in the Slurry Pipelining of Coal. Moore, J.W. (Univ. of Arkansas, University Hall, Fayetteville, AR, 72701). **Contract:** B-059-ARK. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(30); hydroelectric(30); conservation(40) **R and D categories:** Pollutant characterization and analysis.

The objectives of this program are: (1) to develop viable process methodologies to allow reuse of slurry pipeline wastewater as make-up cooling water for electric power generation and/or cooling water for coal gasification/liquefaction; and (2) to determine technical feasibility of utilizing municipal and industrial wastewater for the same purpose.
Keywords: slurry pipelines; waste water; waste product utilization; fossil-fuel power plants; cooling; coal gasification plants; coal liquefaction plants; waste processing plants; feasibility studies; water treatment.

56006 Influence of Geochemical Origin and Drought Conditions on Aquatic Biota of the Known Geothermal Resource Area of California. Resh, V.H. (Univ. of California, 201 Wellman Hall, Berkeley, CA, 94720). **Contract:** B-200-CAL. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) evaluate recovery rate of streams in known geothermal resource area (KGRA) affected by drought in the last 2 years and which received highly concentrated effluents from geothermal activities establishing information on environmental effects of geothermal energy operations; (2) compare dynamics of benthic communities in hot-water dominated geothermal systems (Big Canyon Creek Watershed) with those of vapor-dominated (Big Sulfur Creek Watershed); (3) describe benthic fauna of KGRA and develop sampling regimes for monitoring systems; and (4) include organization analysis, energy transfer processes, instantaneous growth rates, behavioral responses, fecundity, and morphometric analysis. The results will include the development of geothermal energy industry in Imperial Valley and Great Britain.
Keywords: aquatic ecosystems; kgra; california; geothermal fluids; arid lands; rain; environmental effects; hot-water systems; sampling; monitoring; benthos.

56007 Improving Cold Weather Operation of Sewage Lagoons with Solar Heat. Klemetson, S.L. (Colorado State Univ., School of Engineering, Ft. Collins, CO, 80523). **Contract:** A-046-COLO. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate use of solar heating of wastewater stabilization ponds to improve treatment efficiency and odor control during cold portions of year. The approach is to evaluate liquid and hot air flat plate solar collectors to heat pond water sufficiently to maintain ice-free conditions; improve winter time reaeration; and increase biological treatment efficiency.
Keywords: water treatment; water treatment plants; waste water; sewage; ponds; odor; solar water heaters; flat plate collectors; evaluation; aeration; industry.

56008 Photocatalytic Oxidation of Organic Pollutants. Schrader, G.L. (Univ. of Delaware, School of Engineering, Newark, DE, 19711). **Contract:** A-042-DEL. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to investigate and develop a method for purification of drinking water and treatment of wastewater by photocatalytic oxidation of organic species. The approach is to: (1) study homogeneous catalytic systems; (2) develop catalyst for aqueous-phase oxidation; (3) determine kinetics and mechanisms of photoca-

talytic reactions; (4) develop solid state catalyst which functions analogously; and (5) use the batch-recycle reactor system and perform economic evaluations of photocatalytic systems.
Keywords: drinking water; water treatment; photochemistry; oxidation; organic wastes; catalysts; photochemical reactions; reaction kinetics; economic analysis.

56009 Enivronmentally Acceptable Design of Multiport Diffuser-Pipes Discharging Industrial and Thermal Wastes into Florida's Waters. Christenson, B.A. (Univ. of Florida, 220 Black Hall, Gainesville, FL, 32611). **Contract:** A-035-FLA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Pollutant characterization and analysis.

Predictive methods for environmentally acceptable design and evaluation of multiport diffuser-pipes discharging industrial and thermal wastes into shallow, flowing, confined surface waters in Florida will be determined. Laboratory experiments will be performed in 8-ft wide, 140-ft long channel. Both diffuser and ambient conditions will be stuided with variable parameters representing Florida's surface waters. Results of physical model will be combined with mathematical results to satisfy objectives. Results will assist local, state and federal agencies in evaluating proposed and existing installations and will aid industries, power plant companies and consulting engineering firms in choosing plant sites and in designing diffuser-pipe systems.
Keywords: florida; environmental engineering; industrial wastes; thermal effluents; pipes; diffusers; design; power plants; water quality.

56010 Anaerobic-Activated Carbon Filters for the Removal of Refractory and Toxic Organic Compounds in Water Waste. Suidan, M.T. (Georgia Inst. of Tech., 225 North Ave. NW, Atlanta, GA, 30332). **Contract:** A-077-GA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

A wastewater treatment system for high-strength phenolic wastewater is developed. The system consists of: anaerobic biological filter with granular activated carbon as contact media; sample water at intermediate points in a series of fluidized bed reactors to determine adsorption, desorption and biodegradation of compounds; first-study waste of readily biodegraded substate; and second-study effect of various levels of phenol on performance of contactor.
Keywords: activated carbon; filters; adsorption; sorptive properties; organic compounds; waste water; water pollution abatement; phenols; coal gasification; waste processing; toxicity.

56011 Enhanced Solar Drying of Wastewater Sludge. Craft, T.F. (Georgia Inst. of Technology, 225 North Avenue NW, Atlanta, GA, 30332). **Contract:** A-080-GA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective is the design, construction, and testing of pilot-scale covers for enhanced solar sludge-drying beds. The approach is to design the system; evaluate materials to be used; compare drying times with conventional open beds; and test pilot-scale models. The results will be used to build a full-scale drying bed cover.
Keywords: sewage sludge; design; performance testing; solar drying; solar dryers.

56012 Microbial Degradation of Industrial Wastes Applied to Freshwater Swamps and Marshes. Hodson, R.E. (Univ. of Georgia, Dept. of Microbiology, Athens, GA, 30601). **Contract:** A-082-GA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(25); oil and gas(25); geothermal(25); hydroelectric(25) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to assess the effects of low concentrations of industrial wastes on microbial biomass and metabolic activity in freshwater swamps and marshes of Georgia; and to evaluate the relative significance of the overall turnover of toxic pollutants in wetlands on microbial populations, in order to assess the feasibility of using these environments in the tertiary treatment of industrial effluents. Microbial biomass in water and sediment samples will be determined by measuring intercellular concentrations of ATP. In addition, determinations will be made of: the cellular energy charge of microbial populations before and after additions of phenol, anidine, tuolene, and other compounds; the rates of mineralization of naturally occurring organic compounds; and in-situ rates of microbial degradation of toxic organic compounds in wetland environments.
Keywords: biodegradation; industrial wastes; fresh water; aquatic ecosystems; marshes; swamps; microorganisms; water pollution control; metabolism; toxic materials; hydrocarbons; coal industry; petroleum industry; natural gas industry; geothermal energy; hydroelectric power.

56013 Comparative Water Value in Humid and Arid Zones for Food Crop Production Strategy. Fok, Y. (Univ. of Hawaii, 2540 Dale St., Room 283, Honolulu, HI, 96822). **Contract:** B-060-HI. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

Methodology will be provided to assess the impact on reallocation of irrigation water for energy production and other uses. The trade-off value of irrigation water for corn production in semi-arid region (Colorado) and in humid mid-west (Illinois) will be determined and analyzed. Results will be used for multiple-objective system optimization and flexible planning strategies for decision makers.
Keywords: food; crops; production; water requirements; agriculture; water resources; management; irrigation.

56014 Undeveloped Hydropower as a Potential Energy Source in Idaho. Warnick, C.C. (Univ. of Idaho, Dept. of Civil Engineering, Moscow, ID, 83843). **Contract:** A-057-IDA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this study is to seek methods and criteria for defining extent of available low-head hydropower sites in Idaho. Development of dams that do not have hydro development and development of sites on streams that still have undeveloped sites will be considered. Utilizing drops in irrigation pumping, research will be recommended to prioritize sites and develop as soon as possilbe. This will be done in cooperation with state energy officials, Public Utilities Commission, and electrical energy producers.
Keywords: low-head hydroelectric power plants; idaho; site selection; dams; hydroelectric power.

56015 Optimal Pricing and Regulation of Electrical Energy in a System Depending on Hydroelectric Capacity. Lyman, R.A. (Univ. of Idaho, Moscow, ID, 83843). **Contract:** A-059-IDA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this study are to review regulatory practices on pricing of energy and to consider policies to define rate base used in electric utilities. The approach used is to evaluate the possibilities of peak-load pricing as an energy conservation strategy; to find effect of policies and pricing on seasonal reservoir levels; and to use modeling techniques to study optimum utility behavior.
Keywords: hydroelectric power; regulations; rate structure; electric power; optimization; hydroelectric power plants; peak-load pricing.

56016 Biological Treatment of Acid Mine Drainage Incorporating Anaerobic Microbial Processes. Herricks, E.E. (Univ. of Illinois, 2527 Hydrosystems Lab., Urbana, IL, 61801). **Contract:** A-096-ILL. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to design a biological treatment process for acid mine drainage (AMD). The approach will be to utilize solid wastes as feed to an anaerobic reactor; precipitate matals; and improve pH of AMD by reactor liquors high in alkalinity and sulfides. A high sulfate stream will be fed to the reactor to provide sulfate to sulfate-reducing bacteria, producing high sulfide levels for metal precipitation. The effluent will undergo a final polish with lime or limestone to produce good water quality for stream discharge or irrigation. Waste sludge from the initial contact step will make metal recovery possible, and sludges from the reactor can be used as soil amendments for land reclamation.
Keywords: acid mine drainage; anaerobic digestion; microorganisms; water treatment; land reclamation; irrigation; soil chemistry; ground disposal; coal mining; surface mining.

56017 Solar Radiation Transfer in Water Bodies Relevant to Environmental and Energy Applications. Incropera, F.R. (Purdue Univ., Executive Bldg., West Lafayette, IN, 47907). **Contract:** A-058-IND. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide experimental results for inherent optical properties of aqueous suspensions and for distribution of visible radiation in suspension subjected to various environments. Radiation environment will be measured in a large water tank irradiated by light which simulates solar radiation environment. Measurements will be made as a function of time of day and cloud

conditions. Water samples will be characterized according to population and size of suspended particles, pigment and optical properties. Results will be compared with predictions. This project is expected to contribute to the understanding of aquatic processes and result in the design of water bodies to serve engineered systems for human needs.
Keywords: optical properties; solar flux; heat transfer; public health; suspensions; environmental effects; solar energy; water reservoirs.

56018 Solubility of Selected Major and Minor Elements from Coal, Gob, and Fly Ash Accumulations. Angino, E.E. (Univ. of Kansas, 112 Bailey Hall, Lawrence, KS, 66045). **Contract:** A-087-KAN. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); conservation(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to study the deterioration of ground and surface waters by runoff waters from coal, gob, coal washings, and fly ash piles. The approach is: (1) to collect samples from existing gob and fly ash piles; (2) to evaluate, on a temporal basis, ease of leaching the elements Ca, Mg, Na, K, Fe, Mn, Pb, and Zn; (3) to hold temperatures near 70 degrees C throughout the test; (4) to measure leaching rates as well as factors that may control leaching (e.g. time); and (5) to review data collected for use in rational predictions of the impact of such water on water supplies. The results should provide information for devising guidelines for handling runoff from such sources.
Keywords: ground water; surface waters; water pollution; stockpiles; mineral wastes; fly ash; runoff; leaching; calcium; magnesium; sodium; iron; potassium; manganese; lead; zinc; water resources; water pollution; forecasting.

56019 Environmental Study of the Origin, Distribution, and Bioaccumulation of Selenium in Kentucky and Barkley Lakes. McClellan, B.E. (Murray State Univ., Graduate School, Murray, KY, 42071). **Contract:** A-075-KY. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to study the environmental impact of selenium on flora and fauna for use in epidemiologic studies of the effects of selenium. Approaches to be utilized include: (1) obtaining bioaccumulation data under natural and laboratory conditions; (2) assessing the problem and recommending environmental improvements; (3) taking monthly samples (including sampling from coal mine drainage pools); (4) studying the uptake rate in plants and animals; and (5) conducting analyses by hydride generation atomic absorption spectrometry.
Keywords: selenium; biological accumulation; water quality; pollution sources; ecological concentration; lakes; aquatic ecosystems.

56020 Water Reuse by a Unique Low-Pressure Membrane Separation Process to Remove Heavy Metals from Metal Processing Wastewaters. Grieves, R.B. (Univ. of Kentucky, Limestone and Euclid Sts., Lexington, KY, 40506). **Contract:** B-059-KY. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine the feasibility of treating diversified metal processing wastewaters by using commercially available, non-cellulosic membranes; (1) low, 5 to 7 atm-pressure, negatively charged ultrafiltration, containing fixed sulfonic groups; and (2) low, 10 to 15 atm-pressure poly(etherlamide) ultrathin, composite. The approach will be to investigate with: (1) bench-scale unit, multi-salt solutions of Cr, Cu, Zn, Cd, Ni, and complexing agents (including cyanide); (2) computer simulation to scale-up from lab data; (3) membrane process evaluated as to max water recovery; (4) proper ultrafiltrate quality, multiple-pass water reuse, concentrate cycle, and energy consumption; and (5) recovery verified by long-time experiments with actual metal wastewaters.
Keywords: waste water; waste processing; metals; membranes; energy conservation; chromium; copper; zinc; cadmium; nickel; complexes; cyanides; simulation; metallurgy; metal industry.

56021 Use of Twin Wells and Heat Pumps for Energy Conservation in Louisiana. Kazmann, R.G. (Louisiana State Univ., University Station, Baton Rouge, LA, 70803). **Contract:** A-046-LA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this study are to design tables and maps to apply use of twin wells and heat pumps for energy conservation. The approach is to: adapt existing heat pumps to varying flow; compare computed and actual results; and streamline tracking using well configurations resulting from multihouse developments to determine break-through times.
Keywords: louisiana; water source heat pumps; wells; technology assessment; energy conservation.

56022 Key Social Factors Affecting Water-Related Resource Development Decisions in Minnesota. Gerlach, L.P. (Univ. of Minnesota, 322 Johnston Hall, Minneapolis, MN, 55455). **Contract:** B-131-MINN. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(25); hydroelectric(35); conservation(40) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to study the impact of social factors, such as local level structure, interest group dynamics, and sub-cultural perceptions and premises, affecting mineral-mining, forestry, tourism, and energy production in Minnesota. Models to facilitate decision-making in these areas will be developed. The study is designed to meet Minnesota's immediate needs, but will be applicable to other areas in the United States with similar problems.
Keywords: minnesota; water resources; energy source development; social impact; water requirements.

56023 Quality and Treatment of Water Involved With Coal Slurry Transport by Pipeline. Manahan, S.E. (Univ. of Missouri, 130 Jesse Hall, Columbia, MO, 65201). **Contract:** A-110-M0. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to develop a standard test for water from a coal slurry pipeline. The approach is: to agitate coal with water for a time similar to that of slurry transport; to investigate interchange of pollutants; to develop economical treatment for removal of pollutants; and to consider acidity, alkalinity, organic materials, and heavy metals.
Keywords: coal; hydraulic transport; slurry pipelines; water treatment; coal; leaching.

56024 Ex Post Facto Analysis of Army Corp of Engineers and Bureau of Reclamation Projects in Montana. Konizfski, R. (Univ. of Montana, School of Forestry, Missoula, MT, 59801). **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this study are to analyze and evaluate projects undertaken by Army Corps of Engineers and Bureau of Reclamation and to assess benefits to electric power generation. The approach used is to compare commitments for compensation for losses to state and private holdings; review construction practices; examine operating techniques and effects on streams and pool water levels; assess physical changes in stream and flood plain morphology; and assess the benefits to electric power generation.
Keywords: power generation; cost benefit analysis; us organizations; construction; montana; operation; hydroelectric power; dams; water reservoirs.

56025 Investigation of Possible Techniques to Predict Groundwater Quality in Mined Lands. Hedges, R.B. (Montana College of Mineral Science and Technology, Butte, MT, 59701). **Contract:** A-113-MONT. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to evaluate methods for predicting chemical quality and changes in groundwater in mined lands and unmined coal beds. The approach is to examine various methods, including earth resistivity (measured from land surface), saturated-paste extracts (from cores and highwalls), and leachates of core and highwall samples. Adequacy of methods will be based on ability to generate values comparable to existing mined-area waters.
Keywords: coal deposits; coal mining; water pollution; ground water; water quality; forecasting.

56026 Sulfur and Coal Mining in MONTana: Potential Impact on Ground and Surface Water. McFeters, G.A. (Montana State Univ., Dept. of Microbiology, Bozeman, MT, 59715). **Contract:** B-050-Mont. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to study sulfur-cycling activities at strip mines to determine impacts on water quality. The approach is to isolate and enumerate acid-producing thiobacilli; to check acid production and metal solubilization; to quantify bacterial hydrogen sulfides through radioisotope techniques; to determine limiting nutrients; and to evaluate methods for control of sulfide formation.
Keywords: montana; coal mining; surface mining; environmental effects; ground water; surface waters; acid mine drainage; sulfides;

thiobacillus ferroxidans; thiobacillus oxidans; tracer techniques; nutrients; control; sulfur compounds; metals; dissolution; water quality.

56027 Water and Energy Conservation Using Center-Pivot Irrigation and Reduction Tillage Systems. Gilley, J.R. (Univ. of Nebraska, School of Eng. and Tech., Lincoln, NE, 68508). **Contract:** B-048-NEB. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objectives of this study are to develop mathematical models of center-pivot irrigation and reduced tillage systems and to determine feasibility of using the systems in other geographical areas. Field experiments are used to determine quantity and quality of runoff crop land as affected by reduced tillage systems. Water and energy requirements and savings from reduced pressure, discharge and tillage are calculated from field results. Mathematical models will be developed and validated by field results, and the models will be used to determine feasibility of using the system elsewhere.
Keywords: irrigation; water supply; energy conservation; farms; crops; water requirements.

56028 Investigation into Hazardous Phenolic Compounds from Petroleum Source and Urban Runoff. Faust, S.D. (Rutgers--the State Univ., Old Queens Bldg., New Brunswick, NJ, 08903). **Contract:** B-071-NJ. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental effects assessment.

The objective is to identify the specific phenolic compounds in estuary waters and sediments to establish extent of urban runoff, petroleum, and other sources that contribute to pollution. The result will be the identification of phenols that would lead to control and elimination.
Keywords: phenols; petroleum industry; pollution sources; urban areas; runoff; water pollution.

56029 Geochemical and Hydrological Investigation of Ground Water Recharge in the Roswell Basin of New Mexico. Gelhar, L.W. (New Mexico Inst. of Mining and Technology, Campus Station, Socorro, NM, 87801). **Contract:** A-055-NMEX. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(25); conservation(75) **R and D categories:** Environmental effects assessment.

The objective is to develop methods of water and energy conservation in groundwater basins beset by decline in water levels and water quality. The approach will be to: (1) coordinate radiochemical, geochemical, hydrological, and statistical methods to investigate recharge in time and space; (2) collect data on source areas, flow directions, and seasonal variations of recharge; (3) analyze by spectral analysis 15 years of records; and (4) elucidate evapotranspiration losses of the soil-moisture model. An understanding of the physical variables affecting recharge in semi-arid regions is the expected result.
Keywords: new mexico; ground water; hydrology; geology; water quality; flow models; seasonal variations; soils; recharge.

56030 Proposal to Assess the Problems of Water Supply Contamination Due to Underground Coal Gasification. Niemczyk, T.M. (Univ. of New Mexico, University Hill NE, Albuquerque, NM, 87106). **Contract:** B-061-NMEX. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental effects assessment.

The objective of this program is to determine if establishing an underground coal gasification facility would have adverse effects and pose a threat to underground water supplies. The approach is: (1) to assess the possibility of water contamination by inorganic and organic species; (2) to make baseline study of water from test site for lab tests; and (3) to develop criteria to be used for selecting sites with minimal impact on environment.
Keywords: coal gasification; in-situ gasification; water pollution; ground water; organic compounds; inorganic compounds; site selection; environmental effects; acid mine drainage.

56031 Transport of Heavy Metals, Nutrients, and Radioactive Species from Grants Uranium Belt. Branvold, L.A. (New Mexico Inst. of Mining and Technology, Dept. of Chemistry, Socorro, NM, 87801). **Contract:** B-062-NMEX. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to investigate levels of chemical pollutants from the mining activity in the Grants, New Mexico, area. Runoff water through Rio San Jose-Rio Puerco River system is investigated. Transport mechanisms and potential effects of sediment on the retaining dam on the Rio Puerco are studied.
Keywords: metals; uranium mines; water pollution; new mexico; runoff; rivers; environmental transport; radionuclide migration; sediments; dams; environmental impacts; uranium deposits; radioisotopes.

56032 Optimizing Water Treatment Operations for Savings in Water and Energy Consumption. Chao, A.C. (Univ. of North Carolina, Dept. of Civil Engineering, Raleigh, NC, 27607). **Contract:** A-108-NC. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this study is to conduct research on a new variable-rate method for filter backwash to realize the efficient use of energy and backwash water. The studies will be conducted to: (1) measure particle de-attachment and transport efficiencies; (2) determine optimum backwash schedule for filters; (3) compare the proposed method with the present methods; and (4) formulate tables and/or diagrams to implement laboratory results in operations.
Keywords: energy consumption; water treatment plants; granular bed filters; filtration; waste water; variations; cleaning; washing.

56033 Development and Application of SED System Employing Microcomputer Control for HPLC of Phenols in Water. Tallman, D.E. (North Dakota State Univ., Dept. of Chemistry, Fargo, ND, 58102). **Contract:** A-063-NDAK. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop analytical methods for speciation and quantitation of organic compounds in natural waters, particularly analysis of monohydric and polyhydric phenols from strip mines and coal gasification. The approach will be to: (1) develop microcomputer-based electrochemical detector for analysis of effluent from high performance liquid chromatography; (2) develop reverse-phase HPLC techniques for separation of phenolic compounds; (3) employ microcomputer for control and real-time optimization of electrode potential to produce signal; (4) permit evaluation of advantages of time-dependent wave forms applied to electrodes; (5) compare performance of this SMART electrochemical detector with conventional detector; and (6) apply analysis system to studies of phenolic compounds and lab investigation of extraction of phenols by water from lignite coals.
Keywords: phenols; water; surface mining; coal gasification plants; water pollution monitors; quantitative chemical analysis; waste water; liquid column chromatography.

56034 Subsurface Water Quality Model for Western Surface Mine Sites. Koob, R.D. (North Dakota State Univ., State Water Resources Inst., Fargo, ND, 58102). **Contract:** B-053-NDAK. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to test hypotheses associated with a model for subsurface water quality in the Northern Great Plains surface mine areas. The approach is: (1) to determine sulfur in overburden materials as oxidize and reduced forms; (2) to determine molecular oxygen content of soil cross sections and total alkalinity of overburden materials; and (3) to refine technique for determining redox potentials of natural water systems. If hypotheses are reasonable, the model will be formalized as a computer program.
Keywords: great plains; coal mining; surface mining; ground water; water quality; environmental effects; overburden; sulfur compounds; quantity ratio; chemical composition; mathematical models; oxygen.

56035 Acid Mine Pollution: Effects on Survival, Reproduction and Aging of Stream Bottom Microinvertebrates. Hummon, W.D. (Ohio Univ., Dept. of Zoology and Microbiology, Athens, OH, 45701). **Contract:** A-050-OHIO. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to study the relationship between acid mine pollution and the occurrence of hyporrheic meiofauna (stream-bottom microinvertibrates). The study may include as many as fourteen higher taxa. Fauna and the environmental parameters of both unpolluted and acid-mine-polluted streams will be analyzed, as will streams in vegetatively reclaimed areas. Approaches will include: (1) using statistical procedures to characterize microinvertibrate communities and their relationship and tolerance to acid mine pollution; (2) measuring changes in longivity and the reproductive rate of test animals; (3) calculating selection coefficients; (4) relating the lab work to observe occurrences in test animals; and (5) studying, by light transmission electron and scanning electron microscope techniques, alterations in the normal development of test animals.
Keywords: acid mine drainage; invertebrates; benthos; aging; reproduction; survival curves; aquatic ecosystems; biological effects;

physiology; land reclamation; pathological changes; water pollution abatement.

56036 Mechanism of Soil Erosion by Surface Runoff. Wu, T.H. (Ohio State Univ., 190 N. Oval Dr., Columbus, OH, 43210). **Contract:** A-056-OHIO. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to develop a rational model of erosion process that can account for input variables of rainfall, soil properties, and topography as statistical quantities. The approach will be to: present flow of runoff as stochastic process that will account for rainfall characteristics and surface conditions; use sediment transport equations to compute erosion by rill flow; consider breaking up soil aggregates by rainfall impact; and use experimental studies to evaluate relation between impact and soil dispersed and available for transport. Computed erosion rates are compared with results of the field experiments.
Keywords: soil conservation; runoff; erosion; rain; soil mechanics; topography; mathematical models; coal mines.

56037 Inhibition of Microbiological Acid Production in Coal Mine Refuse and Strip Mine Spoils. Dugan, P.R. (Ohio State Univ., 190 N. Oval Dr., Columbus, OH, 43210). **Contract:** B-073-OHIO. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine the cost-effectiveness of using specific bacterial-growth inhibitors in the coal fields. The approach will be to assess biological production of sulfuric acid in spoil banks and refuse piles in coal fields; to correlate acid production against population of acid-producing thiobacillus in banks and spoils; to determine effectiveness of specific bacterial-growth inhibitors against the acid-producing bacteria in fields and laboratories; and to examine cost-effectiveness of using the inhibitors in fields.
Keywords: spoil banks; acid mine drainage; surface mining; coal mining; microorganisms; growth; control; sulfuric acid; economics; inhibition; water pollution abatement.

56038 Investigation of Factors Affecting Energy for Irrigation Pumping. Barefoot, A.D. (Oklahoma State Univ., Agriculture Hall, Stillwater, OK, 74075). **Contract:** A-081-OKLA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil and gas(25); hydroelectric(25); conservation(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this study are to improve pumping plant efficiencies for irrigation systems in Oklahoma and to decrease the energy usage per unit of irrigation water applied. The approach used is to measure below ground head, friction head, pressure head, flow rate, fuel consumption of several irrigation systems; determine relationship of below ground head and flow rate; determine efficiencies of irrigation pumps now in use and new wells; determine efficiencies of power units using electricity, natural gas, and liquid petroleum; and determine Btu's per ac. in. of water applied.
Keywords: irrigation; farms; crops; oklahoma; pumps; efficiency; energy consumption; flow rate; electric power.

56039 Impact of Variations in Availability and Cost of Energy Inputs on Water Use in the Oklahoma Panhandle. Mapp, H.P. (Oklahoma State Univ., Agriculture Hall, Stillwater, OK, 74075). **Contract:** A-085-OKLA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(25); conservation(75) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this study is to evaluate the impact of variations in availability and costs of energy input, related to gas, on water use and agricultural output in Oklahoma panhandle. The approach used is to focus on energy and water conserving irrigation technology, reduced tillage production practices, and substitutions among energy sources; and to draw implications for economic life of underground water supply in area.
Keywords: oklahoma; water requirements; water supply; variations; energy supplies; cost; agriculture; energy conservation.

56040 Efficiency Performance Criteria for Irrigation Systems. Hansen, H.J. (Oregon State Univ., 126 Agricultural Hall, Corvallis, OR, 97331). **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this study is to improve energy-use efficiency of Oregon's irrigation pumping systems. The approach used is to field test representative systems to establish efficiency performance base; to compare to published efficiency curves; and to identify factors which are causing low efficiency.
Keywords: irrigation; oregon; farms; energy consumption; energy efficiency; pumps; performance testing; electric power.

56041 Packed-Bed Reactors for Concentrated Waste Treatment and Energy Production. Pedersen, K.B. (Univ. of Puerto Rico, School of Engineering, Mayaquez, PR, 00708). **Contract:** A-052-PR. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to test packed-bed reactors for concentrated waste treatment and energy production. In the first phase, domestic sewage as activated sludge will be fed anaerobic filter. Feed will be changed to raw sewage with biological load constant. When equilibrium has been reached, temperature and hydraulic retention time will be varied for optimum conditions. In the second phase, filter will be integrated into sewage treatment plant for simultaneous treatment and recovery of methane. The process will be applied to local tuna-packing industry waste.
Keywords: industrial plants; wastes; waste product utilization; waste processing; activated sludge process; anaerobic digestion; sewage; parametric analysis; methane; biosynthesis; packed bed.

56042 Economics of Delay Experienced by Electrical Utilities in Meeting Water Quality Standards. Maloney, M.T. (Clemson Univ., Clemson, SC, 29631). **Contract:** A-042-SC. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this study is to determine cost associated with delayed construction and production for electric utilities when meeting water quality standards. The approach used is to identify regulations which pose delay costs; develop a model to measure costs when standards, laws, and regulations are satisified; apply model to actual cost studies; and assess effect of costs.
Keywords: electric utilities; standards; water quality; cost; regulations; mathematical models; power generation.

56043 Regional Evaluation of Off-Season Agricultural Use of Water and Energy Resources. Stone, L.R. (Kansas State Univ., Anderson Hall, Manhattan, KS, 66502). **Contract:** B-052-SDAK. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to evaluate seasonal irrigations to reduce peak requirements of water and energy, and to relate those requirements to system size, water-use efficiency, crop production, and soil temperature. Combinations of fall, spring, and in-season irrigations will be used to profile soil water contents taken before and after irrigation. Soil temperatures will be taken monthly during the off-season. Grain yield will be used to calculate water use efficiency and agronomic performance. Daily measurements will be taken of maximum air temperature, precipitation, solar radiation, wind run, relative humidity, and evaporation from standard pan. Modeling techniques will be applied to field data to evaluate the benefits and costs of extended seasonal irrigation.
Keywords: agriculture; water requirements; water resources; energy demand; irrigation; optimization.

56044 Bacterial Degradation of Coal Conversion By-Products (Polycyclic Aromatic Hydrocarbons) in Aquatic Environments. Sayler, G.S. (Univ. of Tennessee, W. Cumberland Ave. SW, Knoxville, TN, 37916). **Contract:** B-040-TENN. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

Field and lab investigation will be conducted over 33 months to predict residence time of coal conversion by-products in contaminated aquatic environments. The approach will include: (1) using phenanthrene as a primary model substrate; (2) carrying out in-vitro and in-situ biodegradation studies; (3) determining biodegradation of substrates by gas-liquid chromatography; and (4) identifying isolated microorganisms and comparing them to isolates from contaminated and pristine lakes to determine the capacity of bacteria to degrade biorefractile organic contaminants. Anticipated results include the elucidation of seasonal, chemical, physical, and biological factors in the biodegradation rates of polycyclic aromatic hydrocarbons and a model for the study of the biodegradative fate of coal conversion contaminants.
Keywords: biodegradation; by-products; polycyclic aromatic hydrocarbons; aquatic ecosystems; coal mines; coal liquefaction; coal gasification; environmental transport; phenanthrene; waste management.

56045 Automation of Pivot Sprinkler Irrigation Systems to More Efficiently Utilize Rainfall and Irrigation Water. Runkles, J.R. (Texas A and M Univ., Dept. of Soil and Corp Sciences, College Station,

TX, 77843). **Contract:** A-044-TEX. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to develop and field test an energy-saving automated pivot sprinkler system which is activated by the needs of crops.
Keywords: agriculture; energy conservation; irrigation; equipment; crops; automation; remote control; rain.

56046 Feasibility Study of Using Municipal Water Supplies as Condenser Cooling Water for Power Generating Facilities. Ramsey, R.H. (Texas Tech Univ., P.O. Box 4340, Lubbock, TX, 79409). **Contract:** B-226-TEX. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this study is to prepare a feasibility study of using municipal water supplies as condenser cooling water to power generating facilities. The approach used is to determine (1) ranges of temperature gradients in water treatment and municipal systems, (2) effects of elevated temperatures on treatment, (3) effects on energy consumption when waste heat is utilized for municipal uses, (4) environmental impacts of this approach, and (5) public acceptance of elevated water temperatures for home use. The study will utilize engineering analysis, laboratory and bench tests, literature reviews, correspondence and interviews with health officals, and analysis of test population response to questionnaire. Savings in energy and water treatment costs should result.
Keywords: feasibility studies; water supply; water requirements; steam condensers; thermal power plants; temperature gradients; residential sector; energy conservation; water treatment; environmental impacts; cooling.

56047 Cost-Effective Solar-Powered Water Pump. Chadwick, D.G. (Utah State Univ., Main Building, Office 104, Logan, UT, 84321). **Contract:** A-036-UTAH. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to perfect the prototype solar-powered water pump now in existence to be cost-effective for small farms having nearby groundwater or surface water supplies that requires lifting 5 to 25 feet. The pump has no moving parts and should not require technically knowledgeable people to operate.
Keywords: solar water pumps; wells; economics; ground water; farms.

56048 Water Requirements and Pollution Potential of Gas Production from Lignite Shale and Plentiful Lesser Grade Carbon Sources. Filip, D.S. (Utah State Univ., Main Bldg., Office 104, Logan, UT, 84321). **Contract:** A-043-UTAH. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this program is to determine proper controls in reducing contamination of water used in full-scale production of fuel gas from lignite shale found in Utah and other western states. The approach is: (1) to detail quantity, quality, and accessibility of shale; (2) to test gasification processes to determine optimal gas production with minimal water consumption; (3) to quantify contaminants for each shale by gas chromatography; (4) to measure water consumption and potential contaminants; and (5) to detail the feasibility of large-scale lignite shale development with water resources available in Utah.
Keywords: coal gasification; lignite; coal gasification plants; water pollution; utah; water requirements; gas chromatography; water resources; availability; feasibility studies; fuel gas.

56049 Management of the Hydrologic System I Areas Subject to Coal Mining Activities. Riley, J.P. (Utah State Univ., Main Bldg., Office 104, Logan, UT, 84321). **Contract:** A-046-UTAH. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this program is to identify hydrologic (including water quality) opportunities associated with coal mining in western United States. The approach is to examine mining techniques and management practices which will manipulate the hydrologic system in terms of local geology to create opportunities, including, groundwater recharge areas and artificial groundwater aquifers. Emphasis will be on sites of existing and future coal mines.
Keywords: coal mines; hydrology; surface mining; recharge; aquifers; ground water; management.

56050 Evaluation of Trade-Offs among Water Use, Air Quality, and Economics in Power Plant Siting. Keith, J.E. (Utah State Univ., Room 223A, Logan, UT, 84321). **Contract:** A-047-UTAH. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this study is to determine effects of air quality standards on water allocations and communities' economic structure. The approach used is to utilize linear programming and input-output models to determine trade-offs between water use in agriculture and electric generation plants in Utah, given air quality standards and resultant plant siting.
Keywords: input-output analysis; air quality; thermal power plants; communities; water supply; water requirements; economics; site selection; agriculture; utah; irrigation; allocations.

56051 Identification of Presumptive Carcinogenic Compounds Released to Water Supplies by Oil Shale. Adams, V.D. (Utah State Univ., Utah Water Research Lab., Main Bldg., Office 104, Logan, UT, 84321). **Contract:** B-154-UTAH. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine the potential mutagenic and carcinogenic hazards posed by development of oil shale in Utah, Wyoming and Colorado, using the Ames test as a means for studying complex mixtures to isolate compounds that are mutagens and carcinogens. Tests will be conducted on raw shale, spent shale from different kinds of processes, stream water in shale development areas before and after development, leachate from spent shale, and chlorination and oxidation of products produced from chlorination or ozonization of drinking water supplies and wastewaters containing possible shale leachates.
Keywords: oil shale industry; chemical effluents; carcinogens; quantitative chemical analysis; water pollution; waste management; health hazards; monitoring.

56052 Effect of Risk of Drought on Energy Development and Water Allocations: a Programming Model for Utah. keith, J.E. (Utah State Univ., Main Bldg., Office 104, Logan, UT, 84321). **Contract:** B-182-UTAH. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(90); conservation(10) **R and D categories:** Biological effects of pollutants in experimental systems.

The impact of water production variability on allocations of water between energy development and other uses will be examined. A stochastic programming model, which includes demand functions of water by various using sectors and availability and costs of water and water development, will be used to analyze the effects of drought and water variability.
Keywords: energy source development; water requirements; climates; rain; utah; water resources; management.

56053 Functional Polymers for Removal of Heavy-Metal Pollutants from Water. Winston, A. (West Virginia Univ., Water Research Inst., Chemistry Dept., Morgantown, WV, 26506). **Contract:** A-031-WVA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this study are to remove heavy metals from acid mine drainage; and to design, synthesize and evaluate new polymeric material having chelating-type functional groups for selective removal to maintain natural environment and eliminate toxic substances. Polymers will be synthesized by polymerization of substituted monomers or by chemical modification of existing polymers. These polymers are then tested for effectiveness and selectivity toward certain metal ions at various concentration levels.
Keywords: metals; separation processes; acid mine drainage; waste water; trace amounts; polymerization; polymers; water pollution control; water pollution abatement; coal mines.

56054 Indicator-Organism Persistence in Acid Mine Water Environments. Bissonnette, G.K. (West Virginia Univ., Plant Sciences Div., Morgantown, WV, 26506). **Contract:** A-039-WVA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Survival capabilities in situ of sewage organisms in streams containing acid mine water will be studied. Natural suspensions of new sewage or primary-treated wastewater effluent will be inoculated into specially designed environmental diffusion chambers, then immersed in stream water influenced by acid mine water. Samples will be taken from environmental chambers and examined for sanitary-indicator bacteria. Public-health significance of using polluted streams for drinking water or recreational activities will be assessed.
Keywords: acid mine drainage; environmental impacts; water pollution; biological indicators; microorganisms; sewage; drinking water; recycling; coal mining; waste management.

56055 Structural and Chemical Studies of Framboidal Pyrite Related to Acid Mine Water. McCormick, B.J. (West Virginia Univ., Dept. of Chemistry, Morgantown, WV, 26506). **Contract:** A-040-WVA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to determine the chemical processes involved in the formation of acid mine water, with special emphasis on Framboidal iron pyrite. The approach is to define structure and composition of Framboidal pyrite; investigate associated iron materials; explore differences; determine mechanisms of chemical reactions; determine analytical procedures for determining pyrite; and develop predictive strategies.
Keywords: pyrite; acid mine drainage; synthesis; crystal structure; chemical composition; chemical reactions; chemical analysis; origin.

56056 Removal of Hydrocarbon Pollutants from Water by Prototheca zopfii. Pore, R.S. (West Virginia Univ., Water Research Inst., Morgantown, WV, 26506). **Contract:** A-041-WVA. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to develop a biological system for waste removal. Investigation of laboratory methods, models, and innovative techniques will be performed. Microorganisms capable of bioconcentration of various categories of organics amenable to concentration will be selected. Organics accumulated in the water can be metabolized by these organisms.
Keywords: hydrocarbons; water pollution; microorganisms; water pollution abatement; growth; metabolism.

56057 Hydrochemical and Geophysical Investigation of Effects of Fly Ash Disposal on Groundwater. Cherkauer, D.S. (Univ. of Wisconsin, Water Resources Center, Madison, WI, 53706). **Contract:** A-077-WIS. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Field determination of effects of fly ash disposal by landfilling on groundwater quality is the object of this research. Three-dimensional array of monitoring wells around a disposal site will determine groundwater flow patterns and will allow collection of water samples. Samples will be analyzed for major dissolved ions, heavy metals, and nutrients. Materials leached from fly ash and in groundwater will be determined. Close observation of active fill locations to assess relative mobility of various dissolved ions will be performed. Chemical changes in groundwater correlated with mineralogic composition of aquifer materials to determine presence of natural chemical sinks for leachate will be monitored. The project will use surface electrical resistivity to supplement stratigraphic water level and water quality data from the wells.
Keywords: fly ash; waste disposal; ground water; water pollution; monitoring; leaching; sampling; qualitative chemical analysis; environmental transport; aquifers; water quality; wells; trace amounts; elements.

56058 Fabrication of a 25,000 GPD Absorption-Freezing Vapor Compression Process. Fraser, J. (Concentration Specialists, Inc., 10 Champney St., Groton, MA, 01450). **Contract:** 14-34-0001-8502. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(50); conservation(50) **R and D categories:** Environmental effects assessment.

The objective of this study is the design and fabrication of a desalination pilot plant for testing. The approach used is to produce water at a power consumption rate of 49 kWh/1000 gal; prepare installation drawings for all equipment; procure equipment and hardware for plant; install at Wrightsville Beach, NC test facility; and prepare report containing descriptions of processes and operations, analysis of energy consumption, suggestions for use of LNG, waste heat, solar energy, and application of process in petrochemical, food, pulp, and paper industries.
Keywords: desalination plants; pilot plants; test facilities; design; fabrication; energy consumption; absorption; freezing; vapor compression refrigeration cycle.

56059 Light-Driven Water Desalination Through Artificial Membranes Containing Bacteriorhodopsin. Korenbrot, J. (Univ. of California, 3rd and Parnassus Ave., San Francisco, CA, 94143). **Contract:** 14-34-0001-8511. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Environmental effects assessment.

The objective is to investigate desalination by use of solar energy, using artificial membranes containing bacteriorhodopsin. The following procedures are investigated: isolating and purifying purple membrane fragments; constructing planar films containing purple membrane and separating large aqueous compartments; and coupling proton electrochemical gradient generated by illumination of membranes to the transport of salts through appropriate carrier molecules such as ionophoric molecules trimethyl tin and monazomycin.
Keywords: membranes; biomimetic processes; desalination; pigments; solar energy; purification; membrane transport; salts; water.

56060 Design of Indirect Freezing Process Pilot Plant Based on Bulk Crystallization. Johnson, W. (Wallace E. Johnson, One Ledgewood Circle, Topsfield, MA, 01983). **Contract:** 14-34-0001-8514. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Environmental effects assessment.

The objectives of this study are to produce a conceptual design and specifications for a desalination pilot plant; to evaluate a bulk crystallization, indirect freezing process; and to determine the smallest size pilot plant; to produce potable water at a power consumption rate of less than 50 kWh/1000 gal. The approach used is to prepare process and instrumentation diagrams for interpretation and analysis of process; to include crystallizer-tube bundle configuration and method of refrigerant distribution; and to provide cost estimates and energy requirements for pilot plant and IMGD production plant.
Keywords: desalination plants; pilot plants; design; freezing; energy consumption; power demand; crystallization.

56061 Design, Fabrication, and Shop Test of a Large-Scale Electrodialysis Stack. Lundstrom, J. (Ionics, Inc., 65 Grove St., Watertown, MA, 02172). **Contract:** 14-34-0001-8517. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objectives of this study are to establish technical feasibility, design integrity of large-scale high membrane area utilization, and brackish water electrodialysis stack which will minimize desalting costs including equipment, energy, pumping and stack costs. The approach used is to design stack as a unit-stage; die cut spacers from low-density polyethylene or composite material; conduct flow tests of spacer designs; fabricate electro-dialysis membranes; design and fabricate hydraulic distribution blocks; and verify the integrity of components through shop testing.
Keywords: desalination plants; design; technology assessment; seawater; feasibility studies; electrodialysis; spacers; fabrication; performance testing.

56062 Development of Non-Chemical Cleaning Techniques for Reverse-Osmosis Membranes. Leahy, T. (Dow Chemical Co., 2800 Mitchell Dr., Walnut Creek, CA, 94598). **Contract:** 14-34-0001-8519. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objective of this study is to develop techniques designed to reduce reverse-osmosis fouling. The approach used is to propose techniques applicable to a wide range of RO membrane configurations (non-chemical, existing systems) that can be retrofitted to accept them. These are: (1) sustained back permeation at maximum practical pressure coupled with low pressure, high-feed velocities; (2) sonic energy application to feedwater; and (3) flow reversal during operation or cleaning. Each technique is to be evaluated independently and in various combinations. It is expected that these techniques will show synergistic effects when applied with established anti-fouling techniques such as feedwater pretreatment and staging.
Keywords: desalination plants; feedwater; membranes; osmosis; cleaning; fouling.

56063 Use of Surfactant Additives of Inhibit Fouling, Scaling, and Corrosion While Reducing Energy and Capital Costs. Sephton, H. (Univ. of California, 47th and Hoffman Blvd., Richmond, CA, 94804). **Contract:** 14-34-0001-8526. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(50); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to develop a test to measure inhibition of fouling, scaling, and corrosion by surfactant additives used as heat-transfer enhancement agents in vapor compression, vertical type evaporators. Beneficial impacts will be evaluated in terms of reduction of operation maintenance costs and savings in energy and capital costs. The approach is to modify and instrument a 600-gpd pilot plant for continuous production of potable water from sea- or bay-water. Evaporator will be operated in upflow and downflow modes. Evaporative heat flow and power consumption will be measured. Fouling and/or scaling rates will be determined under conventional and enhanced conditions. Data on metal ions in

brine, erosion, and corrosion will also be obtained. Cost and energy savings by this new method will be evaluated.
Keywords: evaporators; fouling; scaling; corrosion; surfactants; inhibition; heat transfer; maintenance; seawater; drinking water; production; maintenance; cost; additives.

56064 Use of Saline Water in Energy Development. Israelsen, C. (Utah State Univ., Logan, UT, 84322). **Contract:** 14-34-0001-8553. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(35); oil shale(35); hydroelectric(30) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this study is to assess benefits and problems of using saline water to supply energy-related demands in upper Colorado River region. The uses include coal slurry transport medium, cooling process water at coal-fired generating plants, and coal gasification plants, materials processing and handling at electric generating plants, and at shale and coal mining sites. The approach used is to prepare location map of fossil fuel deposits, saline water reserves, coal slurry lines, and proposed fossil-fueled power plants; identify power plant cooling systems which may utilize brackish water; determine technical and economic impacts of using this water; make laboratory analysis of powdered coal quality produced by this water; and identify pollution problems.
Keywords: cost benefit analysis; fossil-fuel power plants; energy source development; cooling systems; slurries; coal; slurry pipelines; coal gasification; colorado river basin; seawater; uses; economic impact.

56065 Field Evaluation of an Energy Recovery Device to be Used with Reverse Osmosis Equipment. Miller, C.S. (Polymetrics, Inc., 3011 Corvin Drive, Santa Clara, CA, 95051). **Contract:** 14-34-0001-8554. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this study is to field test and evaluate a device for recovering energy from high pressure reject stream of seawater RO system. The approach involves engineering, equipment fabrication, monitoring field operation at test site, and summarizing data generated. The equipment will be supplied on 2 skids: energy recovery unit on one and peripheral equipment for operation on the other. The unit will operate for one year. It is hoped that the results will prove the energy efficiency and reliability of passive reciprocating energy transfer systems for net reduction in energy consumption per unit volume of pure water produced.
Keywords: energy recovery; osmosis; desalination plants; performance testing; steam; seawater; design; fabrication; operation; heat recovery equipment; waste heat utilization; waste heat; energy consumption.

56066 Compressor Technology as Related to Freeze Desalination Processes. Engdahl, G. (Chicago Bridge and Iron Co., 800 Jorie Blvd., Oak Brook, IL, 60544). **Contract:** 14-34-001-8559. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this study are to identify compressor types and load requirements for freeze desalination processes; to check availability; and to determine improvements in compressor technology necessary for viable freeze distillation plant design. The approach is to: (1)investigate 1, 5, and 10 MGD plants; (2) consider vacuum freeze vapor compression, vacuum freeze ejector absorption, secondary refrigerant methods, and indirect freezing; (3) include closed-loop refrigerant compressors (axial, centrifugal, screw), first-stage vacuum equipment (pumps), second-stage (blowers), flexblade compressors, and eductors/ejectors; and (4) recommend equipment based on cost, availability, energy efficiency, and corrosion resistance.
Keywords: desalination plants; freezing; technology assessment; compressors; vapor compression refrigeration cycle; energy efficiency; corrosion resistance; refrigerating machinery.

56067 Design, Fabrication, and Field Test of a Solar Powered, Electrodialysis System for Desalting Remote Brackish Water Sources (Phase I). Lundstrom, J. (Ionics, Inc., 65 Grove Street, Watertown, MA, 02172). **Contract:** 14-34-0001-8576. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to design an effective system to produce fresh water at remote locations by combining solar energy and electrodialysis without developing new photovoltaic systems or electrodialysis equipment. The approach to Phase I is to: (1) design a system based on a field unit of 4000 gpd; (2) evaluate alternate systems on the basis of total water costs; (3) examine the cost balances of solar and desalting equipment with energy storage to extend and normalize power cycle; and (4) examine the effects of allocation of solar energy among solar thermal and solar photovoltaic and the solar voltaic energy among pumping, desalting, and storage as a function of depth of water source. Research will continue under Contract 14-34-0001-9532.
Keywords: design; fabrication; field tests; water; drinking water; desalination; electrodialysis; photovoltaic power supplies; water pumps; cost.

56068 Evaluation of Treatment Technologies for Water Reuse in Coal Coking and Gasification. Luthy, R. (Carnegie-Mellon Univ., Schenley Park, Pittsburgh, PA, 15213). **Contract:** 14-34-0001-8815. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(20); oil and gas(20); oil shale(20); conservation(40) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this program are: (1) to assess water treatment technologies and sequence effectiveness; (2) to explore economic incentives; and (3) to identify the treatment of modules and training worthy of further study. The approach is: (1) to investigate recycle strategies for gasification wastes heavily contaminated with organic compounds; (2) to perform a literature survey of wastewater reuse criteria for solids quenching, gas quenching, indriect cooling, and process steam production for coal coking and coal gasification; and (3) to test treatment schemes on a bench-shale using actual process wastewater. Unit operations will include oil and solids separation, dissolved gas removal, phenol removal/recovery, chemical treatment, biological oxidation and nitrification/denitrification, carbon and trace metals removal, and demineralization.
Keywords: coal gasification; coal; coking; water requirements; recycling; waste water; water treatment; technology assessment; economic analysis; separation processes; gases; phenols; removal; recovery; nitration; elements; trace amounts; demineralization; biodegradation.

56069 Desalination/Power Cycles with Biphase Rotary Separator and Turbine. Studhalter, W. (Biphase Energy Systems, 2907 Ocean Park Blvd., Santa Monica, CA, 90405). **Contract:** 14-34-0001-9407. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to optimize conceptual designs of a system to produce power and fresh water using waste heat and using biphase desalination/power cycle. The approach will be to: (1) use computer techniques to optimize parameters including temperatures and tradeoff between water and power production; (2) consider shortening residence times if advantageous from scale standpoint; (3) include economic effects; and (4) use sea water.
Keywords: desalination plants; thermodynamic cycles; waste heat utilization; economic impact; design; computer calculations; fresh water; seawater; power generation; optimization.

56070 Methodology for Assessing the Regional Interrelationships of Water Resource, Energy Supply and Economic Development. Hardy, R.W. (Univ. of Rhode Island, New England Council of Water Center Directors, Kingston, RI, 02881). **Contract:** 14-34-0001-9412. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this study is to develop a methodology for evaluation and prediction at regional consequences of public policy decisions in water resources, energy, and economic development as they interact. The approach will be to: develop methodology; prepare agenda for confirmatory research; show interrelationships; and prepare guidelines for application to water resource, electric energy, economic development decisions in policy formulation, planning, and management.
Keywords: regional analysis; public policy; water resources; electric power; planning; recommendations; economics; power generation; economic development.

56071 Treatment of Oil Field Wastewaters for Reuse: an Evaluation of Membrane Process. McNulty, K. (Abcor, Inc., Walden Div., 850 Main St., Wilmington, MA, 01887). **Contract:** 14-34-0001-9441. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: oil and gas(50); conservation(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to evaluate applicability of ultrafiltration and reverse osmosis systems for treatment of wastewaters produced from stream-injected enhanced oil-recovery facilities in California. Research will be conducted in 3 field sites in California using small portable test units that can be rapidly deployed. Tests will be conducted with UF and RO equipment on various potential feed streams to determine flux and rejection as a function of feed concentration and of time. Fouling index will be used to assess potential of

feed-solids fouling. Tests to determine nature of membrane foulants will be performed.
Keywords: waste water; petroleum deposits; enhanced recovery; steam injection; waste processing; recycling; california; membranes.

56072 Sidestream Treatment of High Silica Cooling Water and Reverse Osmosis Desalination for Reuse in Geothermal Power Generation. Mindler, A.B. (Permutit Co., Inc., 567 Ridge Road, Monmouth Junction, NJ, 08852). **Contract:** 14-34-0001-9527. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: hydroelectric(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this study is to develop a method for silica removal with minimum increase in pH in sidestream treatment. The approach used is to employ adsorption of SiO2 on ferric oxide produced by accelerated rusting of iron turnings available as short shovel shavings. Pilot plant work will be performed at DOE geothermal energy recovery complex on warm recirculating water going to cooling tower operating at 5x concentration cycles with make-up of 3000 ppM total dissolved solids and 20 to 30 ppM silica. Make-up water and desilicized water will be ion exchange softened with regeneration by reject brine from RO desalination. Blowdown water reuse by RO for control of dissolved salts will be studied with product water used for potable supply and reject for regeneration of softeners. Potable permeate will be treated for fluoride removal by adsorption on alumina. Chromate recovery will be by adsorption on anion exchange resin for reuse as corrosion inhibitor. Corrosion data on carbon steel and alloys will be obtained.
Keywords: silica; osmosis; desalination; geothermal power plants; cooling systems; recycling; water; coolants; adsorption; iron oxides.

56073 Energy Recovery from the Reject Brine of Reverse Osmosis Systems. May, S.C. (Bechtel National, Inc., P.O. Box 3965, San Francisco, CA, 94119). **Contract:** 14-34-0001-9528. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this study are to (1) construct and test an energy recovery device; (2) establish reliability of the system under repeated cycling; and (3) test several energy transfer fluids for stability, safety, and physical properties. The approach was to design and test a skid-mounted test unit preferably at Roswell, NM, OWRT test site and on the basis of this test, prepare conceptual design for full-scale energy recovery system for multi-million gal/day RO plant. The energy saving potential of the equipment is to be estimated for more important applications. The results should be of value to owners and operators of RO plants for purification of seawater, brackish waters, and agricultural and industrial aqueous waste streams; and should provide a basis for equipment design for energy recovery systems.
Keywords: desalination plants; energy recovery; brines; waste heat utilization; osmosis; heat recovery equipment; reliability; energy conservation; safety; stability; fabrication; performance testing.

56074 Design, Fabrication, and Field Test of a Solar Powered, Electrodialysis System for Desalting Remote Brackish Water Sources (Phase II). Lundstrom, J. (Ionics, Inc., 65 Grove Street, Watertown, MA, 02172). **Contract:** 14-34-0001-9532. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: solar(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of Phase II is to conduct laboratory and field testing of some components to prove out design developed under Contract 14-34-0001-8576.
Keywords: design; fabrication; field tests; electrodialysis; desalination; water; drinking water; photovoltaic power supplies; water; economics.

56075 Minimizing Total Energy Requirements of Irrigation Water Management Systems. Wensink, R.B. (Oregon State Univ., 200 Covell Hall, Corvallis, OR, 97331). **Contract:** C-7133. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this study is to develop mathematical models which optimally design irrigation water management systems to minimize energy requirements while maintaining design standards. The approach is to: (1) develop a model so that uniformity coefficients, sprinkler sizes, lateral spacings, etc. can be readily varied for sensitivity analysis about optimum energy design; (2) determine economic cost of design by a model; and (3) present optimum design and its energy requirements. Solutions will be formulated as mixed integer programming problems and solved by partitioning or branch and bound techniques. Each formulation of the system will contain an objective function which minimizes energy requirements while satisfying all critical functional parameters and resources. The functional components that are mathematically combined in sets of equations which constrain energy objective functions are given.
Keywords: irrigation; energy demand; water supply; mathematical models; optimization; design; standards; farms; water requirements.

56076 Use of Saline Water in Energy Development. Israelsen, C.E. (Utah State Univ., Main Bldg., Office 104, Logan, UT, 84321). **Contract:** C80322-S. **Supported by:** Office of Water Research and Technology, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(30); hydroelectric(30); conservation(40) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) analyze potential benefits from using saline or brackish water to supply energy-related demands; (2) use saline water as coal slurry transport medium and slurry destination uses as cooling and as process water at coal-fired generating plants and coal gasification plants; and (3) examine other unrelated uses. A proximity map will be prepared of locations of fossil fuel deposits, saline water reserves, and proposed coal slurry lines, and proposed fossil-fueled power plants in relation to each other. Existing data and laboratory-type studies will be used to determine technological and economic feasibility of utilizing saline water. The results will be quality requirements and changes of water and fueling coal slurry pipelines.
Keywords: seawater; uses; energy source development; coal; slurries; coal gasification; fossil-fuel power plants; feasibility studies; slurry pipelines; cooling systems; energy facilities; energy conservation.

57000 Soil Conservation Service Plant Materials Studies. (Soil Conservation Service, Plant Materials Centers, P.O. Box 2890, Washington, DC, 20013). **Contract:** AR-79-0912. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI; EPA; DOA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

These studies will develop a wide diversity of plant materials for use in the reclamation of mined lands. Work will be done with commercial seed growers and nurserymen to assure their commercial availability. The approach will be to develop plants for reclamation in the arid and semi-arid regions and to increase the amounts of plants available when quantities are limited.
Keywords: plants; land reclamation; surface mining; arid lands; availability; plant breeding.

57001 Investigation of Coal Mine Effluents: Regrade to Bond Release. Bucek, M.F. (HRB-Singer, Inc., P.O. Box 60, State College, PA, 16801). **Project number:** 68-03-2762. **Contract:** H5180113. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** DOI; EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the study is to characterize the coal mine effluents draining from surface-mined lands or from surface disturbances associated with underground mining. The study sites are to be reclamation stages between regrade and bond release. The study is also to document the impact of various mining and reclamation practices on the mine effluent quality. The overall technical approach comprises two major technical tasks that related to (1) performing surveys at 50 mine sites and (2) monitoring water quality of discharges at 12 mine sites for a period of up to one year. The study sites are located in coal mining regions of the United States.
Keywords: coal mines; surface mining; waste water; underground mining; land reclamation; environmental impacts; water quality.

57002 Physical Monitoring of Valley Fills in Cross-Ridge Mining Demonstration. Ettinger, C. (Skelly and Loy, 2601 N. Front St., Harrisburg, PA, 17110). **Project number:** J5191297. **Contract:** J5191297. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

An integral part of the Cross-Ridge Mining concept is the utilization of valley fill placement of excess spoil material above that which can be backstacked on the coal bench. Safety, environmental matters, and economics should be carefully considered before undertaking construction of a valley fill. Before actual construction commences, an intense testing program will be put in effect to more precisely determine the safety, environmental, and economic factors associated with each fill. A demonstration program has been established for two fills, and it will be divided into three phases, namely: pre-mine investigation, fill monitoring, and post mining analysis.
Keywords: surface mining; environmental impacts; land reclamation.

57003 Hydrologic Evaluation and Monitoring of Valley and head-of-hollow fills. Martin, J.F. (EPA, Industrial Environmental Research Lab., 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** H5180113-6. **Contract:** H5180113-6. **Supported by:** Depart-

ment of the Interior, Charlestown, WV (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Plans are to collect and analyze information from the literature, State and Federal agencies, and industry on current technology for mountaintop-removal and head-of-hollow fill. Not only should the information pertaining to mining be considered but also for fill construction methods and procedures as practiced by other industries, i.e., highway construction. All available methods and equipment that are currently being used to surface mine by removing mountaintops and making head-of-hollow fills, or that can be adapted to these uses will be reviewed. An environmental assessment of nine mountaintop removal and head-of-hollow fill operations in southern West Virginia and eastern Kentucky, where terrain is steep and these techniques are most frequently used, will be conducted.
Keywords: surface mining; land reclamation; mountains; west virginia; kentucky; environmental impacts.

57004 Coal and the Environment Abstract Series. Hill, R.D. (EPA, Resource Extraction and Handling Div., 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** H5180113-7. **Contract:** H5180113-7. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project includes searching, collecting, abstracting, and indexing of new material to add to the environmental collections. Publications to be reviewed include the more than 130 periodicals subscribed to by BCR, Chemical Abstracts, symposia and conference proceedings, and reports by various governmental, university, and private section organizations. Resulting from this project will be an update of current bibliographies in the Coal and the Environment Abstract Series and a yearly subsequent bibliographic addition to the first abstract series entitled Bibliograhy on Mined-Land Reclamation.
Keywords: coal mining; land reclamation; bibliographies; environmental impacts.

57005 Study Surface Coal Mining and Reclamation Operations in State of Alaska. Long, R. (National Academy of Sciences, 2101 Constitution Ave. NW, Washington, DC, 20418). **Project number:** J5180010. **Contract:** J5180010. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Section 708 of P.L. 95-87 directed the Secretary to undertake an in-depth study of surface coal mining operations in the state of Alaska. The study will provide information on the physical, hydrologic and climatic conditions in Alaska with the purpose of the developing specific regulations for protecting the environment to an extent equivalent to those standards or other coal regions. The study will also assess the impact of Alaskan coal resource development on cultural and socio-economic conditions in that state.
Keywords: coal mining; alaska; hydrology; regulations; environmental impacts; surface mining; meteorology; coal industry; socio-economic factors; energy source development; environmental policy.

57006 Plant Information Network: Phase II. McIntyre, G. (Colorado State Univ., Dept. of Botany and Plant Pathology, Fort Collins, CO, 80523). **Project number:** J5180102. **Contract:** 14-16-0008-2058. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

PIN is a computer-based data bank for rapidly retrieving and organizing information on the vascular plants, native and naturalized to the states of Colorado, Montana, and Wyoming. It currently includes information on over 4000 plants. PIN is an expansion and modification of an earlier plant information system, the Rapid Access Plant Information Center (RAPIC), which was developed by Dr. Robert Adams (while at Colorado State University in the Botany and Plant Pathology Department). The RAPIC system was developed to make biological information more available to persons interested in the use of native plants or land management.
Keywords: colorado; montana; wyoming; plants; information systems; land use.

57007 Emission Factors and Control Technology for Fugitive Dust from Coal Mines. Hermann, J.G. (EPA, 5555 Ridge Rd., Cincinnati, OH, 45268). **Project number:** Subagreement No. 4. **Contract:** H5180113. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to develop emission factors for significant surface coal mining operations with emphasis on four size ranges. Selected control measures will also be evaluated for their efficiency in reducing these emissions.
Keywords: coal mining; dusts; emission; air pollution control; surface mining; comparative evaluations.

57008 Development of a Coal Surface Mine Monitoring Capability Utilizing Landsat Satellite Technology. Inglis, M. (Univ. of New Mexico, Technology Application Center, 2500 Central Ave. SE, Albuquerque, NM, 87131). **Project number:** H5180101. **Contract:** H5180101. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objective is to develop an operational strategy for the OSM to develop a coal surface mining monitoring capability using Landsat satellite technology. Through the use of digital analysis of Landsat imagery of minicomputers at Stanford University and the Technology Application Center of the University of New Mexico, this project will demonstrate that the use of Landsat data and change detection techniques are feasible to supplement and/or guide OSM inspections of coal surface mines. The use of minicomputers is an important aspect of this demonstration and will make it feasible to use such technology in regional or sub-regional office of OSM. Two demonstrations, one at the Navajo mine in New Mexico and a second at The Rogers No. 2 Mine in Oklahoma, will serve as the basic project sites for this activity. To date, the software and hardware are located at TAC, and reports, papers and analysis are progressing for the technology transfer to develop an operational strategy.
Keywords: coal mines; surface mining; monitoring; telemetry; technology transfer; satellites; new mexico; oklahoma; digital computers; waste water.

57009 Water Resources Protection Technology: a Handbook of Measures to Protect the Water Resources in Small Mining Operations. Varrin, R.D. (Univ. of Delaware, Water Resources Center, 42 East Delaware Ave., Newark, DE, 19711). **Project number:** J5180110. **Contract:** J5180110. **Supported by:** Department of the Interior, Washington, DC (USA). Office of Surface Mining. **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Purpose of the program is to develop a handbook entitled A Handbook of Measures to Protect Water Resources in Small Mining Operations. This handbook, designed primarily for small mine operators (yearly production under 100,000 tons), will graphically show techniques and/or methods of exploration, mining, and reclamation which will decrease adverse impacts on surface and groundwater supplies. Emphasis is on mining activities and reclamation techniques performed east of the 100th meridian. Suggested techniques will include an evaluation of effectiveness, cost and applicability for implementation by small operators' capabilities. The handbook will function as a technology transfer instrument for operators who want to prepare a reclamation plan and implement it with a limited amount of consultant participation. A review draft of the handbook is scheduled for completion by February 1980.
Keywords: water resources; manuals; exploration; mining; land reclamation; cost; technology transfer; mines.

57010 Coal and the Environment Abstract Series. Hill, R.D. (EPA, Resource Extraction and Handling Div., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** H5180113-7. **Contract:** H5180113-7. **Supported by:** Office of Surface Mining Reclamation and Enforcement, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project includes seaching, collecting, abstracting, and indexing of new material to add to the environmental collections. Publications to be reviewed include the more than 130 periodicals subscribed to by BCR, Chemical Abstracts, symposia and conference proceedings, and reports by various governmental, university, and private sector organizations. Resulting from this project will be an update of current bibliographies in the Coal and the Environment Abstract Series and a yearly subsequent bibliographic addition to the first abstract series entitled Bibliography on Mined-Land Reclamation.
Keywords: coal mining; land reclamation; abstracts; data compilation; environmental impacts; bibliographies.

57011 Water Resources Protection Technology: A Handbook of Measures to Protect the Water Resources in Small Mining Operations. Varrin, R.D. (Univ. of Delaware, Water Resources Center, 42 East Delaware Avenue, Newark, DE, 19711). **Project number:** J5180110. **Contract:** J5180110. **Supported by:** Office of Surface Mining Reclamation and Enforcement, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

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Keywords: water resources; water pollution control; land reclamation; environmental impacts; coal mining; surface mining; manuals; waste management; surface waters; ground water; technology transfer; metals; elements; sediments; water quality.

57012 Development of a Coal Surface Mine Monitoring Capability Utilizing Landsat Satellite Technology. Inglis, M. (Technology Application Center, 2500 Central Avenue, SE, Albuquerque, NM, 87131). **Project number:** H5180101. **Contract:** H5180101. **Supported by:** Office of Surface Mining Reclamation and Enforcement, Washington, DC (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objective is to develop an operational strategy for the OSM to develop a coal surface mining monitoring capability using Landsat satellite technology. Through the use of digital analysis of Landsat imagery of minicomputers at Stanford University and the Technology Application Center of the University of New Mexico, this project will demonstrate that the use of Landsat data and change detection techniques are feasible to supplement and/or guide OSM inspections of coal surface mines. The use of minicomputers is an important aspect of this demonstration and will make it feasible to use such technology in regional or sub-regional office of OSM. Two demonstrations, one at the Navajo mine in New Mexico and a second at The Rogers No. 2 Mine in Oklahoma, will serve as the basic project sites for this activity. To date, the software and hardware are located at TAC, and reports, papers and analysis are progressing for the technology transfer to develop an operational strategy.
Keywords: coal mining; surface mining; remote sensing; satellites; monitoring.

57013 Investigation of Coal Mine Effluents: Regrade to Bond Release. Bucek, M.F. (HRB-Singer, Inc., P.O. Box 60, State College, PA, 16801). **Project number:** 68-03-2762. **Contract:** H5180113. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** DOI; EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the study is to characterize the coal mine effluents draining from surface-mined lands or from surface disturbances associated with underground mining. The study sites are to be reclamation stages between regrade and bond release. The study is also to document the impact of various mining and reclamation practices on the mine effluent quality. The overall technical approach conprises two major technical tasks that related to (1) performing surveys at 50 mine sites, and (2) monitoring water quality of discharges at 12 mine sites for a period of up to one year. The study sites are located in coal mining regions of the United States.
Keywords: coal mines; surface mining; land reclamation; acid mine drainage; water quality; water pollution; underground mining.

57014 Plant Information Network: Phase II. McIntyre, G. (Colorado State Univ., Dept. of Botany and Plant Pathology, Fort Collins, CO, 80523). **Project number:** J5180102. **Contract:** 14-16-0008-2058. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A computer-based data bank for rapidly retrieving and organizing information on vascular plants, native and naturalized to the states of Colorado, Montana, and Wyoming has been developed. It currently includes information on over 4000 plants. PIN is an extension and modification of an earlier plant information system RAPIC (Rapid Plant Information Center) which was developed by Dr. Robert Adams (while at Colorado State University in the Botany and Plant Pathology Department). The RAPIC was developed to make biological information more available to persons interested in the use of native plants or land management.
Keywords: colorado; montana; wyoming; baseline ecology; plants; inventories; information systems; computer codes; p codes; land use; management; coal industry; land reclamation.

57015 Hydrologic Evaluation and Monitoring of Valley and Head-of-Hollow Fills. Martin, J.E. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** H5180113-6. **Contract:** H5180113-6. **Supported by:** Office of Surface Mining Reclamation and Enforcement, Charlestown, WV (USA). **Funding:** DOI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to collect and analyze information from the literature, state and federal agencies, and industry on current technology for mountaintop-removal and head-of-hollow fill. Not only should the information pertaining to mining be considered but also the fill construction methods and procedures as practiced by other industries, i.e., highway construction. All available methods and equipment that are currently being used to surface mine by removing mountaintops and making head-of-hollow fills, or those that can be adapted to these uses, are reviewed. Environmental assessments of nine mountaintop removal and head-of-hollow fill operations in southern West Virginia and eastern Kentucky, where terrain is steep and these techniques are most frequently used, will be conducted.
Keywords: data compilation; data analysis; surface mining; roads; construction; technology assessment; mountains; environmental effects; kentucky; hydrology; coal mining; valleys; spoil banks; overburden; waste management.

DEPARTMENT OF TRANSPORTATION

60000 Power Consumption of Truck Tires. Gusakov, I. (Calspan Corp., P.O. Box 400, Buffalo, NY, 14225). **Project number:** 61-224. **Contract:** DOT-HS-9-02139. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The unique Calspan flat surface tire test facility is being utilized to acquire truck tire rolling resistance data, to serve as the basis for the development of a standardized test procedure for the measurement of truck tire rolling resistance, the development of algorithms to allow laboratory rolling resistance data to be used to predict in-service fueleconomy and the development of data on the effect of pavement surface on in-service rolling resistance. These data are necessary to understand the very important economic factor of fuel consumption associated with tire rolling resistance differences between current noisy bias-ply truck tires and the quieter radial-ply ties. Noise studies, treadwear studies and life cycle cost studies conducted by DOT all indicate an advantage to the use of low rolling resistance radial-ply tires.
Keywords: trucks; tires; fuel consumption; fuel economy; life-cycle cost; rolling friction; algorithms; noise; wear.

60001 Purdue Automotive Research. Goodsen, E. (Purdue Univ., Automotive Transportation Center, Lafayette, IN, 47907). **Project number:** DOT-RC-92004. **Contract:** DOT-RC-92004. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The energy-related environmental research in the Automotive Research sponsored by DOT at Purdue includes three tasks entitled: (1) respiratory exposure analysis, (2) diesel engine particulates, and (3) truck noise reduction. The objective of the first task is to develop a method for estimating respiratory intake of automotive pollutants by urban populations as a function of diurnal population mobility. The second task is to empirically determine the crank angle or time dependency of diesel particulates to the exhaust products as a function of various engine controls so as to determine improved means to reduce these exhaust pollutants. The third task is to survey noise sources in commercial vehicles and determine improved instrumentation for identifying noise sources on the engines/vehicles.
Keywords: noise pollution abatement; trucks; diesel engines; research programs; exhaust gases; inhalation; respiratory system; particles; urban areas.

60002 Transportation Energy Research (Air Quality Assessment). Marmo, F. (Transportation Systems Center, Kendall Square, Cambridge, MA). **Project number:** PPA-912. **Contract:** PPA-912. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The energy-related environmental research in the Transportation Energy Research sponsored by DOT/RSPA at TSC includes two tasks entitled: (1) Characterization of Transportation Sources Inventories, and (2) Air Quality Modelling Assessment. The objec-

tive of the first task is to characterize urban transportation air pollution source inventories, with emphasis on vehicle emission factor evaluation. This effort is being done by JPL and it was 20% complete in FY 1979. The objective of the second task is being redefined at this time.
Keywords: air quality; environmental impacts; urban areas; vehicles; exhaust gases; mathematical models; transportation systems.

60003 Collection of Data Related to Master Meter Operators. Grapsas, G. (Systems and Applied Sciences, 6811 Kenilworth Avenue, Riverdale, MD, 20840). **Contract:** RC-82038. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

A data base exists for most gas pipeline systems. A complete data base does not exist, however, for a segment of the gas distribution system--master meter systems. These systems consist of facilities often not owned by a gas utility and used to supply gas to a number of different outlets, including apartment complexes, trailer parks, and hospital or university campuses. Master meter systems could present certain safety hazards, but the magnitude of the potential hazard is unknwon because of the lack of a data base. Phase I of the study (now complete) will provide a statistical sampling for projecting the approximate number, location, and character of the nation's master meter systems, and specify a plan for a full exchange of information with master meter operators. Phase II, if undertaken, will involve development of a complete directory of master meter systems, including name, address, and selected system characteristics. Results of the study will be used to develop and implement a federal enforcement policy toward master meter systems.
Keywords: natural gas distribution systems; master metering; hospitals; apartment buildings; mobile homes; school buildings; pipelines; data base management; technology assessment.

60004 Study of the Factors Affecting the Safety of Arctic Pipelines. Luscher, U. (Woodward-Clyde Consulants, 3 Embarcadero Center, San Francisco, CA, 94111). **Contract:** RC-92050. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The study will provide detailed information and analysis concerning the current practices and procedures employed to mitigate the effects of the Arctic environment in the design, construction, testing, inspection, and operation and maintenance of Arctic pipelines to provide for public safety and environmental protection. Present, past, and proposed future research dealing with Arctic problems will also be investigated and evaluated in terms of the advantages and disadvantages concerning protection of people, property, and the environment. The results will be used as a basis for revision of the gas and liquid pipeline safety regulations in those areas where revisions are required, and to recommend areas where future research would be beneficial to Arctic pipeline safety.
Keywords: arctic gas pipelines; arctic regions; safety engineering; environmental impacts; design; construction; testing; maintenance; pipelines; operation.

60005 National Liquefied Petroleum Gas Safety Policy Model. Butler, S. (Transportation Systems Center, Kendall Square, Cambridge, MA, 02142). **Contract:** RS-930. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

A computer-based mathematical programming model will be developed to analyze the feasibility and costs of alternative storage sites and distribution systems for liquefied petroleum gas (LPG). The model will be used to assess the safety consequences of shifting the storage of LPG to less heavily populated areas and establishing new multi-modal distribution networks. The model will also be used to assess the economic consequences of these new storage and distribution systems.
Keywords: liquefied petroleum gases; mathematical models; storage facilities; site selection; transport; safety.

60006 Assessment of Arctic Offshore Pipelines. Brown, W. (Energy Interface Associates, P.O. Box 1173, Palos Verdes, CA). **Contract:** RA-82017. **Supported by:** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. **Funding:** DOT.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to conduct a technology review of current outer continental shelf (OCS) pipeline designs and new concepts being considered by industry for oil/gas transportation. The results of this effort will provide (1) descriptions of new pipeline designs, concepts, and their estimated costs; (2) basic information on the OCS hazards that may affect the design and operation of Arctic OCS pipelines; (3) an estimate of the vulnerabilities of these designs in the presence of Arctic hazards; and (4) recommendations for improving the effectiveness and enforceability of the existing standards and regulations.
Keywords: arctic regions; pipelines; continental shelf; petroleum; natural gas; transport; pollution regulations; standards; baseline ecology; offshore sites.

62000 Aircraft Systems Fire Safety. Sarkos, C.P. (National Aviation Facilities Experimental Center, ANA-350, Building 10, Atlantic City, NJ, 08405). **Project number:** 181-521. **Supported by:** Federal Aviation Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The ultimate objective of the Aircraft Systems Fire Safety Program is to improve the survival of occupants during a postcrash transport aircraft cabin fire. The emphasis of the program is understanding and minimizing the fire hazards of cabin materials, including flammability, smoke, and toxicity. Currently, in-house efforts consist primarily of conducting full-scale and modeling tests to determine the cabin hazards created by an external fuel fire adjacent to a door opening in an intact fuselage. Wind velocity and door opening locations are the most important factors affecting the cabin hazards of a fuel fire, which are primarily high temperature and smoke. Projects completed in FY 1979 include: (1) studying the effect of heat flux on smoke emission by typical cabin materials; (2) comparing five widely-used flammability test methods; and (3) measuring the cabin hazards in a full-scale test article from a large external fuel fire. A new project consists of developing methods of testing and improving the integrity of evacuation slides subjected to intense thermal radiation. Contractual studies in FY 1979 continued in the development of a methodology for combining the effects of heat, smoke, and toxic gas emissions from a burning material into a single rating index (combined hazard index, or CHI) and the development of a computer program for predicting the growth of a cabin fire and the distribution of hazards produced by burning interior materials.
Keywords: aircraft; fires; safety; fire hazards; fire prevention; fire resistance; aviation fuels; computer codes; accidents; occupants.

62001 Transport Crashworthiness. Caiafa, C.A. (FAA, Aircraft and Safety Development Division, Atlantic City, NJ, 08405). **Project number:** 182-520. **Contract:** 182-520-100. **Supported by:** Federal Aviation Administration, Washington, DC (USA). **Funding:** DOT-$975,000; NASA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The project objective is to develop crashworthiness requirements Sor transport aircraft to improve occupant survivability. Several factors are involved in the survival of passengers following airline accidents. This program is intended to study these factors and propose solutions. Some technical approaches to be pursued are: (a) development and evaluation of new systems of cabin fire hazard control to improve escape time for passengers and crew; (b) development of a math model of cabin fire to assess effect of different materials and areas on cabin fire environment; and (c) development of hollow fire fabrication techniques required to produce membrane material of consistent properties. It will be necessary to evaluate manufacturing techniques, to develop optimum fiber configuration and geometry, and to establish sufficient design data to permit the design of a large-scale laboratory unit for the purpose of testing and evaluating nitrogen for fuel tank inerting. The results are new regulations leading to safer aircraft, aircraft interiors and fuels.
Keywords: aircraft; safety engineering; accidents; fire hazards; fire prevention; materials; fabrication; occupants.

62002 Development of Cost Methodology to Measure Benefits to Communities from Aircraft Noise Abatement. Cambell, H. (Charles River Associates, Inc., Boston, MA, 02116). **Project number:** LGR-7-3805. **Contract:** LGR-7-3805 (RFP). **Supported by:** Federal Aviation Administration, Washington, DC (USA). **Funding:** DOT-$200,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a model to be used in assessing the costs and benefits of proposed noise abatement policies. A computerized model will be developed which utilizes user specified noise abatement scenarios for specified aircraft types, operations, and airports, and computes the noise abatement costs and benefits. Benefits are measured as the property values change in the noise impacted areas. Total and fuel only cost-benefit ratios are generated and will be used in policy analysis.
Keywords: noise pollution abatement; cost benefit analysis; aircraft; mathematical models.

62003 Development of an Aircraft Fuel Consumption Simulation Model. Winer, D.E. (Office of Environment and Energy, 800 Independence Ave., SW, Washington, DC, 20591). **Project number:** 08995-00999. **Contract:** DOT-FA79WA-4391. **Supported by:** Federal Aviation Administration, Washington, DC (USA). **Funding:** DOT.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this program was to develop an aircraft fuel burn simulation model to facilitate the energy impact analysis of (1) proposed changes to operating procedures; (2) airport delay effects; and (3) other regulatory changes. The model will be made available to the public, providing a uniform and accurate methodology for assessing fuel consumption characteristics of complex flight patterns enroute and in terminal areas around airports.

Keywords: fuel consumption; aircraft; airports; simulation; operation; aviation fuels; consumption rates.

63000 Integrated Motorist Information System: Evaluation Plan. Ferlis, R. (Peat, Marwick, Mitchell and Co., 1990 K St. SW, Washington, DC, 20006). **Project number:** 3203-034. **Contract:** DOT-FH-11-9590. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this program is the design of the evaluation plan for the Integrated Motorist Information System (IMIS) including data collection, analysis and evaluation of costs and effectiveness of the installed IMIS in the Long Island Corridor.

Keywords: evaluation; automobiles; information systems; communications; cost; data acquisition; new york; motor vehicle operators.

63001 Evaluation of Preferential Lanes for High Occupancy Vehicles at Metered On Ramps. Burk, C.G. (California Dept. of Transportation, 120 S Spring Street, Los Angeles, CA, 90012). **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT; CDOT.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

An eight mile length of the Golden State Freeway (I-5) in Los Angeles, California, had by-pass ramps built for carpools and buses to bypass the ramp meter. Some 15 ramps were so constructed and the effectiveness of this system was evaluated in terms of the number of carpools generated and the operation of the freeway system. This is the first system-wide application of ramp meter bypasses for carpools and buses.

Keywords: carpooling; roads; traffic control; vehicles; evaluation.

63002 Fringe Parking for Carpool Staging. Thompson, R.P. (California Dept. of Transportation, 1120 N Street, Sacramento, CA, 95814). **Contract:** DOT-FH-11-9125. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT; CDOT.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

Three park and ride lots were constructed in California and the resulting usage was monitored. Results of the study shows that two of the lots were very successful and the third one was less so. Location is a very important factor as it should not be located too close to the CBD.

Keywords: automobiles; uses; carpooling; california.

63003 Freeway Control and Management for Energy Conservation. Torres, J.F. (JFT Associates, 6305 Arizona Place, Los Angeles, CA, 90045). **Contract:** DOT-FH-11-9635. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT-$118,000.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The goals of this project are: (1) to determine the short-range and long-range freeway management objectives to promote energy conservation; and (2) to provide guidelines on how to best obtain the freeway management objectives specified. The management strategies to be considered must treat energy conservation as the primary goal. These strategies will include requirements for alternate routing, preferential treatments for carpools and buses, and traffic controls to minimize the effects of freeway incidents and distrubances. Both urban and rural freeways are to be included in this study.

Keywords: roads; energy conservation; management; traffic control; carpooling; accidents; vanpooling; urban areas; rural areas; control.

63004 IMIS Evaluation Plan. Ferlis, R.A. (Peat, Marwick, Mitchell and Co., 1990 K St. SW, Washington, DC, 20006). **Contract:** DOT-FH-11-9590. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT-$60,000.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this project are to specify goals for the Integrated Motorists Information System (IMIS) located on Long Island in New York; to develop the experimental plan and evaluation schedule; to design and test the data collection and analysis procedures; and to identify hardware requirements for the evaluation.

Keywords: evaluation; automobiles; information systems; communications; cost; data acquisition; new york; motor vehicle operators.

63005 Evaluation of the Dallas Freeway Corridor System. Bruggeman, J.M. (Peat, Marwick, Mitchell and Co., 1990 K St. SW, Washington, DC, 20006). **Contract:** DOT-FH-11-9611. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT-$136,000.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to evaluate the effectiveness of the freeway corridor surveillance and a control system which is operating in the corridor along the North Central Expressway in Dallas, Texas. The controls include 35 entrance ramp meters, 15 frontage road traffic signals, 75 arterial signals, drum type changeable message signs, closed circuit TV, and support equipment. The amount of fuel saving attributed to the systems operation will be estimated.

Keywords: roads; traffic control; energy conservation; texas; communications; control systems; surveillance.

63006 Criteria for Removing Traffic Signals. Neudorff, L.G. (JHK and Associates, 4660 Kenmore Ave., Alexandria, VA, 22304). **Contract:** DOT-FH-11-9524. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT-$82,000.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this project are to develop and test criteria that may be adopted for the removal of existing traffic signals. The work included reviewing data at 227 locations where signals were successfully removed and 46 intersections where attempted removals were unsuccessful. Tentative criterion, based on traffic volumes, sight distances, and expected accidents, was developed. This criterion is being tested in three cities. Fuel savings estimates are part of the supporting information used to justify traffic signal removals.

Keywords: energy conservation; traffic control; vehicles; removal; accidents; roads.

63007 Fringe Parking Lots for Carpoolers. Flora, J. (Voorhees, A.M., and Associates, Inc., 7798 Old Springhouse Rd., McLean, VA, 22101). **Contract:** DOT-FH-11-9463. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT-$76,000.

Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The experience of 150 park and pool lots was obtained in Connecticut, Michigan, Missouri, and California. Guidelines are being developed for locating, signing, liability requirements, design and construction, and financing and operating costs. This study will indicate the extent to which park and pool lots actually serve as an incentive to the formation of new carpools and what costs and benefits can be expected. Energy savings is one of the measures of effectiveness.

Keywords: carpooling; vehicles; motor vehicle operators; energy conservation; financial incentives; liabilities; cost benefit analysis; design; construction; operation.

63008 Planning and Scheduling Work Zone Traffic Control. Abrams, C. (JHK and Associates, Box 3727, Bay Bridge Office Plaza, San Francisco, CA, 94119). **Project number:** 31Y1024. **Contract:** DOT-FH-11-9417. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.

Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The purpose of this project was to develop a procedure for estimating the costs and consequences of alternative work zone strategies under varying traffic demands and environmental conditions, and selecting the appropriate strategy for the given demands and conditions. The synthesis of findings reported in previous studies, modeling of relationships and analysis of empirical (field) data on traffic impacts, safety, construction costs, and environmental impacts are the methods employed. A guide that can be used in the early planning or preliminary design stages of construction is developed to estimate the consequences of alternative work zone strategies for site-specific conditions in terms of traffic flow, safety, non-motorist impact, and construction cost and efficiency. To obtain the best available balance between these factors, a decision methodology will be developed for use by raodway administrators and engineers.

Keywords: traffic control; planning; cost; safety; construction; forecasting; decision making; environmental impacts; roads.

63009 Determination of Traffic Signal Intensity Levels. King, G.F. (KLD Associates, Inc., 300 Broadway, Huntington Station, NY, 11746). **Project number:** 31A1832. **Contract:** DOT-FH-11-9512. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.

Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of the study was to determine if the dimming of traffic signals is feasible.

Keywords: traffic control; roads; equipment; lighting systems; feasibility studies.

63010 Implications of Lightweight, Low-Powered Future Vehicles in the Traffic Stream. St John, A.D. (Midwest Research Inst., 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** 39B2-002. **Contract:** DOT-FH-11-9424. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this program is to determine the impact of lightweight, low-powered future vehicles on trafic flow, roadway capacity, and level of revenue for each year through 1985 and for 1995. The approach is to simulate the traffic behavior expected as a result of low-powered vehicles entering the vehicle population in the next 15 years. Freeway and 2-lane rural road applications will be studied. Results of the study are not available at this time. Recommendations will be made on what operational changes, if any, will be needed to assure highway safety.
Keywords: roads; safety; simulation; traffic control; vehicles; economic impact.

63011 Signing for Low Volume Intersections. Stockton, W. (Texas Transportation Inst., Texas A and M Univ., College Station, TX, 77843). **Project number:** 31A1794. **Contract:** DOT-FH-11-9449. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this study was to develop and validate criteria for the use of two-way stop signs, yield signs, and no signs at low volume intersections.
Keywords: roads; traffic control; vehicles.

63012 Integration of BPS Strategies with NETSIM. Torres, J.F. (JFT Associates, 6305 Arizona Place, Los Angeles, CA, 90045). **Project number:** 32M3-053. **Contract:** DOT-FH-11-9640. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of the study is to program and debug bus priority system (BPS) strategies submitted by the New Jersey Department of Transportation for integration with the NETSIM traffic simulation model. This will permit the evaluation of these strategies using the NETSIM model. Effective BPS strategies can reduce bus delay, thus encouraging ridership and reducing fuel consumption.
Keywords: buses; roads; traffic control; simulation; fuel consumption; mathematical models; new jersey.

63013 Development of an Arterial Analysis Package (AAP). Courage, K. (Univ. of Florida, 346 Weil Hall, Gainesville, FL, 32611). **Project number:** 32M2-014. **Contract:** DOT-FH-11-9511. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of the study is to develop a package of computer programs which will be able to analyze the operation of arterial facilities. Traffic engineers will be able to use the AAP as a tool to determine effective control strategies on urban arterials and, thus, improve traffic flow and reduce fuel consumption and emissions.
Keywords: traffic control; urban areas; roads; fuel consumption; exhaust gases; vehicles; operation; computer codes; energy conservation.

63014 Call-In System for Motorist Navigation Information. Parikh, B.S. (Input Output Computer Services, Inc., DOT, 400 Totten Pond Road, Waltham, MA, 02154). **Project number:** DOT-FH-11-9509. **Contract:** DOT-FH-11-9509. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this study is to determine the feasibility of a computer-controlled voice response system for motorist navigation information. A limited system will be developed and evaluated to identify its potential capabilities and limitations. The motorists' access to the routing information system will be by any touch-tone telephone. The system will be limited in coverage to the Washington, DC, area and will not have real-time update capability. The hardware and software components of the system have been completed. Preparations are in progress for the evaluation of the system. Driver navigation problems constitute an important source of energy waste in the highway transportation system. It is estimated that even a modest improvement in motorist navigation performance would result in a considerable savings of automobile fuel.
Keywords: vehicles; traffic control; navigational instruments; information systems; feasibility studies; washington dc; energy conservation; computer codes; telephones; roads; communications; occupants.

63015 Macroscopic Simulation for Urban Traffic Management. Lieberman, E.B. (KLD Associates, Inc., 300 Broadway, Huntington Station, NY, 11746). **Project number:** 32K2-012. **Contract:** DOT-FH-11-9369. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this study was to adapt a macroscopic symbolic simulation model of traffic flow in urban areas that will be useful for pretesting and evaluating traffic management strategies. Urban traffic is represented by a set of variables whose values change during a simulated time period according to pre-established logical and empirical relationships. The representation is defined by a computer program. The model thus developed is then tested and its results compared against real-life data. Output of the model include traffic characteristics, fuel consumption, and vehicle emissions. A model named TRAFW has been developed and tested. It is now being subjected to a series of demonstrations to insure reliability. The model will allow the prediction of the effect of traffic management strategies on measures of effectiveness such as fuel consumption.
Keywords: traffic control; roads; urban areas; fuel consumption; vehicles; computerized simulation; energy conservation.

63016 Peak Hour System Analysis on the Eastern Shore of Maryland. Renshaw, D.L. (Univ. of Maryland, College Park, MD, 20742). **Contract:** PR-5-78. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this research are to develop and evaluate motorist information and advisory strategies to reduce congestion on Route 50 and other selected primary routes on summer weekends.
Keywords: motor vehicle operators; roads; evaluation; maryland; information systems; energy conservation; systems analysis.

63017 Integrated Motorist Information System, Phase III: Design. Zove, P. (Sperry Systems Management, Great Neck, NY, 11020). **Project number:** 32C3-042. **Contract:** DOT-FH-11-9557. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT; NYDOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to develop detailed design and plans, specifications, and estimates for an Integrated Motorist Information System for the Northern Long Island Corridor. Implementation and demonstration of IMIS in the New York Corridor is expected to save 2.7 million gallons of fuel per year.
Keywords: motor vehicle operators; planning; information systems; communications; new york; energy conservation; specifications; vehicles.

63018 MIDS: Research and Evaluation in San Antonio, Texas. Dudek, C. (Texas Transportation Inst., Texas A and M Univ., College Station, TX, 77843). **Contract:** DOT-FH-11-8505. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project was to plan and carry out research and evaluation for the San Antonio, Texas, diversion system, including conduct of experiments, data collection and analysis, comparisons of different routing algorithms and manual control. The current phase is expected to determine diversion more accurately, and to develop better procedures for system operation. Interstate-35 in San Antonio was redesigned and its impacts were evaluated.
Keywords: texas; roads; traffic control; planning; algorithms; evaluation.

63019 Bus Signal Priority Strategies: Phase I. Yedlin, M. (KLD Associates, Inc., 300 Broadway, Huntington Station, NY, 11746). **Project number:** 32M3-023. **Contract:** FH-11-9609. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to formulate an experimental design for the development of control logic for advanced bus control strategies for a variety of traffic, street, and bus characteristics. The work will encompass bus signal preemption strategies, reversible lane control systems including separate lanes for buses, and will incorporate third generation signal control concepts. The majority of the work will utilize simulation investigative techniques. However, a portion of the work will also be performed at one-street sites.
Keywords: control systems; traffic control; buses; roads; design; energy conservation.

63020 Application of Existing Strategies to Arterial Signal Control. Kittleson, W. (Alan M. Voorhees and Associates, McLean, VA, 22101). **Project number:** 32M2-043. **Contract:** FH-11-9399. **Supported**

by: Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to develop and test arterial system control concepts. UTCS strategies as well as other existing strategies which have been implemented in various arterial systems will be analyzed via simulation and limited field testing where appropriate. This analysis will define potential application of the control strategies which may then be combined to form systems requirements also established in this study.
Keywords: roads; traffic control; vehicles; control systems; testing.

63021 Motorist Aid CB as a Wide Area Communications System. Wilson, C. (Georgia Tech. Engineering Experiment Station, Atlanta, GA, 30332). **Project number:** 32L3-022. **Contract:** DOT-FH-11-9232. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to design, fabricate, test, demonstrate, and deliver an automatic telephone interconnect device which can be used in conjunction with CB radio link for motorist emergencies and assistance. The interconnect device was designed and fabricated and installed for testing in Dade County, Georgia, and evaluation of the system was conducted using three remote stations and one base station. Results of testing are currently being evaluated.
Keywords: communications; vehicles; occupants; telephones; roads; radio equipment; accidents; design.

63022 *Application of UTCS First Generation Control Software to Arterials.* Henry, D.R. (JHK and Associates, 4660 Kenmore Avenue, Suite 112, Alexandria, VA, 22304). **Project number:** 32M2-024. **Contract:** DOT-FH-11-9286. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are (1) to examine quantitatively, the applicability of UTCS 1-GC to arterial control and to corroborate results of the UTCS evaluation in Washington, DC; (2) to compare the evaluation technique used in the evaluation to the widely used regression technique used in other evaluations; and (3) to examine other factors that affect the outcome of system evaluations. A comparative evaluation of 1-GC traffic responsive mode in New Orleans and using moving car and automatic surveillance data collection methods will be performed. The data analysis programs prepared for a UTCS evaluation will be used to perform analysis of the system performance and to compare with an alternative, widely-accepted analysis process for system performance evaluations.
Keywords: vehicles; roads; urban areas; traffic control; performance; systems analysis; control systems.

63023 Speed Control on High Speed Roadways. Lee, R.B. (Urbitran Associates, Inc., 16 Park Row, New York, NY, 10038). **Project number:** 31A1-784. **Contract:** DOT-FH-11-9456. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to develop and conduct laboratory evaluations, through driving simulation, pavement marking and delineation systems as potentially safe and effective means of controlling vehicle speeds on high speed highways. The end product will be marking systems for use in field tests. Six marking systems have been developed and preparation of the experimental design for driving simulation testing is underway.
Keywords: vehicles; roads; simulation; speed limit; control systems; design; evaluation; traffic control.

63024 Analysis of Feasibility and Design Configuration for Route Guidance. Gordon, R.S. (Sperry Rand Corp., Great Neck, NY, 11020). **Project number:** 32L3-042. **Contract:** DOT-FH-11-9522. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this study is to determine the feasibility of and possible design configuration for an in-vehicle route guidance system. The approach is to (1) determine the need for vehicle route guidance in the U.S.; (2) provide competing system comcepts; (3) select one concept for in-depth evaluations of legal, institutional, deployment, maintenance, cost, etc., factors; and (4) provide hardware design of concept. Results to date include establishment of need, selection of concept, and in-depth evaluation of the concept. Assuming study output is encouraging, FHWA will determine if additional work to develop system is advisable.
Keywords: feasibility studies; vehicles; roads; design; electronic guidance.

63025 Air Quality of Intermittent Cut and Cover Highway Tunnels. Dayman, B. (California Inst. of Technology, Jet Propulsion Lab., 4800 Oak Grove Drive, Pasadena, CA, 91103). **Project number:** 35BY112. **Contract:** PO-730112. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives are to establish principles of passive ventilation through openings in cut-and-cover tunnels and similar structures, and to develop criteria for maximum use of natural ventilation.
Keywords: air quality; tunnels; roads; ventilation; air pollution; exhaust gases; automobiles; meteorology.

63026 Fabrication and Research Evaluation of a New Combination Sensing System to Determine Ground Conditions for Tunnel Design and Construction. Schuler, S. (Southwest Research Inst., 8500 Culbera Road, P.O. Drawer 28510, San Antonio, TX, 78284). **Project number:** 35B2202. **Contract:** DOT-FH-11-9323. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to develop, fabricate, and demonstrate a prototype multiple sensor borehole probe system capable of obtaining exploratory subsurface information relevant to transportation tunnel design and construction, utilizing electromagnetic, acoustic, and resistivity measurements; and to perform an in-depth analysis and evaluation of the system.
Keywords: tunnels; boreholes; geological surveys; construction; transportation systems; acoustic measurements; resistivity logging; fabrication; feasibility studies; subsurface structures; excavation; probes.

63027 Fabrication of an Inductive Resistivity Probe for Site Exploration. Scarborough, D.R. (Westinghouse System Center, 1111 Schilling Road, Hunt Valley, MD, 21030). **Project number:** 35B2142. **Contract:** DOT-FH-11-9395. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to develop and test a prototype geophysical inductive probe. Tasks include state-of-the-art study, breadboard and prototype construction, final design, testing and evaluation, field experiments, and demonstration. The probe would be capable of monitoring the resistivity and dielectric constant of borehole walls inductively and would use a frequency range from 250 kHz to 32 MHz.
Keywords: probes; feasibility studies; resistivity logging; boreholes; fabrication; geological surveys; site selection; transportation systems.

63028 Borehole Radar Rehabilitation and System Integration. Fowler, J. (Ensco, Inc., 5408A Port Royal Road, Springfield, VA, 22151). **Project number:** 35B2232. **Contract:** DOT-FH-9422. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to rehabilitate antennas for e.m. underground radar system and update it to operate with acoustic systems; prepare and test for installation in a government-furnished mobile unit for subsurface exploration vehicle; field test at four sites; and analyze and interpret data.
Keywords: antennas; boreholes; transportation systems; underground; radar; feasibility studies; acoustics; modifications; geological surveys; electromagnetic radiation.

63029 Acoustic Sensing System for Mapping Soil--Rock Interface. Fowler, J. (Ensco, Inc., 5408A Port Royal Road, Springfield, VA, 22151). **Project number:** 35B2012. **Contract:** DOT-FH-11-9120. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to develop and fabricate a portable sensing system which will identify and locate boulders, irregularities of grouted soil, utility lines, buried structures, and foundations, and which will map soil/rock interfaces.
Keywords: soils; rocks; interfaces; mapping; underground; pipelines; geological surveys; feasibility studies; transportation systems; probes; foundations.

63030 Analysis of Residential Property Values Within the Highway Impact Zone. Darnbusch, D.M. (David M. Darnbusch and Co., Inc., 1736 Stockton Street, San Francisco, CA, 94133). **Project number:** DOT-FH-11-9432. **Contract:** DOT-FH-11-9432. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are (1) to determine if and under what conditions residential properties adjacent to major highway facilities decrease in value or fail to increase in value at the same rate as comparable non-impacted residential properties due to the operation of the facility; (2) to compare the findings in different locations and determine whether a single model can be developed for all locations or whether individual models must be specified at each location; and (3) to determine how results of the analysis of highway proximity and residential property values affect simulation, evaluation, and ultimate implementation of a comprehensive policy to ameliorate adverse impacts and take advantage of beneficial impacts on individuals and institutions in areas adjacent to key highway facilities.
Keywords: residential buildings; roads; economic impact; property values; evaluation; mathematical models.

63031 Local Rural Road Problem. Cunningham, G. (Texas Research and Development Foundation, 2602 Delana Lane, Austin, TX, 78746). **Project number:** DOT-FH-11-9529. **Contract:** DOT-FH-11-9529. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

Concern is growing over the adequacy of rural local and collector roads in meeting present and future needs for hauling commodities, serving transportation demands, and carrying public service vehicles. Lack of basic information on rural transportation problems limits the Department of Transportation's ability to provide assistance and formulate policies responsive to rural needs. Objectives of the study are to identify the types of problems encountered by users of rural roads, determine the severity of the problems and their geographic locations, analyze data on problems, identify costs, and assess trade-offs between road improvements, alternative road use restrictions, and alternative transportation modes. A sample of 300 counties will be surveyed, with 6 to 9 counties being more extensively analyzed as case studies. A questionnaire has been prepared for the survey. The project is awaiting OMB approval before continuing work.
Keywords: rural areas; roads; commodities; land transport; cost; uses; demand; vehicles; social impact.

63032 Reducing Urban Blight Adjacent to Highways in Central Business Districts. Norris, C. (Stull Associates, Inc., 100 Boylston Street, Boston, MA, 02116). **Project number:** DOT-FH-11-9652. **Contract:** DOT-FH-11-9652. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objectives are: (1) to identify and evaluate the adverse impacts of highways in CBD environments which may contribute to urban blight; (2) to identify and evaluate a wide range of potential techniques for mitigating adverse highway impacts in CBD's and to describe the conditions under which each may most effectively be applied; (3) to estimate in absolute and/or relative terms the costs and benefits of a representative sample of the measures which may be taken to mitigate adverse highway impects which contribute to sustaining urban blight; (4) to assess the feasibility of using air rights and land adjacent to highways in blighted CBD areas for new housing, commercial, retail and institutional development, recreational opportunities, and urban employment opportunities; and (5) to develop financial and/or legislative proposals in cooperation with state and local government agencies and private developers which would improve the responsiveness of the federal-aid highway program to urban revitalization initiatives.
Keywords: roads; land use; environmental impacts; industry; public opinion; recreational areas; employment; buildings; optimization; social impact; economic impact; urban areas; government policies.

63033 Recycled Rubber in Roads. Stephens, J. (Univ. of Connecticut, Box U-37, Storrs, CT, 06268). **Contract:** HPR-471. **Supported by:** Connecticut Dept. of Transportation, Hartford (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The goal of this project is to determine the potential for beneficially using large amounts of recycled or reclaimed rubber in the solution of a solid waste problem while simultaneously solving road building and maintenance problems. This will be done by establishing a statistical base for determining sound cost and longevity performance data from full-scale experimental pavement applications.
Keywords: recycling; roads; pavements; uses; solid wastes; rubbers; waste product utilization; construction; maintenance; feasibility studies; cost; materials recovery.

63034 Bituminous Concrete Pavement Recycling: Placement and Evaluation of Experimental Pavements. Christman. (Connecticut Dept. of Transportation, Wethersfield, CT, 06109). **Contract:** HPR-647. **Supported by:** Connecticut Dept. of Transportation, Hartford (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

This study will evaluate the performance of recycled bituminous concrete pavements using conventional pavement designs for control. Various methods will be used to remove, blend, and replace the disturbed pavement materials in the full-scale evaluations.
Keywords: solid wastes; concretes; pavements; recycling; design; performance; bituminous materials; construction; evaluation; waste product utilization.

63035 Data Bank for Recycled Bituminous Concrete Pavement. Lee, D.Y. (Iowa State Univ., Engineering Research Inst., 476 Town Engineering Building, Ames, IA, 50011). **Contract:** DOT-FH-11-9576. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives of this project are to design and establish a comprehensive, cross-reference data bank containing information on construction projects employing recycled bituminous concrete materials. Data categories include location, soil types, drainage materials, structural section, traffic loads, environmental factors, construction records, maintenance, and evaluation of performance.
Keywords: pavements; bituminous materials; roads; recycling; data acquisition systems; construction; maintenance; environmental effects; performance; waste product utilization; feasibility studies.

63036 Design of Open Friction Courses with Sulfur Extended Asphalt. Saylak, D. (Texas Transportation Inst., Texas A and M Univ., College Station, TX, 77843). **Contract:** DOT-FH-11-9588. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective is to develop mixture designs for open friction courses based on the use of sulfur extended asphalt in place of asphalt cement.
Keywords: roads; building materials; asphalts; mixtures; design; friction; sulfur; cements; pavements.

63037 Materials and Techniques for Improving the Engineering Properties of Sulfur. Lugwig, A.C. (Southwest Research Inst., P.O. Drawer 28510, San Antonio, TX, 78284). **Contract:** DOT-FH-11-9111. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective is to develop materials and processes that can be used to improve the engineering properties of sulfur to provide sulfur cements as alternatives for asphalt and Portland cement.
Keywords: roads; pavements; building materials; sulfur; cements; asphalts; portland cement; engineering; physical properties.

63038 Highway Binder Materials from Cellulosic and Related Wastes. Butte, W. (Suntech, Inc., P.O. Box 1135, Marcus Hook, PA, 19061). **Contract:** DOT-FH-11-9131. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objectives are to investigate the technical and economic feasibility of producing binder materials from cellulosic and related wastes, and to develop an appropriate process(es) for their production.
Keywords: roads; building materials; feasibility studies; cellulose; industrial wastes; waste product utilization; binders; waste processing.

63039 Test for Efficiency of Mixing Recycled Asphalt Pavements. Terrel, R.L. (Univ. of Washington, Dept. of Civil Engineering, Seattle, WA, 98195). **Contract:** DOT-FH-11-9501. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to develop a technique and the necessary test equipment to establish a mixing operations ability to produce an intimate mixture consisting of reclaimed bituminous materials, modifying agent, new asphalt, and new reclaimed aggregates. The test will not alter properties of the reconstituted binder after mixing, will be applicable to all types of mixing operations and types of mixtures, and will be capable of supplying accurate results within a reasonable length of time.
Keywords: pavements; roads; asphalts; bituminous materials; recycling; mixtures; waste product utilization; feasibility studies; binders.

63040 Environmental and Safety Aspects of the Use of Sulfur in Highway Pavements. Saylak, D. (Texas A and M Univ., College

Station, TX, 77843). **Contract:** DOT-FH-11-9457. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

This contract will evaluate the environmental and safety hazards of the use of sulfur in highway pavements. Emissions generated during the storage and handling, formulation, and construction of highway pavements containing sulfur have been collected and are now being characterized. Leachates generated during and after rains on pavements in service have also been collected and are now being analyzed. Environmental and safety guidelines for the use of sulfur in highways will be prepared based on the results of these analyses.
Keywords: pavements; sulfur; roads; environmental effects; hazards; safety.

63041 Softening or Rejuvenating Agents for Recycled Bituminous Binders. Epps, J.A. (Texas Transportation Inst., Texas A and M Univ., College Station, TX, 77843). **Project number:** RF-80-260(3895). **Contract:** DOT-FH-11-9504. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This work consists of: the development of tests and techniques to evaluate the compositions of salvaged bituminous binders and the determination of the necessary properties and composition of rejuvenators to restore the salvaged binder to a condition suitable for paving purposes with a reasonably defined performance.
Keywords: pavements; bituminous materials; binders; recycling; physical properties; roads; building materials; mixtures; performance; hardness.

63042 Potential Use of Deflection Measurements to Assist in Designing Recycled Asphalt Pavements. Matthews, J.A. (California Dept. of Transportation, 1120 N. Street, Sacramento, CA, 95814). **Contract:** D-4-162. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This study will determine the effect of recycling asphalt pavements on roadway deflections, and develop an overlay design method for recycled asphalt pavements based on deflection analysis.
Keywords: recycling; asphalts; pavements; roads; design; deformation; building materials.

63043 Pavement Surface Texture: Significance and Measurement. Henry, J.J. (Pennsylvania Transportation Inst. , University Park, PA, 16802). **Contract:** DOT-FH-11-9591. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives of this project are to: develop, evaluate, and demonstrate measurement methods for pavement surface texture; demonstrate the effects of texture on skid resistance and on skid resistance-speed gradients and establish secondary effects of texture and their significance; and develop empirical relationships between pavement texture and the variables identified. This research will focus on the development of a high-speed measurement method (30 to 60 mph (45 to 90 km/h)) for pavement surface texture. The method should produce a direct texture measure, such as texture profile, root mean square (rms) value, or similar descriptors. However, indirect texture descriptors, such as noise, reflectivity, or a determination of gradients, will also be considered, either as a substitute or backup system.
Keywords: pavements; texture; surfaces; friction; velocity; noise; measuring methods.

63044 *Simulation of pavement--vehicle interactions.* Bohn, P.F. (Applied Physics Lab., Johns Hopkins Road, Laurel, MD, 20810). **Project number:** N00024-78-C-5384. **Contract:** P.O. 6-3-0068. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Pavement--vehicle interactions as these are affected by road roughness will be investigated. These investigations will be done by means of computer simulations, using a perfectly smooth and level road as a reference. Using these simulations, it is possible to compute dynamic interaction forces between tires and pavements during the different maneuvers in driving. These forces include: vertical forces affecting pavement life, ride comfort, and stresses on vehicles and cargo; horizontal forces affecting safety of operation and wear of pavements and tires; and wheel torques in free rolling affecting the rolling resistance of tires.
Keywords: pavements; vehicles; computerized simulation; roughness; roads; tires; stresses; wheels; dynamic loads; safety; wear; service life.

63045 Highway Advisory Radio System Analysis and Design Guidelines. Turnage, H.C. (Atlantic Research Corp., 5390 Cherokee Avenue, Alexandria, VA, 22314). **Project number:** 3212-102. **Contract:** DOT-FH-11-9517. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

Highway Advisory Radio (HAR) is a means of providing motorists with pertinent driving- and travel-related information over their vehicle's standard AM radio. The objectives of this contract are to: conduct an analysis of HAR components; develop HAR system design guidelines; and prepare a users guide to HAR. The specific of this contract include laboratory and field testing of HAR electronics, mathematical and empirical analysis of HAR antennas, and data collection from existing HAR sites. To date, this study has developed mathematical models for HAR antenna types, evaluated HAR electronics, and surveyed ten operational HAR sites. Currently, this information is being consolidated into HAR system design guidelines and a users guide to HAR.
Keywords: vehicles; communications; radio equipment; antennas; data acquisition; design; information.

63046 Energy Consumption of Surface Transportation Projects, Methodology and Manual. Noel, E. (Automated Management Systems, 9301 Annopolis Rd., Lanham, MD, 20801). **Project number:** DOT-FH-11-9643. **Contract:** DOT-FH-11-9643. **Supported by:** Federal Highway Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objectives of this project are to: compile existing energy consumption factors for surface transportation; develop energy consumption factors for surface transportation where none exist; develop an energy assessment methodology for surface transportation projects; and produce a users manual from energy assessment methodology and energy consumption factors developed in the above tasks to allow state transportation agencies to easily, and step-by-step, analyze a project for energy consumption.
Keywords: land transport; transportation systems; energy consumption; vehicles; energy analysis.

64000 Replacement of PCB Coolants in Railroad Transformers. Tewarson, A. (Factory Mutual Research Corp., 1151 Boston-Providence Turnpike, Norwood, MA, 02062). **Project number:** FRA-RR-930. **Contract:** DOT-TSC-1703. **Supported by:** Federal Railroad Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective of this R and D task is to find a substitute transformer coolant that does not contain PCB and has satisfactory dielectric characteristics. If this can be done it will be possible to retrofill existing electrical equipment and thus retain use of service life and not be necessary for Amtrak and Transit Authorities to replace all such equipment. Tests have been made of the three presently available substitutes. The two most desirable fluids have difficulty keeping the existing transformers adequately cool at high operating temperatures. Experimentation is going on with alternative pumping and cooling arrangements. The third fluid passed all laboratory tests and is being tested in service. The objection to this fluid is that it contains chemicals which may themselves be outlawed by EPA in the near future.
Keywords: railways; transformers; coolants; aromatics; organic chlorine compounds; trains; evaluation.

64001 Exhaust Emission Characteristics of Alternate Fuels for Diesel Locomotives. Wood, C.D. (Southwest Research Institute, 8500 Culebra Road, San Antonio, TX, 78284). **Project number:** AR-8163. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$115,000; DOT-$61,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental effects assessment.

The exhaust emission characteristics of various alternative fuels will be measured in a medium-speed diesel engine as part of a program to evaluate the performance and wear aspects of various engine/fuel combinations. The tests will be conducted on a 2-cylinder test bed laboratory installation and will utilize off-spec diesel fuels, alcohol, gasoline, and simulated coal-derived synthetic blends. The final report will indicate the performance and wear rate characteristics of the test engine/alternative fuel combination, fuel economy, combustion aspects, and exhaust emission levels. Recommendations for further testing and other potential candidate fuels for medium-speed diesel engines will be included.
Keywords: diesel engines; liquid fuels; comparative evaluations; coal liquids; gasoline; alcohols; performance; exhaust gases; wear; combustion; recommendations; emission; particles; hydrocarbons.

65000 Research and Policy Implications of the Substitution of Diesel Engines in Future Light Duty Vehicles. Barrington, L.F.

(National Academy of Sciences, 2101 Constitution Ave., Washington, DC, 20418). **Project number:** 68-01-5972. **Contract:** DOT-HS-9-02222-IA. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT; DOE; EPA.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objective of this project is to provide information and analyses on the risks and benefits associated with the potential widespread use of the diesel engine (which has higher fuel economy than the conventional gasoline engine) for powering cars and light trucks. The key issues are that diesel emissions may cause short-term and long-term damages to human health, resulting, in the most extreme cases, in cancer; and that the technology for reducing or eliminating the harmful emissions is not sufficiently developed. The technological, biomedical, environmental, and economic, as well as the energy aspects of the issues, will be examined, and the alternatives for dealing with the potential problems will be discussed and evaluated. Two interim and one final report will be prepared.
Keywords: automobiles; trucks; diesel engines; exhaust gases; risk assessment; environmental impacts; air pollution abatement; economic impact; technology assessment; biological effects; energy policy.

65001 Initial Assessment of the Literature on the Measurement, Control, Transport, Transformation, and Health Effects of Unregulated Diesel Engine Emissions. Johnson, J.H. (Michigan Technological Univ., Houghton, MI, 49931). **Project number:** DOT-HS-7-01790. **Contract:** DOT-HS-7-01790. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: medical applications(100) **R and D categories:** Health effects assessments.

The objective of the project is explicitly shown in its title. The approach included literature review as well as an evaluation of the information gathered during the Workshop on Unregulated Diesel Emissions and Their Potential Health Effects, which was held 27--28 April 1978.
Keywords: diesel engines; health hazards; environmental impacts; pollution regulations; exhaust gases; environmental transport; control; quantitative chemical analysis; monitoring.

65002 Independent Assessment of the 3-Way Catalyst. Ketcham, B. (Citizens for Clean Air, 32 Broadway, New York, NY, 10004). **Contract:** DOT-HS-8-01912. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objectives of this program are to demonstrate for a 1978 3500 automobile that final statuatory emissions levels (.41/3.4/.41) can be met with no fuel economy loss. Phase I involves the achievement of .2/1.7/2.5 gm/mi, HC, CO, NOx, respectively, at the EPA 4000 miles emission/fuel economy test with the use of advance emissions/fuel economy systems. Phase II involves the demonstration of system durability over 50,000 miles. Results to date indicate that the Phase I emission objectives probably can be met, but with a slight loss in fuel economy.
Keywords: automobiles; exhaust gases; fuel economy; hydrocarbons; carbon monoxide; nitrogen oxides; catalytic converters; catalysts; air pollution control; evaluation.

65003 Investigation of Compression Ignition Power Plant Parametric Trade-Offs. Bold, W. (Ricardo Consulting Engineers, Bridge Works, Shoreham-by-Sea, Sussex, England, BN4 5FG). **Contract:** DOT-TSC-1545. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objective of this study is to investigate means of achieving the statutory gaseous emissions from a diesel-powered light duty vehicle with acceptable fuel economy and particulate emissions. The investigation includes single-cylinder, multi-cyliner, and vehicle tests. The most basic research will be carried out first on the single-cylinder configuration, and then continued on a multiple cylinder engine and the vehicle, if the results are promising. The basic research will investigate fuel injection rate, fuel nozzle type and orientation, insulated and catalyzed combustion chamber walls, and combustion chamber split and throat area. The more conventional items (injection timing, EGR, etc.) will be investigated directly on the multi-cylinder engine and vehicle tests. The research will also include some work to determine the impact of fuel type, and some biological activation tests of exhaust particulates. A final report will be issued at the completion of the work.
Keywords: diesel engines; fuel economy; exhaust gases; combustion chambers; design; fuel systems.

65004 Lightweight Automotive Diesel Data Base. Cornetti, G.M. (Centro Ricerche Fiat, Strada Torino, Orbassano, Italy 10043). **Project number:** DOT-TSC-1424. **Contract:** DOT-TSC-1424. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objective is to obtain a data base on a family of production, lightweight, small displacement (below 225 CID) naturally aspirated and turbocharged diesel engines. Exhaust emissions and combined fuel economy are investigated for a 3000-lb inertia weight vehicle for the following engine combinations: naturally aspirated, naturally aspirated + oxidation catalyst, turbocharged, turbocharged + EGR, and turbocharged + EGR + oxidation catalyst. Biological activation tests of particulates are also being made. A final report will be issued at the completion of the work.
Keywords: automobiles; diesel engines; exhaust gases; superchargers; fuel economy; catalysts; data acquisition; nitrogen oxides.

65005 Data Base for Light-Weight Automotive Diesel Power Plant. Bauer, R. (Chrysler Corp., P.O. Box 1118, Detroit, MI, 48288). **Project number:** DOT-TSC-1423. **Contract:** DOT-TSC-1423. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objective is to obtain data on a 6-cylinder, 225 CID engine applicable for 5 and 6 passenger cars and potential light trucks. The engine will be tested on the dynamometer in its naturally aspirated and turbocharged versions. After obtaining the baseline maps of the engine, the impact on fuel economy and emissions of valve timing, injection time, EGR, compression ratio, and oxidation catalyst will be determined. Combined fuel economy and exhaust emissions will also be determined with the engine installed in the vehicle, using both manual and automatic transmissions. Biological activation tests of exhaust particulates will also be made. A final report will be issued at the completion of the work.
Keywords: automobiles; diesel engines; exhaust gases; superchargers; fuel economy; catalysts; data acquisition; nitrogen oxides.

65006 Environmental Impacts of Light Duty Vehicle Dieselization. Forrest, L. (Aerospace Corp., P.O. Box 92957, Los Angeles, CA, 90009). **Project number:** DOT-TSC-1530. **Contract:** DOT-TSC-1530. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT.
Related energy source: medical applications(100) **R and D categories:** Environmental effects assessment.

The objective is to define the potential environmental impacts associated with the operation of diesel powered light duty vehicles in urban areas. A case study framework and parametric analysis of key variables are the principal aspects to the approach selected for this study. Impacts are projected to the year 2000, based on several selected scenarios for the growth in diesel population. Two types of air quality analyses are conducted: area wide and local site. Results are presented in terms of trends in the emission inventories for the city-wide analysis and as pollutant concentration profiles for the local site analysis. The area-wide analysis indicates that dieselization would increase urban total suspended particulate by less than 3%, while air quality relative to HC, CO, and NOx would improve. The local site analysis shows that dieselization would produce diesel particulate concentrations ranging from 9 to 13 mu-g/cubic m at long term exposure locations in the freeway and street canyon sites and 24 mu-g/cubic m in the enclosed parking garage. Odor effects in a nominal diesel-gasoline vehicle mix are found to be negligible.
Keywords: environmental impacts; diesel engines; exhaust gases; urban areas; air quality; air pollution; particles; aerosols; odor; vehicles; air pollution abatement.

67000 Natural Dispersion of Oil Slicks. Marsh, G.D. (US Coast Guard, 2100 Second Street, SW, Washington, DC, 20593). **Project number:** 4120. **Supported by:** Coast Guard, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objectives are to develop the capability to predict dispersion of oil in rough seas, predict the amount of recoverable and dispersed oil as function of sea state, predict the extent and performance of dispersion, and provide integrated predictions of surface movement and subsurface dispersion. The general technical approach consists of five basic tasks: (1) development of an algorithm and preliminary model for oil dispersion; (2) full-scale at-sea measurement of waves and oil slick movement; (3) development of a model for horizontal/vertical dispersion model based on Langmuir cells and Windrow formation; and (5) development of components for an integrated 3-dimensional model for oil slick movement and horizontal/vertical dispersion. Tasks will be accomplished under separate commercial contracts and MIPR's. Results to date include completion of development of algorithm and basic dispersion model; arrangement with the Navy for at-sea measurement of waves and slick movement; initiation of developmenof breaking wave dispersion model; and Langmuir cell/Windrow formation model. Expected products include components for an integrated 3-dimensional model for oil slick movement and vertical/horizontal oil dispersion.

Keywords: oil spills; weathering; oceanography; mathematical models; mixing; environmental transport; hydrocarbons.

67001 Electric Hazard Protection of Tank Vessels Moored to Shore Facilities. Harrison, R. (Jet Propulsion Lab., 4800 Oak Grove Rd., Pasadena, CA, 91103). **Contract:** MIPR F 70099-9-95956-1B. **Supported by:** Coast Guard, Washington, DC (USA). **Funding:** DOT. **Related energy source:** oil and gas(100) **R and D categories:** Environmental effects assessment.

The objectives of this project are to study the phenomena of stray currents and static electricity at ship-to-terminal interfaces, to study the occurrence of vapor ignition from static or stray currents, and to develop preventative measures. The approach is to do a literature study, field tests, and evaluation of preventative measures. **Keywords:** terminal facilities; tanker ships; moorings; harbors; electrostatics; safety engineering; electric charges; vapors; ignition.

67002 Hybrid Power Sources for Remote Site Applications. Eberhart, R.; Powell, D. (Johns Hopkins Univ., Applied Physics Lab., Johns Hopkins Rd., Laurel, MD, 20810). **Project number:** 9502.2.2.2. **Contract:** Z 70099-0-01875. **Supported by:** Coast Guard, Washington, DC (USA). **Funding:** DOT.
Related energy source: solar(80); conservation(20) **R and D categories:** Environmental effects assessment.

This project is aimed at developing an alternate power source for remote site applications (particularly lighthouses). The goal of the project is to determine a conceptual design for alternate power sources which can realistically be expected to replace or augment conventional diesel generator sets. In following phases of development, experimental systems will be designed, fabricated, and tested. The objective of this feasibility study is to evaluate the technical, analytical, and economic aspects of substituting alternate hybrid power sources for the conventional diesel systems. The project is due to commence in February 1980.
Keywords: design; diesel engines; feasibility studies; cost; hybrid systems; power systems; remote areas.

67003 Fuel-Water Emulsions--Application to Combustion Systems. Walter, R.A. (Transportation Systems Center, Kendall Square, DTS-331, Cambridge, MA, 02142). **Project number:** 9501.2.1. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$500,000.
Related energy source: oil and gas(50); conservation(50) **R and D categories:** Environmental effects assessment.

The Fuel/Water Emulsions project has as its objective energy conservation through the use of fuel/water emulsions in diesel engines. A 5% reduction in specific fuel consumption has been obtained on a high-performance laboratory diesel engine burning emulsions. Continuing efforts for diesel engines shall see the development of an emulsifying system for a demonstration onboard an operational cutter. Our objective has been broadened to include application of emulsions to shore/side boilers. In addition to increased efficiency, these installations can reap the benefits of lower NOx emissions, reduced smoke, cleaner operation with its commensurate reduction in maintenance, and the use of lower grade fuels providing an advantage of lower base fuel costs. A demonstration program is being planned for a shore/side boiler system. The Research and Special Programs Administration of the Department of Transportation has, through its Office of University Research, supported additional fuel/water emulsions research for the Coast Guard. They awarded a FY77 contract to the University of Michigan for research on the stability and physical properties of fuel oil--water emulsions and a FY78 contract to the University of Oklahoma for research on the combustion characteristics of fuel/water emulsions.
Keywords: ships; diesel engines; diesel fuels; energy conservation; fuel oils; water; emulsions; nitrogen oxides; air pollution control; exhaust gases; smokes; fuel consumption; evaluation.

67004 Diesel Diagnostics: Develop Diesel Performance Monitor. Walter, R.A. (Transportation Systems Center, Kendall Square, Cambridge, MA, 02142). **Project number:** 9501-2.2. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$90,000.
Related energy source: oil and gas(50); conservation(50) **R and D categories:** Environmental effects assessment.

The Diesel Diagnostics project is an attempt to effect energy savings by ensuring optimum engine operation through timely preventive maintenance. Conceptually, an instrument which is compact, light and easy to use is desired. It should involve a minimum number of sensor attachments to diagnose the performance of the center section assembly of a diesel. Our development to date consists of breadboarded electronics for sensing and filtering Instantaneous Crankshaft Angular Velocity (ICAV) and dynamic crankcase pressure signals. ICAV sensing is by optical detection of striped tape on the flywheel. Dynamic crankcase pressure detection is by a pressure transducer tap into the crankcase. Optimization of the diagnostic significance of these parameters will be established on laboratory engines, followed by the development of a prototype which will be tested on operational ship engines. Future years shall see the expansion to all diesels and auxiliary engine systems.
Keywords: diesel engines; diagnostic techniques; operation; performance; measuring instruments.

67005 Hazardous Chemical Discharge Prevention and Reduction. Motherway, D.L. (US Coast Guard, Avery Point, Groton, CT, 06340). **Project number:** 4151. **Supported by:** Coast Guard, Washington, DC (USA). **Funding:** DOT.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to develop equipment and methods to prevent and reduce discharges of hazardous chemicals into U.S. wasters from marine vessels and transport container systems. The approach is divided into three phases: (1) background research, to identify and evaluate existing techniques and new concepts; (2) problem definition, including alternate approaches, technical requirements, development costs, and schedule; and (3) hardware development, including specification development, design and model development, model testing, prototype development, full-scale testing, operational testing, and final specifications and handoff. Background research and problem definition are completed. Hardware development is completed for vapor reduction device, foam plugging device, and evacuated foam plugging device. Pumping systems for off-loading stricken vessels is being tested and evaluated. Development was initiated for temporary storage systems, including flexible and rigid containers and evaluating underwater television system for vessel damage assessment.
Keywords: hazardous materials; maritime transport; chemical effluents; containers; seawater; surface waters; estuaries; water pollution control; ships.

67006 Detonation Arrester Devices for Gasoline Cargo Vapor Recovery. Bjorklund, R. (California Institute of Technology, Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena, CA, 41103). **Project number:** 3304-01-03-4. **Contract:** MIPR 74328-A. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$400,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to find a device which will halt a detonation propagating in a fuel/air mixture within a pipeline. **Keywords:** pipelines; detonation waves; wave propagation; inhibition; gasoline; maritime transport; storage facilities; emission.

67007 Investigation of Hazards Posed by Chemical Vapors Released in Marine Operations. Bass, R.L. (Southwest Research Institute, P.O. Drawer 28510, San Antonio, TX, 78284). **Project number:** 3309.08.01.1. **Contract:** DOT-CG-904571-A. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$200,000.
Related energy source: oil and gas(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective is to collect data and to develop math models concerning worker exposure to toxic and hazardous vapors on board chemical tankers. The methods employed are: (1) background study, (2) math modelling, (3) development of experimental program, (4) data collection, (5) revision of math models, and (6) hazard assessment of the industry.
Keywords: chemical effluents; aquatic ecosystems; data acquisition; occupational safety; personnel; mathematical models; hydrocarbons; plumes; air pollution; terminal facilities; storage facilities; ships; maritime transport; environmental impacts.

67008 Natural Energy Sources: Low Powered Aids to Navigation. Pike, C.D. (U.S. Coast Guard, Washington, DC, 20591). **Project number:** 2705. **Supported by:** Coast Guard, Washington, DC (USA). **Funding:** DOT.
Related energy source: solar(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective of this project is to develop a power source which utilizes solar photovoltaic energy to power Coast Guard aids to navigation. The approach taken to achieve the objective has been to evaluate various candidate systems under laboratory controlled conditions. From those candidate systems the most promising system was then deployed in the field for a field test and as a demonstration of its utility. It is expected that the present field tests plus proposed field tests combined with ongoing laboratory analysis will provide a viable solar photovoltaic power supply system to power all Coast Guard minor (12-volt) aids to navigation.
Keywords: ships; navigational instruments; photovoltaic power supplies; us coast guard; evaluation.

67009 Vapor Cloud Explosion Study. Lind, D. (Naval Weapons Center, China Lake, CA, 93555). **Project number:** 3302.03.01.3. **Contract:** MIPR-34095/816817. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$85,000; AGA-$300,000; DOE-$65,000.

Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objectives are: (1) to study LNG/LPG burning characteristics and vapor dispersion when released onto water; and (2) to study the detonatability of these gases. The methods used are: (1) unconfined detonation tests, (2) pool burns of LNG/LPG, and (3) vapor cloud dispersion. Pool burns/cloud burns produced visual and thermal flux data on behavior of LNG/LPG fires, and several attempts at unconfined detonation of LNG were completed. These included high explosive initiated tests, FAE tests, detonation tube tests, tests with the fuel mixture varied (methane-higher hydrocarbons), and tube-to-hemisphere tests attempting to transition a detonation from confined to unconfined. In addition, LNG monitoring instruments were tested in four vapor dispersion tests. Several reports detailing the various results are in process.

Keywords: liquefied natural gas; liquefied petroleum gases; combustion properties; vapors; gases; water; diffusion; air pollution; detonations; hydrocarbons; safety; risk assessment.

67010 Monitoring of LNG Vapor, Phase II: Four Band Differential Radiometer. Conley, J.M. (Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA, 91103). **Project number:** 3302.03.01.7. **Contract:** MIPR-822868-A. **Supported by:** Coast Guard, Washington, DC (USA). **Funding:** DOT; GRI; NASA/DOE.

Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to develop and test a prototpype four-band differential radiometer capable of field concentration measurements of methane, ethane, and propane resulting from spills of LNG onto water and land. Following prototype testing, FBDRs will be assembled and calibrated in field for use in DOE LNG spill test projects. Phase I has been completed, and Phase II, sensor prototype FBDR, is near completion. These instruments will allow fast response concentration measurements of LNG as it disperses. Results will be used in the development of predictive models.

Keywords: gas spills; vapors; monitoring; liquefied natural gas; water pollution; land pollution; methane; ethane; propane; radiometers; performance testing.

ENVIRONMENTAL PROTECTION AGENCY

70500 Recovery Studies of Pesticides for Surface and Drinking Waters. McGrath, T.F. (Susquehanna Univ., Selinsgrove, PA, 17870). **Project number:** A614-41. **Contract:** R805472-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

This project involves acquisition of accuracy and precision data for a variety of organochlorine and organophosphorus pesticides from drinking water and surface water. The official EPA methods, using liquid-liquid extraction and gas chromatographic (electron capture and flame photometric) analysis will be employed. Forty-two compounds, selected on the basis of either their inclusion in the EPA or because of their current interest to the EPA and the public, will be studied. Data on 33 compounds have been obtained.

Keywords: organic chlorine compounds; organic phosphorus compounds; drinking water; surface waters; us epa; solvent extraction; gas chromatography; photometry; pesticides; monitoring; water pollution; accuracy.

70501 Optimization of the LLE Method for the Analysis of Volatile Halides in Drinking Water. Glaze, W.H. (North Texas State Univ., Box 13707, Denton, TX, 76203). **Project number:** A614D-01. **Contract:** R805472-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to develop, optimize, and test a simple liquid/liquid extraction technique for the analysis of volatile organohalides contained in drinking water at the microgram per liter level. Each parameter of the method is being studied to find how slight variations affect the accuracy and precision of the method. Actual water samples are also being analyzed to determine the accuracy and precision of the optimized method. All of the method parameters have been optimized.

Keywords: drinking water; volatility; accuracy; sensitivity; halogenated aliphatic hydrocarbons; halogenated aromatic hydrocarbons; quantitative chemical analysis; solvent extraction; water; chemical analysis.

70502 Evaluation of Flameless and Hydride Generation Atomic Absorption Methods for Arsenic and Selenium. Kinard, J.T. (Benedict College, Harden and Blanding Streets, Columbia, SC, 29204). **Project number:** A622B-03. **Contract:** R805237-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This research comprises a comparative study of leading methods for the determination of arsenic and selenium, and serves to demonstrate the applicability of each for complex matrices that exist for samples such as industrial and domestic effluents. By utilizing the techniques of flame and flameless atomic absorption spectrophotometry, it should be possible to effect the appraisal of various sample pretreatment procedures including the Parr acid digestion bomb technique for the determination of total arsenic and selenium in effluents charged with a variety of their organic and inorganic species. Kinard will study the procedures for the digestion of effluents containing various inorganic and organic arsenic and selenium. He will also study the five existing methods for the determination of these elements and provide precision and accuracy data for each. During the past budget period, Kinard evaluated the flameless atomic absorption method for the determination of arsenic and selenium. He studied the instrument setting and the working ranges, obtained recovery data, and determined the relative standard deviation for these elements. He has also evaluated the furnaces method for the determination of arsenic and selenium.

Keywords: arsenic; selenium; absorption spectroscopy; accuracy; sensitivity; comparative evaluations; quantitative chemical analysis; water pollution.

70503 Evaluation of the Dionex Ion-Exchange Chromatograph for Natural Water Sample Analysis. Schlueter, A. (Central State University, Department of Chemistry, Wilberforce, OH, 45384). **Project number:** A622B-04. **Contract:** R805329-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The principal objective of this research is to evaluate the analytical capability of the Dionex ion exchange chromatograph. This instrument has the potential for determining simultaneously, in a single step, the concentrations of many ions that would otherwise require hours of laboratory work. This project will initially concentrate on using the Dionex instrument to separate and detect the anions typically found in natural water. As work on anion analysis progresses, studies of alkali and alkali-earth metal will begin.

Keywords: ground water; surface waters; ion exchange materials; chromatography; quantitative chemical analysis; water quality; sampling; water; hydrocarbons.

70504 Preservation and Determination of Cr(III) and/or Cr(VI). Duhart, B.T. (Univ. of Arkansas, Pine Bluff, AR, 71601). **Project number:** A622B-47. **Contract:** R805877-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop a procedure for the preservation of Cr(III) and Cr(VI). The analytical techniques used will be atomic absorption spectroscopy and differential pulse polarography. Samples will be measured before and after spiking with reagents. Periodic measurements will also be obtained to indicate the degree of preservation. Duhart has evaluated the methods for determining Cr(III) and Cr(VI).

Keywords: chromium; polarography; absorption spectroscopy; valence; quantitative chemical analysis; preservation; coal; combustion; water pollution.

70505 Continuous Montoring of Total Dissolved Gas Pressure. Daoust, B.G. (Virginia Mason Research Center, 1000 Seneca Street, Seattle, WA, 98101). **Project number:** A625C-14. **Contract:** R804175-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$36,000.

Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective of the project is the further development of simple, inexpensive instrumentation using the existing principle of a diffusion membrane and electronic pressure transducer to measure and record total dissolved gas pressures. Alternatives for membrane materials, configuration and mechanical interfaces and signal analysis will be explored, constructed and field tested. Three systems for measuring dissolved gases in water have been constructed and field tested.

Keywords: monitoring; water quality; hydroelectric power plants; fishes; thermal effluents; mortality; nuclear power plants; environmental impacts.

70506 Development of Oil in Water Monitor. Silvus, H.S. (Southwest Research Institute, 8500 Culebra Road, San Antonio,

TX, 78228). **Project number:** A625C-51. **Contract:** R805817-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$60,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop an oil-in-water device that will provide monitoring of wastewaters from treatment processes involved in coal liquefaction, shale oil recovery plants, and in petroleum refineries, with the combined use of reverse phase liquid chromatography and optical fiber technology.
Keywords: waste water; monitoring; water pollution monitors; hydrocarbons; coal liquefaction; oil shale processing plants; petroleum refineries; design; fabrication; testing; chromatography; fiber optics.

70507 ND Thiocyanates in Wastewater. Coulson, D. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** A801-05. **Contract:** 68-03-2388. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop and evaluate analytical methods for total cyanide and thiocyanate. The literature will be reviewed and the most promising technique will be selected for evaluation and further development. The technique will be evaluated on a variety of wastewaters. The literature review is complete.
Keywords: quantitative chemical analysis; cyanides; thiocyanates; waste water; water pollution.

70508 Secretariat Activities of International Standards Organization Technical Committee 147 on Water Quality. Resnick, I. (American National Standards Inst., 1430 Broadway, New York, NY, 10018). **Project number:** A801-62. **Contract:** R805706-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide support for conducting the Secretariat of the International Standards Organization (ISO) Technical Committee (TC) 147 on water quality which is developing international standards. The TC 147 scope is standardization in the field of water quality, including definition of terms, sampling of waters, measurement, and reporting of water characteristics; limits of acceptability for water quality are excluded. Activities include standardization in chemical, physical, radiological, microbiological, biological, and biochemical methods. Forty-five countries are members of ISO/TC 147 which was organized in 1972. Fourteen drafts of proposed standards have been developed, and 42 working groups which are preparing drafts of international standards have been established.
Keywords: water quality; international organizations; standards; monitoring; sampling; chemical analysis; planning; recommendations.

70509 Validation of Analytical Methodology for Implementation of EPA Regulations on Toxic Substances. Beroza, M. (Association of Official Analytical Chemists, Box 540, Benjamin Franklin Station, Washington, DC, 20044). **Project number:** A801-63. **Contract:** R805829-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to validate selected methods for the analysis of toxic substances. Using the established protocols published in the Statistical Manual of the Association of Official Analytical Chemists, methods will be submitted to a number of collaborators to determine the performance capabilities of the methods. To date, method selection is complete.
Keywords: toxic materials; manuals; quality assurance; quantitative chemical analysis; monitoring; air pollution; water pollution; land pollution; standards.

70510 Continuing Analyses of All Quality Control and Performance Evaluation Samples. Clements, H. (EPA, 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** A801-64. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to make available quality control and performance evaluation samples to supply OWHM programs. Minerals, nutrients, trace metals, LAS, NTA, chlorophyll, pesticides, PCB's purgeables, herbicides, base neutral extracts, acid extracts, and other samples that have been produced for the OWHM programs have been analyzed. A supply of quality control and performance evaluation samples is available. This is a continuing process.
Keywords: quality control; performance; evaluation; water pollution; minerals; metals; trace amounts; nta; chlorophyll; pesticides; aromatics; organic chlorine compounds; herbicides; sampling; water pollution.

70511 Techniques for Handling Emulsions and Solvent Concentrations in Priority Pollutant Analyses. Zweidinger, R. (Research Triangle Inst., P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** A801-66. **Contract:** 68-03-2759. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop analytical technology to cope with emulsions formed during analysis of wastewaters from the soap and detergent industry. Alternatives to shakeout extraction and purge-and-trap will be evaluated to overcome emulsion problems. Techniques will be evaluated for concentrating extracts to extend wastewater methods to achieve drinking water sensitivity requirements. The contractor has evaluated emulsion control chemicals and is studying design factors of continuous extractors.
Keywords: soaps; detergents; industrial wastes; waste water; emulsions; waste processing; demulsification; water treatment.

70512 Evaluation of Proposed Test Procedures for Organic Pollutants in Wastewater. Northington, J. (West Coast Technical Service, Inc., 17605 Fabrica Way, Suite D, Cervitos, CA, 90701). **Project number:** A801-67. **Contract:** 68-03-2697. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide quick turnaround methods evaluation support for agency through EMSL. Where candidate methods may be suitable for monitoring parameter work, directive will be issued to verify applicability on specific waste to define the quality method limitations. First work directive has been assigned: the evaluation of proposed test procedures for wastewaters from 17 pesticide manufacturers. Other work directives will follow.
Keywords: pesticides; waste water; water pollution monitors; measuring methods; chemical analysis.

70513 Development of Analytical Test Procedures for Organic Pollutants on Wastewaters. Going, J.E. (Midwest Research Inst., 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** A801-69. **Contract:** 68-03-2711. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide quick turnaround methods development support for agency through EMSL. Work directives will initiate methods development project to suit needs. The first work directive assigned involves the development of test procedures for pesticides in manufacturing wastewaters.
Keywords: waste water; organic compounds; pesticides; monitoring; water pollution; chemical analysis.

70514 Determination of Pesticides on PCBs in Municipal Sludges. Johnson, D.E. (Southwest Research Inst., 8500 Culebra Road, San Antonio, TX, 78228). **Project number:** A801-70. **Contract:** 68-03-2606. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop survey procedures for pesticides and PCBs in sludges. The approach will be to optimize extraction and cleanup procedures for sensitive GC/MS analysis. The laboratory work for this project has been completed. The final report has been delayed to allow for the inclusion of additional followup research results.
Keywords: pesticides; aromatics; organic chlorine compounds; sewage sludge; gas chromatography; mass spectroscopy; extraction; quantitative chemical analysis.

70515 Application and Evaluation of Analytical Procedures for Metals, Cyanide, and Phenolics. Lu, D. (Biospherics, Inc., 4928 Wyaconda Road, Rockville, MD, 20853). **Project number:** A801-73. **Contract:** 68-03-2714. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectve is to evaluate existing promulgated test procedures for metals, cyanides, and phenolics. The approach is to collect industrial waste samples for applicable types, analyze them by existing methods, and determine accuracy, precision, and matrix effects for these wastes.
Keywords: metals; cyanides; phenols; industrial wastes; chemical analysis; quantitative chemical analysis; evaluation.

70516 Development and Evaluation of Analytical Test Procedures for Priority Pollutants. Monteith, C.S. (Gulf South Research Inst., P.O. Box 26518, New Orleans, LA, 70186). **Project number:** A801-75. **Contract:** 68-03-2779. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

Methods for the preservation and analysis of phenolics and cyanides in sediments, sludges, fish, microinvertebrates, algae, soil, vegetation, mining slag, and fly ash will be identified, optimized, and verified with environmental samples. A literature search will be conducted followed by preliminary screening, followed by modification and optimization. Actual samples will be used to verify the applicability of the methods to solid and semisolid samples of environmental importance. A literature search is in progress.
Keywords: phenols; cyanides; sediments; sludges; fishes; invertebrates; algae; soils; plants; slags; fly ash; reviews; measuring methods; chemical analysis; monitoring; biological materials; environmental materials.

70517 Laboratory Automation Support. Ryan, D. (Univ. of Cincinnati, 3333 Vine St., Cincinnati, OH, 45221). **Project number:** A801-77. **Contract:** GS-055-10458. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide computer program support for the laboratory automation project. The approach taken is to generate functional specifications for automated instruments, and to develop computer programs and program documentation.
Keywords: computer codes; automation; pollution; chemical analysis; measuring instruments; specifications.

70518 New Approaches to the Preservation of Contaminants in Water Samples. Saxena, J. (Syracuse Research Corp., Merrill Lane, Syracuse, NY, 13210). **Project number:** A801-78. **Contract:** R804609-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to devise a new, more effective and pollution-free method of preservation of water/wastewater samples. Antibiotics and bacteriolytic enzymes will be studied for controlling microorganisms and subsequently biochemical changes of pollutants. Final report has been approved and submitted for publication in envrionmental monitoring series.
Keywords: water; waste water; sampling; preservation; antibiotics; enzymes; microorganisms; contamination.

70519 Repository Services for Priority Pollutants, Toxic Pollutants, and Chromatography Supplies. Rosebrook, D.D. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** A801-79. **Contract:** 68-03-2765. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to establish a repository for organic priority pollutants, toxic and hazardous materials, and chromatography supplies. Radian Corporation will initiate and maintain a program for the procurement, synthesis, quantitation, purification, repackaging, and distribution of standards and reference materials to federal, state, local, governmental, and commercial laboratories engaged in water/wastewater analysis.
Keywords: waste disposal; hazardous materials; waste management; research programs; water; waste water; chemical analysis.

70520 Method Validation Study for Priority Pollutants. Johnson, D. (Southwest Research Inst., 8500 Culebra Road, San Antonio, TX, 78228). **Project number:** A801-81. **Contract:** 68-03-2606. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of this program is to conduct formal method validation studies which will define the precision and accuracy of the analytical methods for the following organic pollutants: phthalate esters, pesticides, PCBs, and nitrosamines. Accuracy and precision of the analytical procedure will be determined by interlaboratory analyses (20 labs) of water samples spiked with unknown concentrations of the pollutants specified. Interim analytical methodology has been developed which must be approved before the interlaboratory study begins.
Keywords: pesticides; aromatics; organic chlorine compounds; phthalates; phthalic acid esters; chemical analysis; accuracy; errors; water; sample preparation; nitroso compounds; amines.

70521 Development of Criteria for Evaluation of Microbiological Media and Membrane Filters. Wells, F. (Midwest Research Inst., 425 Volker Blvd., Kansas City, MO, 64160). **Project number:** A801-82. **Contract:** 68-03-2628. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop criteria for evaluation of media and membrane filters used in the enumeration of total coliforms, fecal coliforms, and fecal streptococci in waters/wastewaters. The approach taken is the development of a system of protocol, criteria, and acceptance limits for evaluating the performance of membrane filter culture media, MPN culture media, and membrane filters and pads. Phase II will consist of trial testing of the protocol. Phase I has been completed and a report is being written.
Keywords: membranes; filters; coliforms; feces; streptococcus; performance testing; waste water; water pollution monitors; detection.

70522 Development of Analytical Test Procedures for the Measurements of Organic Priority Pollutants in Sludge and Sediments. Haile, C.L. (Midwest Research Inst., 425 Volker Blvd., Kansas City, MO, 64114). **Project number:** A804-26. **Contract:** 68-03-2695. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of this program are to develop a screening protocol for compounds by GC/MS, and to apply specific approaches by chemical class using conventional GC and CC approaches. The approach is to optimize extraction and cleanup procedure to extend GC/MS sensitivity, and to supplement monitoring of specific pollutants with conventional chromatographic equipment. Emphasis has been placed on the evaluation of a unified approach for sludges to respond to agency needs for a screening protocol for a major plant survey.
Keywords: organic compounds; gas chromatography; mass spectroscopy; extraction; sensitivity; sludges; sediments; water resources; chemical analysis.

70523 Development and Application of an Ozone Voltammetric Membrane Electrode. Mancy, K.H. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** A824-01. **Contract:** R804834-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The purpose of this project is the development and application of a membrane electrode system capable of in-situ measurement of dissolved ozone. Because of the utilization of ozone as an alternative to chlorine in water and wastewater treatment processes, there is need for such a sensor system. Through a knowledge of electrode systems, such a sensor will be developed. Two electrode systems were developed during the first year of the grant. The first system is a manual, hardwired system allowing the measurement and display of electrode current for a fixed set of pulse parameters. The second system is microcomputer-controlled and allows the automated measurement of electrode current over prespecified ranges in pulse parameters. This second system overcomes many of the manual system's limitations and extends its capabilities. The design and construction of an ozone membrane electrode capable of potentiostatic control has been completed. This electrode has been used for steady state measurement as well as the investigation of pulse techniques.
Keywords: ozone; voltametry; water; waste water; water treatment.

70524 Develop and Distribute Performance Evaluation Samples in Support of FWPCA Amendments, Safe Drinking Water, and Toxic Substance Control Acts. Clements, H. (EPA, 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A859-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate the availability of performance evaluation samples for compounds on the priority pollutant list and for other trace organics of interest to the agency. The approach is to produce and distribute six series of samples for phthalate esters, purgeables, compounds, and base neutral extracts. Samples available for phthalate esters, selected purgeables, and selected base neutrals have been evaluated.
Keywords: phthalic acid esters; drinking water; monitoring; water pollution; availability; evaluation; trace amounts; organic compounds; toxicity.

70525 Develop and Distribute Sample Series in Support of Water Supply Laboratory Certification. Clements, H. (EPA, 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** A859-02. **Sup-**

ported by: Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA. **Related energy source:** general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to ensure the availability of performance evaluation samples for water supply program. Performance evaluation samples will be designed, developed, and produced. An adequate supply of chemical water samples for eight trace metals, nitrate/fluoride and residual chlorine has been prepared. **Keywords:** chemical analysis; certification; water; evaluation; elements; trace amounts; nitrates; fluorides; chlorine; water resources.

70526 Method Validation Studies for Priority Pollutants. Kinzer, G. (Battelle Memorial Inst., Columbus, OH, 43201). **Project number:** A859-05. **Contract:** 68-03-2624. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to conduct formal method validation studies which will define the precision and accuracy of the analytical methods developed by the Quality Assurance Branch, EMSL-Cincinnati, for the measurement of organic priority pollutants. Battelle Columbus Laboratories will be concerned with the analytical methodology developed for the following type of compounds: polyaromatic hydrocarbons, nitrobenzene and isophorone, and benzidines. Accuracy and precision will be determined by interlaboratory analysis of water samples spiked with unknown concentrations of the priority pollutants of interest. Ampul concentrates for spiking the waters have been produced, twenty laboratories were selected for prticipation in the study, and interim analytic methodology was received.
Keywords: accuracy; measuring methods; polycyclic aromatic hydrocarbons; nitrobenzene; organic compounds; benzidine; water; chemical analysis; water pollution monitors; water pollution.

70527 Method Validation Studies fo Priority Pollutants. Hall, J. (Hydroscience, Inc., 9041 Executive Park Dr., Knoxville, TN, 37919). **Project number:** A859-06. **Contract:** 68-03-2625. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to conduct formal method validation studies that will define the precision and accuracy of the analytical methods, developed by the Quality Assurance Branch, EMSL in Cincinnati, for the measurement of organic priority pollutants. Hydroscience, Inc., will be concerned with the analytical methodology developed for chlorinated hydrocarbons and phenols. Accuracy and precision will be determined by interlaboratory analysis of water samples spiked with unknown concentrations of the priority pollutants of interest. Twenty laboratories have been selected. The method study will proceed upon receiving approved analytical methodology.
Keywords: organic chlorine compounds; hydrocarbons; phenols; accuracy; chemical analysis; laboratories; comparative evaluations; quality assurance; water pollution; monitoring.

70528 Performance Evaluation of Water Supply Laboratories. Britton, P. (26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A859-07. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate EPA regional, state, and intrastate laboratories for all parameters under NIPDWR as part of the certification program. The approach is to conduct formal studies using unknown samples to participants, evaluate results against true values and performance limits generated from previous data, and provide a working computerized test system with reports to participants and management. Results to date are the completion of annual performance evaluations of EPA and state laboratories and some intrastate laboratories as required by certification program.
Keywords: laboratories; evaluation; regional analysis; us epa; performance; state government; monitoring; water pollution; air pollution.

70529 Development of Improved Enumeration Methods Based on Physiological Studies of Indicator Bacteria Debilitation in Natural Waters. McFeters, G.A. (Montana State Univ., Dept. of Microbiology, Bozeman, MT, 59715). **Project number:** A884-09. **Contract:** R805230-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) to develop improved methods for enumerating stressed indicators and pathogens in natural waters; (2) to obtain the physiological data necessary to define the course of bacterial debilitation; and (3) to recommend procedures to improve survival. This information is urgently needed to improve compliance monitoring, pathogen recovery, and enumeration techniques. The approach will be to study physiologic functions of cells injured by exposure to aquatic environments. The in-situ field studies will use MSU diffusion chambers. Injury will be determined by observed differences on selective and enriched media. Research will measure changes in physiologic functions as well as nucleic acid ribosome and protein synthesis, enzyme structure and activity, membrane structure, and cell division. Progress reports indicate that environmental stress alters the cell envelope observed by electron microscopy. The following diluents promise improved recovery: 1% nonfat dry milk, 1% peptone, phosphate buffer, and 1% mg SO4.
Keywords: bacteria; measuring methods; water pollution monitors; biological indicators; biological stress; physiology; pathological changes; survival curves.

70530 Development of Methods for the Detection and Inactivation of Viruses in Various Waters. Shuval, H.I. (Hebrew Univ. of Jerusalem, P.O. Box 499, Jerusalem, Israel). **Project number:** A884-32. **Contract:** R803510-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The overall objectives of this project are to develop further and to refine efficient, rapid, and inexpensive monitoring methods for the detection and quantitative assay of low levels of viruses in large volumes of water and wastewater, and to evaluate various promising virus monitoring and detection methods by standardized and controlled procedures. A number of the most promising virus monitoring and detection methods will be evaluated by standardized and controlled procedures with the aim of identifying the most effective method or methods for routine monitoring operations. Also, studies will be designed to improve, test, and compare new monitoring methods and to develop a rapid procedure for detecting viruses by the use of the fluorescent antibody method. Results to date are: (1) development of the organic flocculation procedure for secondary concentration of viruses in environmental waters and solids; (2) evaluation of capillary ultrafiltration as a method for the concentration of viruses from water; and (3) development of a modified fluorescent antibody viral quantitative assay.
Keywords: viruses; water pollution monitors; measuring methods; comparative evaluations.

70531 Methodology for Concentration, Recovery and Identification of Viruses. Beng, G. (EPA, Environmental Monitoring and Support Lab., 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A884-30. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to develop procedures for the detection and quantification of viruses in water and associated media. Rapid efficient field methods are sought for recovering virus in a concentrated form ready for shipment to a central laboratory for assay. Identification procedures and more sensitive cell lines will also be sought. The methods and procedures developed should allow studies in health effects and transport and fate and monitoring activities to be conducted rapidly and effectively. Effective systems for recovering small amounts of viruses from large volumes of water will be developed so that a standardized methodology can be promulgated for detecting all viruses that man contacts. Methods will be developed for recovery and concentration of viruses from solids in water and sewage. In line with these goals, a USEPA Methods Manual for Virology will be drafted which will include the more commonly used virus monitoring techniques for water-bone viruses.
Keywords: viruses; sampling; water pollution; measuring methods.

70532 Development of Field Virus Concentration Technology. Sorber, C.A. (Univ. of Texas, San Antonio, TX, 78285). **Project number:** A884-31. **Contract:** R804474-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The overall objective of this study is to optimize a flow-through virus adsorbing filter media system for recovering small numbers of viruses from large volumes of water. A high rate system, capable of concentrating and recovery of particulate associated as well as free viruses from at least 100 gallon volumes of a variety of waters, is sought. Efforts will concentrate on: (1) continued evaluation of candidate filter systems capable of providing a sustained high flow rate in conjunction with the use of diatomaceous earth virus concentration procedure; (2) evaluation of each candidate filter media system in terms of the optimal virus elution system required; (3) upgrading of successful prototype filter-elution systems so that minimum test volumes of 100 gallons can be processed; and (4) field

testing in a variety of waters. The use of bentonite as a virus adsorbent for a high volume flow-through virus concentration procedure was abandoned. This was necessitated by the lack of a filter system capable of maintaining its integrity under high flow conditions. However, diatomaceous earth has been shown to be an effective alternative to bentonite as a virus adsorbent. A prototype system designed to use diatomaceous earth has been developed and tested successfully.
Keywords: viruses; removal; water; adsorbents; particles; diatomaceous earth; sorptive properties; filters; technology assessment.

70533 Use of Energy Dispersive X-Ray to Monitor Heavy Metals in Water. Carlton, T. (Magnavox Govt. and Industries Electronics Co., 1313 Production Rd., Fort Wayne, IN, 46808). **Project number:** A884-40. **Contract:** 68-03-2523. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to (1) develop automated sample and control module, filter paper for presentation to the Magnavox-EDAX x-ray system; (2) develop sample pretreatment function; (3) develop alternative filter paper; and (4) develop a computer/transmitter integrated with the XRF system. The XRF has been delivered; the computer/transmitter is under contract.
Keywords: x-ray fluorescence analysis; water; filters; paper; x-ray fluorescence analyzers; metals; water quality.

70534 Assemble and Test Automatic Wastewater Sample Gathering Subsystems. Shelley, P.E. (EG and G, Inc., Washington Analytical Service Center, 2150 Fields Road, Rockville, MD, 20850). **Project number:** A884-41. **Contract:** 68-03-2470. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to automatically acquire effluent samples for lab analysis. Several automatic sampler systems for collecting waste samples acquired from off-the-shelf have been investigated at the Canadian Inlet Waters Research Laboratory to determine whether samples acquired were representative. The tests performed were controlled, and presently the data are being statistically analyzed. The systems tested were generic types including: low speed and high speed peristaltic pumps; high speed vacuum; pneumatic ejection; and medium speed peristaltic pump. Automatic samplers can acquire samplers for most any project, regardless of environment, in the aquatic medium. Selected applications, however, require special functions.
Keywords: waste water; sampling; automation; samplers; testing; water.

70535 Development and Application of Test Procedures for Specific Organic Substances. Fluegle, R. (Carborundum Co., Buffalo Avenue, P.O. Box 337, Niagara Falls, NY, 14302). **Project number:** A884-43. **Contract:** 68-03-2635. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this program is to develop monitoring methods for dioxin, purgeables, and acrolein. The approach is to optimize chromatography, extraction, preservation, and cleanup and evaluate method on wastewater. Candidate test procedures have been selected and are being evaluated for applicability to wastewaters.
Keywords: organic compounds; monitoring; acrolein; dioxin; chromatography; extraction; preservation; waste water; chemical analysis.

70536 Automated Low-Cost GC/MS Protocol for Monitoring Organics in Drinking Water. Boland, P. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** A884-44. **Contract:** R806053-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this proposed work is to develop a cost-effective protocol for monitoring specific organics in raw and finished drinking water at individual water utilities. Specific criteria for the protocol include: initial capital equipment cost of about $40,000, be usable by a laboratory technician, and give quantitative results for a broad range of specific substances. The approach will be to combine SRI's organic screening protocol, developed for the national screening program for organics in drinking water, with a Hewlett--Packard 5992B low-cost gas chromatography/mass spectrometry system. The proposed program will be conducted in three phases. In the initial phase (year 1), SRI would determine the feasibility of the approach and apply the procedures to purgeable organics analysis. Raw and finished drinking water samples would be analyzed and quality control procedures developed. Equipment is installed and operational.
Keywords: water treatment; drinking water; water quality; monitoring; cost; organic compounds; gas chromatography; mass spectroscopy; feasibility studies; quality control.

70537 Prepare an Illustrated Manual for Estuarine Macroinvertebrates. Culter, J.K. (Conservation Consultants, Inc., P.O. Box 35, Palmetto, FL, 33561). **Project number:** A884-47. **Contract:** CA-8-3159-1. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to prepare an illustrated manual for the identification of the 250 species of common estuarine macroinvertebrates. The illustrations will consist of glossy photographic prints of several different views of each species. Each illustration will be labelled and contain a legend with a systematic description (e.g., phylum, class, order, family, genus, and species). The legend will be followed by a list of literature references of taxonomic keys and a detailed description of each species. Key identification traits will be pointed out for each species.
Keywords: manuals; invertebrates; aquatic organisms; images; taxonomy; species diversity.

70538 Prepare Identification Manual for the Rotifers. Gannon, J. (University of Michigan at Ann Arbor, Biological Station, Pellston, MI, 49769). **Project number:** A612A-12. **Contract:** R804652-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of the project is to develop an identification manual for the common species of rotifers in the United States. The grantee will use personal knowledge of rotifer identification and consolidate published information on the taxonomy and ecology of the rotifers to prepare a key for their identification and summarize data on their environmental requirements and pollution tolerance.
Keywords: usa; invertebrates; taxonomy; ecology; data compilation; manuals.

70539 Prepare Identification Manual for North American Freshwater Snails. Burch, J.B. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** A884-50. **Contract:** 68-03-1280. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to prepare a taxonomic key for the identification of (300-plus) known species of freshwater gastropods (snails) found in North America. The key will be illustrated to species and include the following: family and generic diagnoses, distribution maps for each species, habitat preference for each species, a glossary, an extensive bibliography, and taxonomic synonymy. The identification manual will be published as part of the EPA Environmental Monitoring Series.
Keywords: snails; fresh water; aquatic organisms; distribution; maps; habitat; manuals; monitoring.

70540 State-of-the-Art Report on Freshwater Mussel Taxonomy and Ecology. Isom, B. (TVA, Division of Environmental Planning, Muscle Shoals, AL, 35660). **Project number:** A884-51. **Contract:** D7-F1060. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$4,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of the project is to prepare a review of the current status of freshwater mussel taxonomy and ecology. The task will be carried out under an interagency agreement with the Tennessee Valley Authority. The work will be done by experts on mussel taxonomy and ecology on the TVA staff, and by consultants currently under contract with the TVA, who have extensive personal knowledge in this field and who will compile, review, and summarize the literature.
Keywords: usa; aquatic ecosystems; fresh water; molluscs; taxonomy; ecology; data compilation.

70541 Prepare State-of-the-Art Report on Toxic Substances in Aquatic Organisms. McKown, M. (Gulf South Research Institute, Department of Analytical Chemistry, 8000 Gulf S. Res. Inst., Baton Rouge, LA, 70808). **Project number:** A884-52. **Contract:** R805344-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of the project is to determine the current status of methodology for the collection and analysis of aquatic organisms

for bioaccumulation of toxic substances. The principal investigator will search the literature to obtain information on methods of sample collection, preservation, preparation, and analysis for toxic substances. Special emphasis will be placed on the toxic substances listed in the consent decree. The methods will be evaluated and the data on toxic substances will be compiled and coded for computer storage.
Keywords: aquatic organisms; sampling; bioassay; toxic materials; biological accumulation; data acquisition; data processing; data compilation.

70542 Develop Improved Bioassay Techniques. Collins, G. (EPA, 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A884-53. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to develop improved bioassay techniques for measuring toxicity of municipal and industrial effluents, and to develop methods of monitoring toxic substances in surface waters through bioaccumulation by aquatic organisms. The methods will be designed for use by regional and state NPDES programs; permittees and consulting firms to provide data on permit compliance and violations of water quality standards; and the ocean disposal programs and Office of Solid Waste under Sections 301, 304, 308, 311, and 404. The approach is to prepare existing effluent bioassay methods for publication as an amendment to 304(H). Regulations evaluate acute and chronic Daphnia bioassay techniques for use with solid waste leachate, evaluate Skeletonema toxicity test for 301(H) discharges of POTW's to marine waters and compare results of 96 hr and 14 day algal assays, develop calibration standard for the Coulter counter, develop methods or biomonitoring of toxic substances in surface waters through measurement of bioaccumulation of toxics and by caged clams and free-living aquatic organisms, and evaluate methods for measuring the toxicity of influent to sewage treatment plants.
Keywords: municipal wastes; industrial wastes; toxic materials; biological accumulation; aquatic organisms; bioassay; toxicity; solid wastes; leaching; biological effects; standards; algae; calibration; monitoring.

70543 Update and Republish EPA Biological Methods Manual. Collins, G. (EPA, 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A884-54. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to revise and republish the EPA biological methods manual titled, Biological Field and Laboratoruy Methods for Measuring the Quality of Surface Waters and Wastes. The second edition of the EPA biological methods manual will be completed and published by the biology staff with the assistance of the EPA Biological Advisory Committee. The methods will be designed specifically for use in field and laboratory studies related to sections 104, 106, 301, 302, 304, 308, 311, 314, 316, and 404 of Public Law 95-217 (Clean Water Act of 1977), which involve measurements of the toxicity of effluents and the effects of toxic substances and other pollutants on aquatic life. Results to date are the published biological methods manual and the published interim methods for histopathology and effluent toxicity test.
Keywords: surface waters; monitoring; water quality; federal water pollution control act; amendments; liquid wastes; chemical effluents; toxic materials; manuals; bench-scale experiments; corrections.

70544 Improved Methods for Determining Effects of Pollutants on Aquatic Life. Collins, G. (EPA, 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A884-55. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of the research are to develop and/or evaluate and standardize new methods for the collection and analysis of samples and evaluation of data obtained to determine the effects of toxic substances and other point and non-point sources of pollution on aquatic life and to implement and update a computerized data management system. Methods will be selected to support the NPDES program, the national water monitoring system, ocean disposal program, and 208 programs. The approach will be to evaluate and standardize methods to measure benthic oxygen demand; to prepare annual bibliographies for macroinvertebrates, periphyton, and plankton; to prepare annual bibliographies for profiles for common aquatic organisms; and to evaluate sampling methods for macroinvertebrates and periphyton. The master species list for B10-storet will be updated. Reports on environmental requirements and pollution tolerance of diatoms, midges, mayflies, stoneflies, and caddisflies, and identification guides for aquatic insects have been published. A data management system has been implemented.
Keywords: aquatic ecosystems; toxic materials; water pollution; benthos; biochemical oxygen demand; aufwuchs; plankton; invertebrates; monitoring; sampling; chemical analysis; standardization; biological effects; seas; waste disposal.

70545 Equivalency of Analytical Measurement Systems for Pollutant Measurements for Water Quality or Supply. Simon, P. (Environmental Control Technology Corp., 3983 Research Park Dr., Ann Arbor, MI, 48104). **Project number:** A884-58. **Contract:** 68-03-2749. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to evaluate instruments, systems, or methods proposed as alternate analytical techniques and cooperate in equivalency testing programs, as a referee lab, to confirm credibility of submitted data. This program will benefit both our agency and the user of approved methods by providing current state-of-the-art nationwide methods for our monitoring programs. The contractor will compare the proposed instrument, system, or method to the approved method. Equivalency studies are performed on real samples that are significant to the National Pollutant Discharge Elimination System (NPDES) or the National Interim Primary Drinking Water Regulations (NIPDWR). Two task reports have been received for arsenic and selenium in drinking water to be evaluated for nationwide approval. Task three has been submitted to the contractor.
Keywords: quality control; information needs; water pollution monitors; testing; measuring methods; measuring instruments; research programs.

70546 Equivalence of Analytical Measurement Systems for Pollutant Measurements for Water Quality or Supply. Strem, K. (LFE Corp., 2030 Wright Ave., Richmond, CA, 94804). **Project number:** A884-59. **Contract:** 68-03-2748. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to evaluate instruments, systems, or methods proposed as alternate analytical techniques, and cooperate in equivalency testing programs, as a referee lab to confirm credibility of submitted data. This program will benefit both our agency and the user of approved methods by providing current state-of-the-art nationwide methods for our monitoring programs. The contractor will compare the proposed instrument, system, or method to the approved method. Equivalency studies are performed on real samples that are significant to the National Pollutant Discharge Elimination System (NPDES) or the National Interim Primary Drinking Water Regulations (NIPDWR). Two task reports have been received for arsenic and selenium in drinking water to be evaluated for nationwide approval. Task three has been submitted to the contractor.
Keywords: quality control; information needs; water pollution monitors; testing; measuring methods; measuring instruments; research programs.

70547 Monitoring Systems Development for Operation Applications. Lichtenberg, J. (EPA, Environmental Monitoring and Support Lab., 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** A884-61. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$746,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this effort is to provide the most efficient and effective monitoring techniques to meet the need of EPA and related state monitoring programs. This includes the development, selection, modification and adaptation of existing and proposed measurement technology specifically required to identify, characterize and quanitate all environmental pollutants for EPA and state water monitoring programs; the development and adaptation of improved monitoring techniques to improve the cost effectiveness of monitoring operations; and the development of complete monitoring systems designs to establish and maintain the agency's monitoring data bases.
Keywords: monitoring; fresh water; water pollution; measuring methods; measuring instruments; chemical analysis; technology assessment; us epa; state government.

70548 Automation of Quantitative Analysis by GC/MS. Slivon, L. (Battelle Memorial Inst., 505 King Ave., Columbus, OH, 43201). **Project number:** A884-62. **Contract:** CI-78-1004. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a quantitative analysis program for a GC/MS data system. The approach taken is to write the

program, conduct tests on priority quality control sample, and document the results.
Keywords: gas chromatography; mass spectroscopy; automation; quality control.

70549 Laboratory Automation Support. Barton, G. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** A884-63. **Contract:** 79-D-F0085. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of this program is to provide support in laboratory automation. Functional specifications will be generated for automated instruments, computer programs, and computer program documentation.
Keywords: measuring instruments; specifications; automation; computer calculations; laboratory equipment.

70550 Development of Analytical Test Procedures for the Measurement of Elemental Priority Pollutants in Sludge. Anderson, C.B. (Anwal Analytical and Consulting Lab., 3875 Newport St., Denver, CO, 80207). **Project number:** A884-64. **Contract:** CI-79-0119. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide EPA with manual methods for toxic elemental pollutants suitable for analyzing sludges as well as runoff from sludge disposal sites. This study is designed to provide data in a systematic manner to evaluate the adequacy of the test procedures for thirteen metals plus a digestion comparison study.
Keywords: manuals; measuring methods; elements; sludges; pesticides.

70551 Development of a Field Electrode Method for the Determination of Total Sulfide in Water and Wastewater. Wilson, B.L. (Texas Southern Univ., 3201 Wheeler Avenue, Houston, TX, 77004). **Project number:** A884-65. **Contract:** R806230-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective of this project is to establish a simple, reliable method for determiing total sulfide. The sulfide electrode will be evaluated. A field electrode method will be developed for the determination of sulfide in the range of 0.01 to 10 mg/l. The sulfide electrode has been evaluated.
Keywords: sulfides; ion selective electrode analysis; chemical analysis; water; waste water.

70552 Specifications for Automatic Sampling and Monitoring Instrumentation to Enforce Standards for Effluents and Drinking Water. Mentink, A.F. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** A884-66. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$275,000. **Related energy source:** general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to: provide the agency and its cooperators with field instruments for automatic collection and measurement of pollution parameters, such as oil in water, organic carbon, chlorine, sample pretreatment, auto-samplers, metals, suspended solids, data handling systems and other effluent discharge parameters at industrial and municipality effluents; and provide specifications for field instrumentation and automatic samplers. The approach will be to investigate and develop instruments and automatic samplers for water sample measurement and acquisition and develop specifications for field instrumentation--the former performed under controlled laboratory conditions as well as under selected field conditions. Results to date include improved designs provided by manufacturers resulting from a series of reports developed internally by EMSL-CI.
Keywords: drinking water; automation; sampling; hydrocarbons; standards; carbon; phosphorus; petroleum; metals; water quality.

70553 Development and Evaluation of Methods for Microbiological Pollution Indicators and Pathogens in Water. Bordner, R.H. (EPA, 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** A884A-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The research objectives are: (1) to develop and evaluate more rapid, reliable, and precise methods for the detection and enumeration of microbiological indicators and pathogens in water and wastewater; (2) to select and publish the methods acceptable for agency use; and (3) to provide quality control techniques for microbiological methods. The methods developed and selected respond to agency enforcement, monitoring, and research needs. New, improved, or modified procedures are evaluated against standard reference methods using appropriate natural samples and pure cultures. Research includes: new methods for special parameters that may indicate health risk in water supplies or recreational waters, such as Pseudomonas aeruginosa and Salmonella, or that identify pollution problems in domestic and industrial wastes such as Klebsiella. The effects of environmentally-stressed microorganisms upon water quality determinations are studied and procedures for their resuscitation are recommended. Performance characteristics for a method (precision, accuracy, selectivity, sensitivity, and counting range) are reported. Results of this continuing research are published in in-house reports and technical journals. An EPA manual of microbiological methods has been published in December 1978 and will be periodically updated. An evaluation of modified methods for fecal coliforms in chlorinated effluents has been completed and recommendations for improved recovery will be published. A quality assurance program for microbiology prepared for the rural drinking water survey and a more detailed quality assurance program appears in the EPA manual, Microbiological Methods for Monitoring the Environment.
Keywords: bacteria; indicators; water pollution; water pollution monitors; measuring methods; drinking water; comparative evaluations.

71000 Industrial Application of Activated Carbon. Fox, B. (Hydroscience, Inc., 9041 Executive Park Drive, Knoxville, TN, 37919). **Project number:** B601B-T7009. **Contract:** 68-03-2568. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this program is to review current and planned industrial uses of activated carbon for treating wastewaters and emissions from the manufacture of organic chemicals. Data referring to specific pollutants and their removal by carbon will be analyzed and the major design variables for carbon systems will be defined.
Keywords: activated carbon; uses; waste water; water treatment; organic compounds; adsorption; chemical industry.

71001 Emissions. Purcell, R.Y. (IIT Research Inst., 10 West 35th Street, Chicago, IL, 60616). **Project number:** B604B-407. **Contract:** 68-03-2558. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to demonstrate under actual plant conditions several-fold improvements in baghouses collection efficiency by optimizing the operating parameters. The project involves the following phases: (1) development of an experimental test plan based on the location and design features of the selected baghouse, (2) modifications to the baghouse demonstration unit at an asbestos products manufacturing plant, and (3) full-scale field demonstration project to determine best operating conditions. Three field tests need to be performed to establish guidelines for the optimal operation of a baghouse. Ten out of thirteen field tests have been completed to date.
Keywords: baghouses; optimization; design; asbestos; dusts; air pollution control.

71002 Measurements of Volatile Chemical Emissions from Waste Water Basins. Thiobodeaux, L.J. (Univ. of Arkansas, Dept. of Chemical Engineering, Fayetteville, AR). **Project number:** B604B-618. **Contract:** R805534-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this study is to determine the magnitude of both sulfur and organic compounds that escape into the air from wastewater treatment facilities at pulp and paper mills. Both laboratory and field investigations will be conducted. The laboratory study will perfect appropriate water and air sampling techniques by using a laboratory scale biological reactor. The methods developed during this study will then be used to conduct field investigations.
Keywords: sulfur compounds; organic compounds; air pollution; waste water; waste processing; paper industry; industrial plants; gaseous wastes; sampling; air; environmental effects; emission.

71003 Microwave Regeneration for Carbon Regeneration. Bailin, L.S. (Lockheed Missiles and Space Co., Inc., 3251 Hanover Street, Palo Alto, CA, 94304). **Project number:** B604B-715. **Contract:** 68-03-2660. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The principal objective of the program is the technical evaluation of microwaves for regenerating spent or loaded activated carbon in a laboratory scale system. If the results are considered promising, a first or preliminary design for a potential full-scale system will be conducted. This will include equipment and operating costs, process efficiency, and the options possible for the disposal, reuse, or destruction of the organic products removed from the carbon. The principal tasks will include: (1) a review of the literature associated with microwave heating and its application to activated carbon treatment; (2) tests in a laboratory-scale microwave apparatus in which chemically saturated carbon will be heated and the resultant carbon materials evaluated for determination of the efficiency recovery; and (3) preparation of a preliminary design for a potential full-scale system.
Keywords: activated carbon; regeneration; bench-scale experiments; microwave radiation; organic compounds; recovery; waste disposal; feasibility studies; heat treatments.

71004 Chemical Stabilizers for the Control of Fugitive Asbestos Emissions from Open Sources. Kase, P. (IIT Research Inst., 10 West 35th St., Chicago, IL, 60616). **Project number:** B604B-729. **Contract:** R806269-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to evaluate the effectiveness of chemical stabilizers for reducing asbestos emissions from waste dumps and for reducing asbestos emissions from crushed rock prepared from asbestos serpentinite. Screening and laboratory evaluation of commercial stabilizers will be used for further study. Wind tunnel tests will assess the levels of asbestos emissions after samples have been treated with the chemical and then submitted to accelerated weathering through many heat/cold/rain cycles. Effectiveness of chemicals for fugitive asbestos fiber control from unpaved roads will be assessed in a field test carried out on a stretch of a serpentinite rock surfaced road.
Keywords: asbestos; emission; dusts; air pollution control; evaluation; wind tunnels; testing; air pollution abatement.

71005 Activated Carbon for Control of Standard Solvent Vapor: Dry Cleaning Industry. Maines, C. (Scott Environmental Technology, Inc., 2600 Cajon Blvd., San Bernardino, CA, 92411). **Project number:** B604B-928. **Contract:** 68-02-2655. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to obtain data on life of granular activated carbon in petroleum solvent dry cleaning service. The approach is to simulate 1000 absorption/desorption cycles through accelerated laboratory testing.
Keywords: activated carbon; service life; adsorption; desorption; air pollution; petroleum products.

71006 Engineering Assessment of Synthetic Processes in the Pharmaceutical Industry. Drake, H. (PEDCO-Environmental, Inc., 11499 Chester Road, Cincinnati, OH, 45246). **Project number:** B604B-I0106. **Contract:** 68-03-2577. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to quantify priority pollutant discharges from pharmaceutical manufacturers using synthetic processes. The contractor reviewed the list of pharmaceutical producers and developed summary flow sheets for products where possible. Using the developed flow sheets, the potential for discharging priority pollutants was investigated. Approximate discharge rates were indicated where possible. A draft report has been issued and is being reviewed by the Pharmaceutical Manufacturing Association.
Keywords: chemical industry; drugs; manufacturing; stationary pollutant sources; waste disposal; hydrocarbons; monitoring; environmental engineering.

71007 Assessment of Inorganic Solid Wastes. Abrams, E. (Versar, Inc., 6621 Electronic Drive, Springfield, VA, 22151). **Project number:** B604B-I0402. **Contract:** 68-03-2604. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to determine nature and quantities of solid waste generated by the inorganic chemicals industry and estimate which segments of the inorganic chemicals industry will be impacted by proposed RCRA regulations. The contractor will perform the following subtasks: industry characterization, selection of major wastes sources, analysis of selected waste sources, evaluation of treatment and disposal for generated wastes, and economic analysis of the current and projected disposal practices. The study identified six inorganic chemicals industries that are projected to experience high costs of compliance with the proposed RCRA regulations. These industries were: alumina, barium dioxide, zinc oxide, mercury-cell chloralkali, phosphorus, and hydrochloric acid.
Keywords: chemical industry; solid wastes; waste disposal; waste management; pollution regulations; compliance; economic analysis; aluminium; barium oxides; zinc oxides; phosphorus; hydrochloric acid; economic impact.

71008 Volatile Organic Compound Emissions, Rubber Tire Curing. Abrams, E.F. (Versar, Inc., 6621 Electronic Drive, Springfield, VA, 22151). **Project number:** B604B-I0403. **Contract:** 68-03-2604. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to study the development of a conceptual method for capturing olatile organic compound emissions from the curing process of tire manufacturing. The approach will be to: (1) define the problem; (2) determine the physical limitations on design parameters and operational restraints affecting any installation; (3) prepare conceptual designs of equipment and cost estimates; and (4) identify methods of financing capital and operating costs. Draft report was received in April 1979. A new task is planned to evaluate tire curing press.
Keywords: tires; manufacturing; stationary pollutant sources; volatile matter; organic compounds; air pollution control; design; cost; economic analysis; pollution control equipment.

71009 Revise Inorganic Chemicals Assessment. Abrams, E.F. (Versar, Inc., 6621 Electronic Drive, Springfield, VA, 22151). **Project number:** B604B-I0404. **Contract:** 68-03-2604. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to revise and update a nine-volume assessment document entitled Multimedia Assessment of the Industrial Inorganic Chemicals. The approach is to: (1) review the sources and reliability of information in all volumes of the report; (2) identify voids in the data base and provide the correct information; and (3) prepare report according to the approved format by EPA project officer. The report will consist of two main parts: executive summary and the actual assessment report. Technical reviews and collection of additional information is nearing its completion. Selected parts of the data base are being submitted to extramural reviewers.
Keywords: chemical industry; inorganic compounds; information; reviews; technology transfer.

71010 Control Options, Process Changes for Flexible Packaging Emissions. Boies, D. (Wapora, Inc., 6900 Wisconsin Avenue, NW, Washington, DC, 20015). **Project number:** B604B-I0502. **Contract:** 68-03-2580. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to provide a cost analysis for both incineration and activated carbon methods and to conduct a preliminary study of newer technologies which may be employed to reduce the amount of hydrocarbon solvents employed. The approach is to develop data on capital and operation and maintenance costs for incineration and carbon adsorption systems and to provide an analysis of low-solvent and other technologies applicable to flexible packaging processes.
Keywords: air pollution control; emission; adsorption; combustion; activated carbon; organic solvents; waste disposal; economic analysis; comparative evaluations; pollution control; air filters.

71011 R and D Needs in the Asphalt Paving Industry. (JACA Corp., 506 Bethlehem Pike, Fort Washington, PA, 19034). **Project number:** B604B-I0601. **Contract:** 68-03-2582. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objectives of this program are to identify and define the research and development needs for the asphalt paving industry, and to prioritize these needs to aid decision making. The approach is to survey the current and future developments in asphalt paving technology: raw materials used, process technology, and asphalt application on surfaces to be paved. The environmental consequences of each will be assessed.
Keywords: roads; building materials; asphalts; research programs; recommendations; materials handling; technology transfer.

71012 Air Pollution from Wood Preserving Wastewater Evaporation. Carlson, R. (Acurex Corp., 485 Clyde Avenue, Mountain View,

CA, 94042). **Project number:** B604B-I1102. **Contract:** 68-03-2584. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine the amount of organic compounds which end up in the air phase and in the sludge phase when wood preserving wastes are evaporated. The quality of air emissions will be measured both from a constructed bench-scale PAN evaluation system and from a field-test site using the spray evaporation system.
Keywords: waste water; evaporation; air pollution; organic compounds; wood products industry; environmental effects; air quality; bench-scale experiments; field tests; sampling; atmospheric chemistry.

71013 Evaluation of Waterborne Coatings for Wood Furniture. Carlson, R. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B604B-I1104. **Contract:** 68-03-2584. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to display the furniture produced under a previous research program at a market show and to obtain observational data on the quality of the furniture from buyers. The furniture was produced with waterborne coatings. The furniture will be displayed at a market show in High Point, NC, in April 1979. A questionnaire will be produced to elicit responses as to the quality of furniture produced with waterborne coatings versus those pieces produced with conventional coatings. The furniture has been displayed and the questionnaires were filled out by approximately 50 people at the market show in High Point. The final report is now being produced. The research is relevant to energy conservation by substituting water for petroleum-derived solvents.
Keywords: furniture industry; marketing research; energy conservation; solvents; water.

71014 Preparation and Fifteen Status Assessment Reports. Blackwood, T.R. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** B604B-T1002. **Contract:** 68-03-2550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$25,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to review and rewrite draft reports on the status of 15 hazardous chemicals to supply information for OTS. Initial reports on the status of 15 hazardous chemicals prepared by Radian and by Pedco were submitted to MRC to rewrite, supplying additional information if available, and to prepare as final reports consistent with the established format of ORD. Reports have been rewritten and approved and submitted for publication as final reports.
Keywords: hydrocarbons; risk assessment; chemical effluents; air pollution; lead; cadmium; phosphates; mercury; asbestos; benzene; arsenic; aromatics; organic chlorine compounds; organic compounds; ecological concentration; environmental transport; health hazards; biological effects; us epa.

71015 Asbestos Sealant Evaluation. Mireck, W. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** B604B-T2005. **Contract:** CI-76-0238. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to evaluate commercially available, water-base, sprayable liquid sealants for suitability to hold friable, sprayed-asbestos material fibers in place to prevent fiber release into the indoor air in buildings; and to participate in seminars to acquaint responsible school building engineers with corrective action options for friable asbestos problems. The approach is to: (1) solicit candidate materials from manufacturers, screen them, and select ten for tests of impact resistance flexibility, abrasion resistance, and smoke and toxic products emitted when burned; (2) select four of the ten for test application on 10 x 14 foot ceiling area in a building; (3) evaluate the flame spread index of these four; and (4) measure asbestos fiber count in air before, during, and after applying sealant in building. Three materials appear to be satisfactory for the purpose intended, including two of the four applied in a building on this project and one with widespread previous use both in Europe and the United States. Air samples verify the existence of large numbers of invisible asbestos fibers during activities disturbing the asbestos containing materials, and verify the need for protective practices by the workers.
Keywords: asbestos; indoor air pollution; air pollution control; sprays; sealing materials; toxicity; buildings; construction; health hazards.

71016 Discussion Paper: Nylon Production and Emissions. Cooper, L. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B604B-T4015. **Contract:** 68-03-2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to prepare a discussion paper on the nylon industry and participate in the U.S. Economic Commission for Europe Seminar, 15--20 Oct 1978, in Szczecin, Poland. The approach will be to: (1) discuss production of mylon 6, nylon 66, adipic acid, hexamethylenediamine, and capralactam; (2) discuss emissions and technology to control emissions from the production of the above chemicals; and (3) prepare translations of the paper in French and Russian.
Keywords: nylon; industry; environmental impacts; air pollution; emission; production; manufacturing; research programs; technology transfer.

71017 Technical Awareness in the Nonferrous Metals Industry: Pilot Study. Bartlett, E.S. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** B604C-560. **Contract:** R805095-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this project is to provide a continuing survey of the technical literature on environmental and energy issues related to the nonferrous industry and to conduct engineering evaluation of processes which might merit evaluation by the Metal and Organics Chemicals Branch, Office of Research and Development, EPA. Two hundred periodical journals are reviewed on a monthly basis and items pertinent to the subject are removed, abstracted, and subjected to engineering analysis. The relevant items are reported bimonthly in the Technical Awareness Bulletin. The sections that relate this information consist of: Highlights, In The News, Recent Patents, and an indexed Technology and Trends section. Bimonthly bulletins have been printed since October 1977. A summary of the first year's bulletins has also been prepared for general public consumption.
Keywords: metal industry; process control; technology assessment; energy policy; environmental policy; education; data compilation; metals; organic compounds; environmental engineering.

71018 Demonstration of Fugitive Emissions Control for Secondary Lead Smelter. Hudson, P.E. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX). **Project number:** B604C-740. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this program are to retrofit exemplary fugitive emission control technology for secondary lead smelters and to measure the improvement of the ambient air in the workplace and around the plant. The uncontrolled emission rates around the plant were sampled using EPA and NIOSH test methods. After installations of controls, the improvement of the workplace and atmospheric environment will be measured using the same test program. Monitoring and particle size data will be developed. The preliminary characterization of the plant is complete and controls are being designed and installed. A monitoring program is currently underway.
Keywords: lead; smelting; air pollution control; dusts; aerosols; sulfur dioxide; waste management; water pollution.

71019 Fugitive Emission Control Technology Study in Secondary Non-Ferrous Metals. Gideon, J.A. (Dept. of Health, Education, and Welfare, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** B604C-825. **Contract:** D8-0309. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this program are to identify exemplary fugitive emission control technologies that can be used to control work place and atmospheric emissions of heavy metals, and to promote the application of these technologies in the United States. Exemplary fugitive emission control technology has been identified through the literature and through plant visits. A coordinated sampling and analysis program utilizing EPA and NIOSH methods attempted to quantify the emissions rates from this exemplary technology and to evaluate their applicability to the United States. The results of the sampling study are complete and under review. The technologies show that very low levels of ambient lead can be obtained through use of washdowns, properly designed hoods, enclosed and isolated materials storage and handling, and general attention to plant housekeeping.

Keywords: industrial plants; air pollution control; evaluation; pollution control; lead; air pollution; sampling; lead; technology transfer; elements; trace amounts; particles; aerosols.

71020 Cost Estimates for Primaryy Copper Smelter Weak SO2 Stream Control. Gerstle, R. (PEDCO-Environmental, Inc., 11499 Chester Road, Cincinnati, OH, 45246). **Project number:** B604C-110103. **Contract:** 68-03-2577. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) provide cost estimates for control systems based on lime, limestone, magox, and citrate for weak SO2 stream control for a Green Field copper smelter; and (2) provide estimates for pilot plant research on weak stream SO2 control based upon agency experience. Work is completed and reports are being finalized.
Keywords: sulfur dioxide; water pollution control; copper; smelting; chemical effluents; environmental impacts; air pollution control; air quality.

71021 Detection of Insoluble Hazardous Materials on River Bottoms. Kirsch, M. (Rockwell International Corp., Rocketdyne Division, 8900 DeSoto Avenue, Canoga Park, CA, 91304). **Project number:** B610A-693. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$51,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of this project is to develop a portable device to detect denser-than-water, insoluble hazardous materials on the bottoms of water courses. The desired device should be based on commercially available detection techniques and should be simple and rugged enough for use in the field by a technician. It should be capable of detecting a wide variety of inorganic and organic materials. The development will be conducted in four phases: (1) a product screening phase during which the published literature and manufacturer's promotional information will be collected and analyzed to determine the suitability of existing equipment; (2) a device evaluation phase during which high-probability devices identified in the previous phase will be evaluated against representative hazardous materials in the laboratory and in field situations, the best device selected, and modifications to it recommended; (3) a final design and fabrication phase during which the recommended modifications will be performed and a prototype device fabricated; and (4) a field demonstration phase during which the prototype will be field-tested at spills-of-opportunity, to be selected by the project officer.
Keywords: hazardous materials; rivers; sediments; fabrication; design; water pollution control.

71022 Restoring Spill-Damaged Areas: Technique and Identification. Tuffly, B. (Rockwell International Corp., Rocketdyne Division, 8900 DeSoto Avenue, Canoga Park, CA, 91304). **Project number:** B610A-700. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$32,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are the evaluation and application of restoration methods for the enhancement of the rehabilitation rate of hazardous spill damage terrain. A literature survey will be conducted on the natural recovery and on the accelerated restoration of hazardous spill damaged land areas, ponds, small streams, etc. Economic techniques of restoration will be explored and developed. A manual of operating procedures for restoration of hazardous spill damaged areas will be developed. The initial literature survey has been completed. Current citations will be added as acquired. Two greenhouses have been erected and ecological test chambers installed. The first four chemicals selected for study are dichlorobenzene, ethion, aniline, and dieldrin.
Keywords: hazardous materials; accidents; revegetation; biological recovery; land reclamation; cleaning; economics; manuals.

71023 Capsule Reports on Demonstration of Sulfide Precipitation and Centralized Treatment. Minor, P. (Centec Corp., 11800 Sunrise Valley Dr., Reston, VA, 22091). **Project number:** B610B-452. **Contract:** 68-03-2672. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide for wide-scale dissemination of esults of the pollutant reduction techniques that have been examined by MICB/IERL. Capsule reports on the subject techniques will be published. Documents are being drafted and background information obtained.
Keywords: water pollution control; sulfides; precipitation; sulfur compounds; removal; waste processing; information systems.

71024 Treatment of Wastewater from Chromium Plating Lines. Wheeler, C.R. (Seaboard Metal Finishing Co., Inc., 50 Fresh Meadow Rd., West Haven, CT, 06516). **Project number:** B610B-718. **Contract:** S805760-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to demonstrate on an actual chromeplating line a novel electrodialysis system to recover chromic acid from the rinsewater. A prototype electrodialysis-based treatment system will be installed and operated. Membrane life and mass transfer characteristics of the system will be determined. Chromic acid recovery will be optimized through operating and/or design modifications. The use of electrodialysis of chromic acid recovery appears feasible, but optimum operating conditions are still to be worked out. Relative to electrodialysis recovery of other metals, more membrane area is needed for equivalent chrome recovery.
Keywords: chromium; plating; waste water; electrodialysis; chromic acid; recovery; fcasibility studies; membranes.

71025 Development of an Activated Carbon Process for the Removal of Cadmium(II) from Industrial Wastewaters. Huang, C.P. (Univ. of Delaware, Newark, DE, 19711). **Project number:** B610B-730. **Contract:** R805835-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to develop an activated carbon process for the removal of cadmium from industrial wastewater. Three major experiments are to be conducted in the laboratory: (1) batch mode absorption experiments, (2) batch mode generation experiments, and (3) column operation. The information developed under this study will be applied to develop a prototype process for cadmium removal.
Keywords: cadmium; removal; industrial wastes; waste water; activated carbon; sorptive properties; adsorption; waste processing; water treatment.

71026 Effect of Anions on the Precipitation of Heavy Metal Ions from Electroplating Waste. Schumacherg, H. (American Electroplaters Society, Inc., 1201 Louisiana Ave., Winter Park, FL, 32789). **Project number:** B610B-839. **Contract:** R806247-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to determine the effect of various anions on the low settling efficiency of precipitated metallic hydroxides as well as to determine the methods of counteracting any undesired effects. The proposed program involves laboratory screening tests for the effects of anions and field testing of indicated solutions to problems.
Keywords: anions; precipitation; field tests; hydroxides; electroplating; waste processing.

71027 Air Pollution from Municipal Wastewater Sludge Incinerators. Headley, W. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayyton, OH, 45407). **Project number:** B610B-841. **Contract:** 68-03-2670. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

On-site test programs at 6 sludge incinerators will be used to determine if municipal sludge incinerators are a major source of heavy metal emissions. A draft report is being reviewed. Initial results indicated that the incinerators were not significant sources.
Keywords: municipal wastes; sewage sludge; waste water; incinerators; air pollution; environmental impacts; metals; flue gas; chemical effluents; pollution sources; recycling.

71028 Foam Study River Survey. Groves, S. (Maine State Dept. of Environmental Protection, State House, Augusta, ME, 04333). **Project number:** B610B-913. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to chemically determine the compounds responsible for the foaming problem which exists in the Androscoggin River in Maine. The combination of various compounds from pulp and paper mills on the river will be determined. Three river systems will be sampled in 1979 to determine the contribution of foaming compounds from the pulp and paper mills and from naturally occurring substances. Gas chromatography and mass spectrometry will be employed to identify the compounds. Samples have been

taken at Topsham, Maine, below all the pulp and paper industries, to identify the compounds in the foam at that point.
Keywords: maine; rivers; foams; industrial plants; chemical effluents; water pollution; surface waters; gas chromatography; mass spectroscopy; water.

71029 Removal of Priority Pollutant by Filter Aid/Powdered Activated Carbon. Bell, G.R. (Johns Manville Sales Corp., Ken-Caryl Ranch, Denver, CO, 80217). **Project number:** B610B-918. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to evaluate and demonstrate the practical feasibility of use of the filter aid filtration process to remove priority pollutants from industrial plant effluents common to FWPB activities. The approach is to test diatomite filter aid/powdered activated carbon mixtures utilizing both rotary vacuum precoat and pressure precoat filtration techniques with actual wastewaters. It is anticipated that the solids level and priority pollutant level obtainable will dictate the efficiencies and economics.
Keywords: industrial plants; chemical effluents; filtration; activated carbon; diatomaceous earth; waste water; feasibility studies; bench-scale experiments.

71030 Collection and Analysis of Data on Organic Chemicals Industry. Wetherold, R.C. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** B610B-921. **Contract:** 68-03-2776. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

This is a technical assistance type of contract to support several activities within the laboratory. Tasks currently underway include an assessment of high volume solvent usage for the Office of Toxic Substances (OTS), management of the Organic Chemical Producers Data Base (OCPB), and a field sampling program to determine the effectiveness of leak detection and maintenance programs in reducing fugitive emissions of volatile organic compounds (VOC) from synthetic organic chemicals manufacturing facilities. The research is implemented through individual work effort directives for each task.
Keywords: organic compounds; chemical industry; organic solvents; data compilation; hazardous materials.

71031 Centralized Treatment of Metal Finishing Wastes. Minor, P.S. (Centec Corp., 11800 Sunrise Valley Dr., Reston, VA, 22091). **Project number:** B610B-926. **Contract:** 68-01-5052. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The approach will be to identify those cities in the United States which have large concentrations of metal finishing industries. These cities will be contacted and their interest in the program determined. Five cities will be chosen for case studies including the conceptual design of a centralized treatment facility estimating the costs for each of the industrial sites participating.
Keywords: waste processing; industrial wastes; metal industry; urban areas.

71032 Analytical Analysis of Dioxin-Containing Industrial Samples. Tiernan, T. (Wright State University, Dayton, OH, 45435). **Project number:** B610B-942. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The contractor is to analyze, by high resolution GC/MS techniques, 37 samples from the area of a trichlorophenol manufacturing facility for dioxin (total TCDD's). The samples will be prepared by standard procedures at Wright State University and analyzed by GC/MS techniques. Eleven samples have been analyzed and three have been found to contain dioxins in the parts per trillion range.
Keywords: industrial wastes; gas chromatography; mass spectroscopy.

71033 Dioxin Work Program Preparation and Implementation. Devitt, T. (PEDCO-Environmental, Inc., 11499 Chester Road, Cincinnati, OH, 45246). **Project number:** B610B-I0105. **Contract:** 68-03-2577. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop a protocol for assessing the dioxin discharge problem. Contractor was to review all toxicity data, memos, process information, literature, etc., relative to dioxin and develop a protocol for assessing the magnitude of the existing discharge problem and areas requiring control technology research.
Keywords: dioxin; toxicity.

71034 Analytical Support for Amaco Treatability Study. Dryden, F. (Walk-Haydel and Associates, Inc., 762 Baronne St., New Orleans, LA, 70113). **Project number:** B610B-I0304. **Contract:** 68-03-2579. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is the analysis of priority pollutants in sludge and water samples. Analytical techniques such as gas chromatography and mass spectroscopy will be used.
Keywords: sludges; water; chemical analysis; gas chromatography; mass spectroscopy; water pollution.

71035 Laboratory Studies of Priority Pollutant Treatability. Woodward, C. (Walk-Haydel and Associates, Inc., 762 Baronne St., New Orleans, LA, 70113). **Project number:** B610B-I0306. **Contract:** 68-03-2579. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine the best methods of treating priority pollutants found in an industrial waste stream by conducting actual laboratory experiments. The contractor will prepare a proposed work program for the treatment of priority pollutants in an industrial waste stream. This work program will be based on literature and other references. The proposed treatment methods will then be evaluated by actual laboratory experimentation.
Keywords: water pollution control; industrial wastes; chemical effluents; waste processing.

71036 Multimedia Emission Inventory: Wood Treating Industry. Steiner, J. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B610B-I1106. **Contract:** 68-03-2584. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to establish a multimedia emission inventory of discharges from wastewater disposal facilities at wood treating plants. The approach is to: determine present and future business trends; investigate various treatment methods; and document all related projects being conducted or already conducted by EPA.
Keywords: waste water; waste disposal; waste management; industry; wood; hydrocarbons; environmental impacts; chemical effluents; inventories; preservation.

71037 Application of Industrial Wastewater and Residue Recycle/Reuse. Abrams, E. (Versar, Inc., 6621 Electronic Drive, Springfield, VA, 22151). **Project number:** B610B-T0405. **Contract:** 68-03-2604. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to define industrial water recycle/reuse case histories and novel technology in 13 selected miscellaneous and other industries which are known to have a high environmental impact. The approach is to: perform a literature search to determine published sources of information on recycle/reuse of wastewater; analyze all recycle case histories identified; and select up to 6 key industrial applications of recycle/reuse with mini reports on each.
Keywords: waste water; recycling; waste product utilization; industry; environmental impacts; data compilation.

71038 Neutralization/Precipitation Manual of Practice. Clifford, P. (Mitre Corp., 1820 Dolley Madison Blvd., McLean, VA, 22101). **Project number:** B610C-593. **Contract:** R805623-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to assemble in one design manual all the information that relates to neutralization and precipitation of heavy metals from industrial wastes. The manual will be available for public use in upgrading old systems as well as designing new systems to treat acidic and alkaline heavy metal wastes. It includes some discussion of inhouse wastewater minimization, housekeeping, treatment, and waste and sludge handling. The available literature is to be searched and coupled with design practice available from the contractor. This information will be assembled into a design manual with example problems. Wastewater treatment plants have been sampled and the data generated will be used to provide some additional case studies. Four plants have been sampled to provide some general data on plant performance. All literature searches are complete and the manual is near rough draft stage.

Keywords: industrial plants; industrial wastes; waste water; water treatment; water treatment plants; manuals; ph value; precipitation; sludges; design; technology transfer; water resources.

71039 Emission Factors and Control Technology for Fugitive Dust from Mining Sources. Avtell, K. (PEDCO-Environmental, Inc., 11499 Chester Road, Suite 13, Cincinnati, OH, 45246). **Project number:** B610C-941. **Contract:** 68-02-2585. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

This project will develop improved emission factors for fugitive dust from coal mining sources. The initial emphasis of the program is on sources at western coal mines. Existing control technology will be examined for those operations which are identified as significant fugitive dust emitters. Data will be gathered at three mines with twelve sources being tested at each site. These sources are: haul trucks, light and medium duty vehicles, scrapers, dozers, draglines, blasters, overburden drilling, front end loaders, shovel/truck operations, windblown dust from exposed areas, windblown dust from coal piles, and graders. Monitoring methods to be used are exposure profiling and upwind/downwind. A detailed work plan is being developed by the contractor in consultation with a Fugitive Dust Work Group. Data gathering is to begin at the first mine in late July 1979.
Keywords: air pollution control; emission; dusts; coal mining; aerosols; environmental effects; air quality.

71040 Oil SPill Response Scenarios for Remote Arctic and Sub-Arctic Environments. Schultz, L. (Arctec, Inc., 9104 Red Branch Road, Columbia, MD, 21045). **Project number:** B623-678. **Contract:** CI-78-0274. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to assess and document appropriate control and response procedures in remote Arctic areas. This is to be achieved by developing practical, real world operational programs for oil spill response in inland, river, and coastal areas of Alaska. Contract No. 68-03-2799 was awarded to Arctec, Inc., on April 27, 1979. Detailed project plan was submitted and accepted by project officer in June, 1979.
Keywords: oil spills; arctic regions; oil pollution containment; technology assessment; alaska.

71041 Macro Economic Study: Biomass vs. Coal. Mulligan, R.T. (Bechtel Corp., 50 Beale Street, P.O. Box 3965, San Francisco, CA, 94119). **Project number:** B623A-528. **Contract:** 68-02-2616. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The contractor is to compare multimedia environmental impacts and the cost of clean energy generation from the production and utilization of synthetic fuels from biomass, from biomass energy crops, and from coal. A report on pollutant emissions and control technology assessment will address the economic and environmental comparisons of coal use versus synthetic fuels from biomass versus using energy crops directly for energy generation. The completed report has been submitted to the FTB Chief.
Keywords: power generation; synthetic fuels; biomass; energy sources; biomass plantations; environmental impacts; emission; air pollution; water pollution; pollution control; comparative evaluations; coal; cost; socio-economic factors; economic analysis; energy source development.

71042 Distribution of As, Cd, Hg, Pb, Sb and Se During Simulated In-Situ Oil Shale Retorting. Fox, J.P. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** B623A-828. **Contract:** 78-D-X0350. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to determine the fate of As, Cd, Hg, Pb, Sb, and Se during simulated in-situ oil shale retorting; to develop analytical methods for each element in the gas stream; and to determine the distribution coefficients for those elements. This program will determine how the elements As, Cd, Hg, Pb, Sb, and Se are distributed among the spent oil shale, shale oil, retort water, and offgas during simulated in-situ oil shale retorting. This will be accomplished by operating a small laboratory apparatus designed to stimulate in-situ retorting and to minimize sampling and contamination problems. The results obtained with the laboratory apparatus will be corroborated by making similar measurements at the Laramie Energy Research Center (LERC) on larger retorts. Progress has been reported on the process of the mercury analysis.
Keywords: arsenic; cadmium; mercury; lead; antimony; selenium; in-situ retorting; environmental impacts; oil shale industry; transport; oil shales.

71043 Oil Shale Symposium: Sampling, Analysis, and Quality Assurance. Pressey, R. (Univ. of Denver, University Park, Denver, CO, 80210). **Project number:** B623A-831. **Contract:** R806156-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide a forum for the statement of the state-of-the-art in sampling, analysis, and quality assurance of the oil shale industry pollutants, and opinions from governmental and industrial research organizations as to the future needs in these areas. A grant was let to Denver Research Institute to work with EPA in organizing and holding a symposium in which current research topics in the areas of pollutant sampling, analysis, and quality assurance could be discussed. Papers from industry, government, and academic researchers were solicited for presentation and discussion. The symposium was held March 26--28, 1979, in Denver, Colorado. Two-hundred-sixty registered attendees were present and over 45 papers were presented. The proceedings will be available through NTIS.
Keywords: meetings; oil shale industry; pollution; sampling; chemical analysis; quality assurance.

71044 Oil Shale Researchers Listing. Pressey, R.E. (Denver Research Inst., University Park, Denver, CO, 80210). **Project number:** B623A-832. **Contract:** CA-82-961J. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to identify researchers in government agencies, private industry, and academic circles who are presently conducting investigations in oil shale pollutants in: air sampling and analysis, water sampling and analysis, solids sampling and analysis, health effects, ecological and transport effects, and quality assurance. Those identified researchers will be contacted to determine who are willing and able to participate in a planned conference to discuss current research. Sole-source procurement to Denver Research Institute was used to obtain unique experience and contacts in the oil shale area. The contractor assembled from several sources a prospective list and mailed out invitations to speak; calls for papers were generated from this response. Interested researchers mailing list now totals over 3500. Over 50 papers were received for tentative presentation at the Oil Shale Symposium: Sampling, Analysis, and Quality Assurance, March 26--28, 1979.
Keywords: oil shale industry; environmental effects; air pollution; water pollution; health hazards; quality assurance; meetings; personnel.

71045 Environmental Effects of In Situ Gasification of Texas Lignite. Edgar, T.F. (Univ. of Texas, 200 West 21st, Austin, TX, 78712). **Project number:** B623A-848. **Contract:** R806261-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the location, quantity, and quality of lignite in Texas that may be suitable for underground gasification. The application of various gasification technologies will be evaluated for Texas lignites and their environmental impact will be quantified. Modeling of air and water pollutants will be employed, and the evaluation of applicable control technology will be conducted. Work has started on mapping the lignite reserves and also on determining ground water conditions in those areas.
Keywords: coal gasification; in-situ gasification; texas; lignite; environmental effects; site selection; coal reserves; evaluation; air pollution; water pollution; mathematical models; pollution control; ground water; maps.

71046 Proposal to Assess Metal Ion Pollution of Groundwater as a Consequence of Underground Coal Gasification in the San Juan Basin. Walters, E.A. (Univ. of New Mexico, University Hill NE, Albuquerque, NM, 87106). **Project number:** B623A-850. **Contract:** R806303-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the potential impact on groundwater by metal ions leached from the ash that remains after gasification. An investigation of the baseline conditions of water, coal, and soil from the site will be conducted for metal ions and leachability. Laboratory work will determine rates of solution, distribution coefficients, and the extent of ion exchange and adsorption of the metal

ions. Field studies will follow laboratory work. Baseline characterization of the water has been completed.
Keywords: coal gasification; in-situ gasification; water pollution; ground water; ashes; leaching; bench-scale experiments; elements; trace amounts; environmental effects; anions; ion exchange; adsorption; baseline ecology.

71047 Environmental Characterization of Oil Shale Retorting. Hedley, W. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayton, OH, 45407). **Project number:** B623A-T1007. **Contract:** 68-03-2550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA. **Related energy source:** oil shale(100) **R and D categories:** Pollutant characterization and analysis.

A quick but broad survey of the air, water, and solid waste pollutants emitted from in-situ oil shale retorting is needed. Similar data have already been collected on surface retorting from the Paraho Operation. Similar data from in-situ retorting would allow comparison of these emissions and will serve as a guide to future, more detailed sampling and analysis programs on oil shale. These data can also serve as a guide to areas where additional effort may be needed to define cost-effective solutions to pollution problems from the production of oil from shales.
Keywords: oil shales; in-situ retorting; environmental impacts; air pollution; water pollution; solid wastes.

71048 Environmental Characterization of Shale Oil Processing. Cotter, J.E. (TRW, Environmental Engineering Division, 1 Space Park, Redondo Beach, CA, 90278). **Project number:** B623A-T5001. **Contract:** 68-03-2560. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$48,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant measurements technology.

The objective sought is an environmental characterization of the Paraho surface retort at Anvil Points, Colorado. The primary emphasis will be sampling and measurement for inorganic and organic constituents in the process off-gas and in the stack discharge after the gas is thermally oxidized. Maximum use will be made of in-situ gas chromatography and capture on polymeric materials for subsequent laboratory analysis by gas chromatography--mass spectrometry methods. Two intensive sampling periods of two weeks each will be performed. During these periods, samples of retorted shale and aqueous by-products will be taken for follow-up analysis by EPA and DOE environmental contractors.
Keywords: retorts; environmental impacts; shale oil; gaseous wastes; inorganic compounds; organic compounds; processing; paraho process.

71049 Coal and the Environment Series. Gleason, V.E. (Bituminous Coal Research, Inc., 350 Hochberg Road, Monroeville, PA, 15146). **Project number:** B623B-320. **Contract:** R805336-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to make the literature on the control of environmental problems related to coal mining well known and accessible. Bibliographies on the environmental literature concerned with mining are produced. Bibliographies on (1) Disposal of Refuse from Coal Mines and Coal Cleaning Plants, and (2) Reclamation of Surface-Mined Land, have been completed.
Keywords: coal mining; surface mining; underground mining; coal preparation plants; mineral wastes; waste disposal; land reclamation; bibliographies; environmental effects; technology transfer; acid mine drainage.

71050 Ion Basins. Loy, L.D. (Skelly and Loy, Inc., 2601 North Front Street, Harrisburg, PA, 17110). **Project number:** B623B-352. **Contract:** 68-03-2677. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The project will investigate on lab scale the use of coagulants to improve pond sediment removal performance. During Phase II, two sites will be selected to study (1) physical modifications, and (2) coagulant addition. In the third and trail phase, the two ponds will be studied. Samples were collected from six Go D surface mine ponds and were screened for optimum coagulant dosage. Candidate sites were selected on their location, conformance to the Office of Surface Mining regulations, and on the cooperative attitude of the operator. Demonstration sites will be selected on degree of impact of the demonstration. Phase I is complete; Phase II is underway.
Keywords: sediments; ponds; flocculation; surface mining; waste management; coal mining.

71051 Vegetative Stabilization of Spent Oil Shales. Berg, W.A. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** B623B-358. **Contract:** R804719-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to investigate surface stability of and salt movement in fine-textured (TOSCO), moderately coast-textured (U.S. Bureau of Mines gas combustion process), and coarse-textured (Paraho direct process) spent shales and spent shales covered with soil after vegetation has been established by intensive treatments and then left under natural precipitation conditions. Field plots have been established in the Colorado oil shale region using the above spent oil shales, soil-cover over the spent shales, and soil controls. The plots have surface runoff collectors so the quantity and quality of runoff can be measured. Vegetative surveys are made periodically to determine revegetation success. One report (EPA-600/7-78-02) describes success in revegetating TOSCO and USBM spent shales. A draft report on revegetating Paraho spent shale has been received.
Keywords: oil shales; spent shales; revegetation; colorado; oil shale mining; surface mining; land reclamation; salts; runoff; quantitative chemical analysis; qualitative chemical analysis; evaluation.

71052 Water Quality Hydrology Affected by Oil Shale Development. McWhorter, D.B. (Colorado State University, Department of Agricultural and Chemical Engineering, Fort Collins, CO, 80523). **Project number:** B623B-361. **Contract:** R803684-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.

The objectives are to collect and analyze all available data pertinent to the influence of oil shale development on water quality hydrology, and to carry out an in-depth investigation into local water quality aspects associated with mine spoils and shale residue. The approach will be: (1) to gather all data pertinent, (2) to summarize and analyze the data toward the identification of data deficiencies, and (3) to develop procedures for quantitative assessment of the quantity and quality of surface and subsurface runoff from processed shale residue and mine spoils. Surface water samples have been obtained from USBM, Tosco II, and Paraho spent shale plots. Leachate studies on Paraho spent shale are in progress. Data available in the literature have been reviewed and summarized.
Keywords: hydrology; green river formation; oil shale deposits; water quality; colorado; wyoming; utah.

71053 Environmental Monitoring and Assessment of Coal Strip Mining and Reclamation in the Four Corners Area. Fogel, M.M. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** B623B-418. **Contract:** R804679-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The overall objective of the project is to develop criteria for the optimal management of land that has been disturbed by coal strip mining activities. The criteria will be based on minimizing air and water pollution. Specifically, the project will be devoted principally to monitoring (1) two selected groundwater basins, (2) three surface water steps, and (3) three air quality sites to determine the effects of strip mining on the environment. Several holes will be drilled, cased, and monitored for each of the shallow groundwater basins. Infiltration studies will be used to ascertain the mobility of pollutants from the land surface to groundwater. Results of the study are dependent on the final year's monitoring, and data reduction has not progressed significantly to date.
Keywords: surface mining; coal mines; monitoring; land reclamation; ground water; surface waters; air quality; environmental effects.

71054 Corehole Spacing Models Defining Potential Toxic Rock Bodies in Coal. Horne, J.C.; Ferm, J.C. (Univ. of South Carolina, Columbia, SC, 29208). **Project number:** B623B-503. **Contract:** R805101-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the maximum corehole spacing essential to determining the potential toxicity on coal mining overburden. The contractor will drill exposed highwall and highway cuts and analyze cores taken at variable spacings while maximizing reliability of corehole sample continuity and minimizing costs. Drilling has begun.
Keywords: coal deposits; exploration; boreholes; well spacing; overburden; toxicity; evaluation; cost; sulfur compounds.

71055 Predicting Acid Pollution Potential from Coal Strip Mines. Caruccio, F.T.; Geidel, G. (Univ. of South Carolina, Room 115, Columbia, SC, 29208). **Project number:** B623B-606. **Contract:** R805116-02. **Supported by:** Environmental Protection Agency, Cin-

cinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The project will attempt to develop a reliable and easy field technique for determining if an overburden will produce an acid discharge. Differing quantities of alkali will be added to known acid-producing reclamation project sites to correlate overburden chemical characteristics with the degree of neutralizing capacity. These data will be used to calibrate an analytical productive technique. Site selection has been made and field sampling has begun.
Keywords: coal mines; surface mining; acid mine drainage; forecasting; overburden; chemical properties; ph value.

71056 Geochemistry of Cadmium and Other Selected Heavy Metals as Related to Coal Strip Mining. Hood, W. (Southern Illinois Univ., Carbondale, IL, 62901). **Project number:** B623B-633. **Contract:** R805353-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project will trace the occurrence of selected heavy metals from the overburden strata through the mining process to the final deposition stream sediment in Illinois coal strip mining. The metals are arsenic, cadmium, nickel, cobalt, chromium, and zinc. Overburden samples, mine effluent samples, and stream water and sediment samples will be analyzed to determine the influence and occurrence of the heavy metals in southern Illinois. Many samples have been taken and seasonal variations are to be quantified.
Keywords: cadmium; surface mining; coal mines; illinois; geochemistry; streams; sediments; arsenic; nickel; cobalt; chromium; zinc; seasonal variations; sampling; liquid wastes; environmental effects; environmental transport.

71057 Predicting Response to a Natural System to Uranium Extraction: Oakville Aquifer, Texas. Galloway, W.E. (Univ. of Texas, University Station, Box X, Austin, TX, 78712). **Project number:** B623B-638. **Contract:** R805357-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The principal objectives of this project are to determine and document for one uranium-bearing aquifer system the interrelationships between aquifer geometry, hydrology, hydrochemistry, mineralogy, and uranium mineralization and to determine how this natural system will respond to local chemicals or physical stresses induced by uranium mining. The implication of project results for the design of monitoring systems will be evaluated. These objectives will be met by collecting and analyzing a series of surface and ground water samples and soil samples to determine the existence and magnitude of toxic materials. Models will be produced to evaluate the effects of toxic materials in the Oakville aquifer. Much of the sampling and analysis has been completed and work has been initiated on the preparation of the final report. Various models are being developed.
Keywords: aquifers; hydrology; configuration; mineralogy; uranium; mineralization; uranium mines; surface waters; ground water; baseline ecology; soils; environmental impacts.

71058 Limestone Treatment of Acid Spoil. Kalb, G.W. (John Bedway Coal Co., 212 Main St., Adena, OH, 43901). **Project number:** B623B-705. **Contract:** R805936-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

This project will determine if application of copious quantities of limestone will result in improving the seepage quality by in-situ neutralization of the pyritic material within the porous spoil. Background levels of a reclaimed area have been acquired. Limestone will be spread at various rates over controlled areas of the watersheds. The effluents will be monitored to ascertain effectiveness. Ninety percent of the limestone has been applied. Little improvement in water quality has been observed.
Keywords: spoil banks; acid mine drainage; limestone; land reclamation; water quality; ground water; monitoring; surface mining; coal mines.

71059 Assessment of the Potential Impacts of Proposed Energy Development on Water Resources of Northern Cheyenne Indian Reservation, Montana. Woessner, W.W. (Northern Cheyenne Tribe, Toston, MT, 59643). **Project number:** B623B-706. **Contract:** R806082-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project will increase the data base on the reservation regarding water quality and potential impacts of coal mining. Field monitoring of three priority sites on the reservation will supply information for a new automatic data storage and retrieval system.
Keywords: energy source development; environmental impacts; water quality; coal mining; data acquisition; automation; information retrieval; american indians; indian reservations.

71060 Impact of Modified In-Situ Retorting on Groundwater Quality. Everett, L.G. (General Electric Co., 735 State St., Santa Barbara, CA, 93101). **Project number:** B623B-709. **Contract:** 68-03-2449. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a methodology for monitoring the impact of modified in-situ oil shale retorting on groundwater quality. The approach is to: (1) assemble background water quality information on federal oil shale lease tracts; (2) develop a priority ranking of potential pollution sources; (3) design a monitoring program; (4) implement a field monitoring program; (5) evaluate results; and (6) prepare final report. A preliminary monitoring program design has been completed.
Keywords: modified in-situ processes; retorting; ground water; water quality; monitoring; oil shales; environmental impacts; oil shale industry; waste water; retorts.

71061 Trace Element Analysis of Naval Oil Shale Reserve No. 1 Core Samples. Fox, J.P. (DOE, Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** B623B-829. **Contract:** D8-F0300. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

This project will examine two core samples from the Naval Oil Shale Reserve for 45 elements including the rare earth elements, As, Se, Mo, B, F, Hg, Cd, U, and others. The data which results will then be used to aid in selection of environmentally acceptable sites for in situ oil shale plants or to select zones for mining for surface retorting which would minimize environmental impacts. Core sediments will be selected to include oil shale zones under consideration for commercial development. These samples will be analyzed using the neutron activation method, Zeeman atomic absorption spectroscopy, and other selected methods. X-ray fluorescence spectrometry will be used to validate the methods previously cited in the case of selected samples. Most analyses have been completed. Occurrence of many trace elements appears to be stratigraphically controlled.
Keywords: rare earths; arsenic; selenium; molybdenum; boron; fluorine; mercury; cadmium; uranium; activation analysis; absorption spectroscopy; x-ray fluorescence analysis; neutron reactions; oil shale processing plants; site selection; drill cores.

71062 Phosphate Rock Treatment of Acid Mine Drainage. Huntsman, B. (Wright State Univ., Dayton, OH, 45431). **Project number:** B623B-827. **Contract:** CA-8-2977-J. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

This project will assess the usefulness of rock phosphate addition to precipitate ferrous iron in acid mine drainage as an alternative to oxidation. Rock phosphate will be used in a fixed-media contact system in an acid mine drainage pilot plant to replace the ferrous oxidating step. The flow rates and effluent quality will be monitored to determine effectiveness. All pilot efforts are complete. The rock phosphate was moderately effective in ferrous iron precipitation. The economics may not be too promising.
Keywords: coal mining; acid mine drainage; water treatment; ph value; iron compounds; precipitation; economics; oxidation; comparative evaluations; pilot plants; phosphate rocks; uses.

71063 Large Scale Underground Coal Gasification Experiment. Mead, S.W. (Department of Energy, Washington, DC, 20545). **Project number:** B623B-830. **Contract:** D8-F0354. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$20,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are to develop criteria for preparing detailed plans for subsidence monitoring of large scale underground coal gasification burns, and to develop and describe instrumentation used in monitoring subsidence from underground coal gasification. Experience obtained in monitoring subsidence at the Hoe Creek I and II burns near Gillette, WY, will be described and used to develop an example plan for subsidence monitoring of a large burn. Intrumentation development is planned, since commercial instrumentation is not suitable for this purpose. New unique instrumentation has been developed for use in measuring rock deformation and subsidence associated with undergpound coal gasification. Work on preparing a report describing development of a comprehensive subsidence monitoring plan is in progress.

Keywords: in-situ gasification; coal gasification; ground subsidence; equipment; measuring methods; planning.

71064 Evaluation of Surface and Ground Water Problems Associated with Strip Mine Sites, Phase II. Williams, T.T. (Montana State Univ., Bozeman, MT, 59715). **Project number:** B623B-843. **Contract:** R805935-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A research program involving five universities in the states of Montana, North Dakota, and Wyoming, has been initiated to respond to concerns pertinent to surface mining of coal in the Northern Great Plains. Phase I includes physical and chemical characterization of potential strip mine sites and associated waters, and development of preliminary models to describe water flow patterns and chemical characteristics. Phase II involves (1) development and refinements of a predictive framework capable of explaining satisfactorily initial conditions and providing prediction of the effects of given mine plans, and (2) monitoring of the effects during the initial mining period. Phase II provides for application of predictive framework and the accompanying monitoring. A draft final report of the final phase of this project has been submitted to EPA for review prior to publication.
Keywords: surface waters; ground water; surface mining; coal mines; montana; north dakota; wyoming; geology; hydrology; flow models; geochemistry; site preparation; monitoring; environmental effects; evaluation; forecasting.

71065 Leaching Characteristics of Raw Surface Stored Oil Shale. McWhorter, D.B. (Colorado State Univ., School of Engineering, Fort Collins, CO, 80523). **Project number:** B623B-845. **Contract:** R806278-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to determine the leaching characteristics of raw oil shale for the purpose of determining potential impacts upon water quality of large quantities of surface-stored raw oil shale. Subordinate objectives are to estimate the quantities of leachate water likely to be available in field locations and to combine these data with data on leachate concentrations to estimate potential loading of receiving waters with dissolved solids, trace elements, and organics. Data will be obtained by subjecting columns of mined raw shale to leaching tests under a variety of flow rates, conditions of aeration, and column lengths. Chemical analyses of raw shale and effluent for common ions, trace elements, and organics will be made. Work has started but no results are available as yet.
Keywords: oil shales; leaching; water quality; water pollution; elements; trace amounts; organic compounds; environmental impacts; storage.

71066 Quality Assurance Program for the IERL-CI In-House Locations. Stratton, C.L. (Environmental Science and Engineering Corp., University Station, P.O. Box 13454, Gainesville, FL, 32604). **Project number:** B623B-S4005. **Contract:** 68-03-2656. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to devise a quality assurance program to assist the quality assurance officer in implementing quality assurance in projects conducted by IERL-CI in-house laboratories. After program materials are developed, a training course is to be presented to include laboratory personnel. The preparation of work plan involves: (1) visiting each facility to tour and discuss each lab and its projects, samples, personnel responsibilities, procedures, equipment, and testing; (2) developing a program which will include QA manual describing requirements for QA plans for each project, and action plan recommending how QA policies and procedures can be implemented; and (3) preparing and presenting QA materials in a training course at the locations. Work plan was received and approved April 20, 1979.
Keywords: quality assurance; us epa; education; personnel; laboratory equipment; manuals.

71067 Antimony Removal Technology. Parker, C.L. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** B623B-T3002. **Contract:** 68-03-2566. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The project studied antimony solubility chemistry and evaluated the effectiveness of various technologies for removing antimony from mining wastewaters. Antimony solubility was reviewed on a theoretical basis. Alternative technologies were evaluated on a best-engineering-judgment basis. Starch xanthate and ion exchange have the greatest potential for use in antimony removal.
Keywords: antimony; solubility; removal; waste water; ion exchange; xanthates; coal mines; waste processing; waste management.

71068 Pollution Control Guidance for Oil Shale Development. Cruse, H. (Jacobs Engineering Group, Inc., Environmental Services Group, 251 S. Lake Avenue, Pasadena, CA, 91105). **Project number:** B623B-T8003. **Contract:** 68-03-2569. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$85,000.
Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.

The document, Pollution Control Guidance for Oil Shale Development, will provide a brief yet thorough discussion of the environmental problems of oil shale development. It will serve government agencies and private developers as a source of basic information and environmental impacts and control technologies and will identify concerns and interests of EPA relative to oil shale development. Oil shale developers will find suggestions for development of interim EPA emissions, effluents, and solid waste disposal standards particularly useful. The document is being written by the EPA Oil Shale Work Group with 16 individual authors from nine EPA laboratories or offices. Three drafts will be prepared with reviews sought from all interested EPA program offices, other government agencies, and the oil shale industry. Contract support for preparation of the document is being provided by Jacobs Engineering Group. It contains sections on background, recommendations, environmental impacts, control technology, monitoring and analysis, suggested development of interim standards, overview of oil shale technology, and a volume of appendices.
Keywords: oil shale industry; pollution control; manuals.

71069 Manual of Practice for Oil Shale Dispersants. Castle, R. (Woodward and Clyde Consultants, 600 Montgomery Street, San Francisco, CA, 94111). **Project number:** B623C-272. **Contract:** 68-03-2621. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective of this study is to develop a field users manual of practice for oil spill dispersants which includes decision materials to assist the field user in making a decision to use or not to use oil spill dispersants. The approach is to review the state-of-the-art report on oil spill dispersants and prepare a field users manual consistent with recommended practices and EPA policy and program. First draft copy of Manual of Practice was received for EPA review in June, 1979.
Keywords: oil spills; diffusion; manuals; water pollution; surfactants; decision making.

71070 Environmental Guidelines for Onshore Impact of Offshore Petroleum Development. Doyel, W.W. (USGS, Resources and Land Investigations Program, 12201 Sunrise Valley Drive, Reston, VA, 22092). **Project number:** B623C-300. **Contract:** D6-0008. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$160,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective is to provide state and local planning offices with methodologies and information pertaining to the impact of onshore facilities supporting offshore oil and gas development through a series of 15 workshops at six coastal locations.
Keywords: continental shelf; environmental impacts; petroleum deposits; exploitation; offshore operations.

71071 Evaluation of the Stability Characteristics of Oily Water Emulsions. Tuffly, B. (Rockwell International Corp., Rocketdyne Division, 8900 Desoto Avenue, Canoga Park, CA, 91304). **Project number:** B623C-501. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$80,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective is to characterize the influent to and effluent from each unit process in an oil tank ballast-water treatment plant. Samples within the plant will be taken and subjected to analysis. Almost half the hydrocarbons discharged from the plant are benzene, toulene, or xylene and are completely missed by the method of analysis specified by the plant's discharge permit.
Keywords: emulsions; stability; liquid wastes; waste processing; petroleum; water; separation processes.

71072 Oil Slick Dispersal Mechanics. Ahlert, R.C. (Rutgers State Univ. of New Jersey, New Brunswick, NJ, 08903). **Project number:** B623C-680. **Contract:** R805901-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objectives are to evaluate oil dispersants in laboratory aquarium with simulated chemical variables and study slick surface conditions with respect to surface description, droplet formation and motion. The approach is to undertake simulated slick conditions and environmental variables on lab situation and document results by sampling and analyzing procedures as appropriate. To date laboratory apparatus has been fabricated and tested and supplies and equipment necessary to conduct this project have been acquired.
Keywords: oil spills; diffusion; water pollution; bench-scale experiments; simulation; surfactants.

71073 Oil Spill and Oil Pollution Reports, III. Offen, H.W. (Univ. of California, Santa Barbara, CA, 93106). **Project number:** B623C-781. **Contract:** R805803-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The specific objective will be to compile and issue for publication bibliographic reports containing information on oil pollution. Literature search is the major approach. Seventeen quarterly reports have been issued since July 1974.
Keywords: oil spills; bibliographies; water pollution; land pollution; environmental effects.

71074 Environmental Assessment of Advanced Energy Conversion Technologies. Shaw, H. (Exxon Research and Engineering Co., Government Research Labs., 1600 Linden Avenue, Linden, NJ, 07036). **Project number:** B624B-379. **Contract:** 68-02-2146. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$263,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is the assessment of the environmental impacts of advanced energy conversion technologies to identify the pollutants and the size of the waste streams containing them. The comparative cost of making different systems meet various new source performance standards will be studied, and pollution control research needs will be identified. Material and energy balances will be calculated for a range of operating parameters for the advanced energy conversion technologies. Waste streams were analyzed and control technology effectiveness was determined. Costs were estimated and areas requiring pollutant control technology research and development were identified. Individual reports on the base case conventional steam power plants, open cycle magnetohydrodynamic power plant, high temperature molten carbonate fuel cell power plant, high temperature open cycle gas turbine power plants, a comparison of flue gas clean-up systems, and fluid bed combustion have been submitted for review and will be part of a multi-volume final report.
Keywords: pollution control; magnetohydrodynamics; gas turbines; fuel cells; energy conversion; environmental impacts; energy source development; pollution abatement; planning; energy policy.

71075 Air Pollution Control Technology Development for Waste-As-Fuel Processes. Jutze, G.A. (PEDCO-Environmental, Inc., 11499 Chester Road, Suite 13, Cincinnati, OH, 45246). **Project number:** B624B-403. **Contract:** 68-03-2509. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The Environmental Protection Agency is initiating a study to assess techniques and devices to control air pollutants generated by the use of waste as fuel in energy recovery/generation systems. Pedco-Environmental and Midwest Research Institute intend to provide the personnel and services required to develop environmentally acceptable air pollution control systems for use in conjunction with waste-to-energy processes. A portable fabric filter has been constructed and is being tested at two waste-as-fuel sites. A portable scrubber has been tested at one site. A state-of-the-art report has been submitted by the contractor.
Keywords: air pollution control; technology assessment; waste product utilization; synthetic fuels; heat recovery; pilot plants; waste management; sulfur dioxide; nitrogen oxides; carbon monoxide; photochemical oxidants; incinerators; environmental impacts.

71076 Evaluation of Ames' Waste Process: An Energy Recovery System. Chantland, A.O. (Ames City Government, Ames, IA, 50010). **Project number:** B624B-391. **Contract:** R803903. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$900,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The study will assess the effects of using municipal solid waste (MSW) as a supplementary fuel. Co-firing of MSW with coal in stoker and tangentially-fired boilers will be conducted, and since one boiler is the same as at St. Louis, studies will permit confirmation and comparison of selected St. Louis results. Assessments will be made of the technical and environmental aspects of these co-firing techniques. In addition, technical and economic tests and evaluations will be conducted on the second generation MSW processing facility associated with supplying the refuse-derived fuel. Emissions and performance evaluations have been completed for both the stoker and the pulverized coal boilers. The economic evaluation and the data analyses are continuing.
Keywords: municipal wastes; solid wastes; combustion; environmental impacts; technology assessment; economics; refuse derived fuels; waste processing plants; refuse-fueled power plants.

71077 Portable Unit for Pyrolysis of Agricultural Wastes. Kostrin, H. (Energy Resources Co., Inc., 185 Alewife Brook Parkway, Cambridge, MA, 02138). **Project number:** B624B-511. **Contract:** 68-03-2675. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objective of this program is to determine the environmental, technical, and economic feasibility of a mobile pyrolysis unit to convert agricultural and forestry residues to an energy form. The development of such a technology that takes an environmental liability and converts it to an envionmental and energy asset is highly desirable. To this end the contractor will design, fabricate, and field test a mobile pyrolysis system capable of meeting or exceeding the concept criteria established by previous work (capable of processing agricultural and forestry residues into usable fuel products). The existing concept envisions a unit capable of processing 100 dry tons per day of agricultural waste. The system concept includes a dryer, shredder, reactor, gas cleaning, oil recovery, char recovery, and support equipment, all mounted on two or three trailers meeting highway road height, width, and weight limits. The contractor has completed the conceptual design, 75% of mechanical design, and will start fabrication by June, 1979.
Keywords: feasibility studies; pyrolysis; agricultural wastes; wood wastes; environmental impacts; technology assessment; economic analysis; design; fabrication; field tests; waste processing; mobile reactors.

71078 Monitoring Solar Wastewater Treatment. Fuller. (Wright, Pierce, Barnes, and Wyman, 99 Main Street, Topsham, ME, 04086). **Project number:** B624B-534. **Contract:** 68-03-2587. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: solar(100) **R and D categories:** Environmental effects assessment.

The purpose of this study is to determine the most energy-effective method of operating a municipal wastewater treatment plant using an integrated energy system of solar energy, digester methane, and heat pumps. Each energy demand in the treatment plant will be identified as a percentage contribution of (1) solar energy, (2) digester gas, (3) heat pump, (4) effluent exchange, and (5) emergency electrical generation. The most effective techniques for supplying plant energy demand through the combined use of solar energy, electrical power, and digester gas will also be identified. The plant is in the final stage of construction, and start-up occurred in February. About 60% of the residences have connected their sewage to this municipal treatment plant. The contractor is planning an open house.
Keywords: water treatment plants; monitoring; solar energy; waste water; energy demand; heat pumps; technology assessment; solar-assisted heat pumps; energy conservation; economics.

71079 Assessment of Combustion of Refuse-Derived Fuels. Hartman, D. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-542. **Contract:** 68-02-1885. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to assess pollutant formation during the combustion of refuse-derived fuels as a function of combustion parameters. Pollutant control within the combustion chamber will also be assessed. The approach will be to utilize an already existing, government-owned, small-scale pilot test furnace for the combustion experiments. The RDF fuel system will be capable of firing about 100 pounds of RDF per hour. A draft report of the work is now under review.
Keywords: refuse derived fuels; combustion; air pollution; pilot plants; combustion properties.

71080 Test Firing of Solid Waste as a Supplemental Fuel to an Industrial Boiler. Boley, G. (Madison City Government, 210 Montana Ave., Madison, WI, 53709). **Project number:** B624B-544. **Contract:** R806328-01. **Supported by:** Environmental Protection Agency,

Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

It is the purpose of this project to investigate the feasibility of co-firing municipal solid waste with fossil fuel in an industrial boiler. The environmental impact of the co-firing operation will be evaluated. Economic effects of co-firing will be analyzed for both the municipality supplying the fuel and the industrial plant using the fuel. This investigation shall be in the form of an actual limited duration test-firing at an existing industrial boiler. Testing duration will be for 1000 hours total.
Keywords: solid wastes; refuse-fueled boilers; industrial plants; municipal wastes; economic analysis; environmental impacts; demonstration plants; fuel substitution.

71081 Water Pollution Control Technology Development for Waste as Fuel Processes. Treweek, G.P. (J.M. Montgomery Consulting Engineers, Inc., 555 E. Walnut Street, Pasadena, CA, 91101). **Project number:** B624B-555. **Contract:** 68-03-2657. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$431,000.
Related energy source: Coal(50); conservation(50) **R and D categories:** Pollutant characterization and analysis.

It is the purpose of this contract to investigate the major water pollution problem associated with emerging wastes-as-fuel technologies and to develop appropriate control technologies (on a pilot-plant scale) for the problems thus defined. This investigation will be in the form of providing an independent analysis of the most efficient, most cost-effective method of protecting wastes-as-fuel for energy generation. The assessment will include an analysis of all available data on pollutants produced by wastes-as-fuel. Equipment design will be prepared for each of several mobile pilot-plant-scale water pollution control processes selected for detailed field investigations. Several of these designs will be adopted, and the pilot plants fabricated or acquired and actually installed at existing wastes-as-fuel plant sites to be selected. Each pilot plant will be operated at a specified waste-as-fuel site. A state-of-the-art report has been completed, and pilot plant design has been initiated.
Keywords: solid wastes; energy conversion; water pollution; water pollution control; pilot plants; field tests; pollution control equipment.

71082 Solar-Biomass (Bioconversion) National Conference. Shoen, R. (National Science Foundation, 1800 C Street, NW, Washington, DC, 20550). **Project number:** B624B-650. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to increase the utilization of biomass as an energy source. This project is to provide partial financial support for an international conference on bioconversion co-sponsored by the EPA and the National Science Foundation. The conference was held at the Atlanta World Congress Center, 13--17 March 1979.
Keywords: biomass; bioconversion; energy source development; meetings; us epa; national science foundation.

71083 Demonstration of EIC's Geothermal H2S Removal Process. Follett, A. (DOE, 1717 H Street, NW, Washington, DC, 20545). **Project number:** B624B-659. **Contract:** D8-X0175. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to demonstrate, at 1/20 scale, the removal of hydrogen sulfide from raw geothermal steam. The EIC system for hydrogen sulfide removal will be constructed and operated for six months at The Geysers geothermal power plant. The plant is under construction and is scheduled to begin operation in May 1979.
Keywords: natural steam; hydrogen sulfides; removal; geothermal fluids; geysers geothermal field; geothermal power plants; air pollution abatement.

71084 Contamination of Ground Water in Geothermal Development. Chen, C.W. (Tetra Tech. Inc., 3700 Mt. Diablo Blvd., Lafayette, CA, 94549). **Project number:** B624B-662. **Contract:** 68-03-2671. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$45,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop methodology to assess potential environmental effects, on ground water, of geothermal fluid surface and subsurface releases. The approach is to develop decision points, and rationale for their support, in a screening procedure to define groundwater contamination potential. A manual will be developed for use by regulators and developers to facilitate application of the procedure.
Keywords: geothermal resources; resource development; ground water; water pollution; geothermal fluids; chemical composition; water quality; mathematical models; computer codes; g codes; manuals; environmental impacts; us epa.

71085 Fluidized Bed Combustion of Refuse-Derived Fuel and Sewage Sludge, Duluth, Minnesota. (Western Lake Superior Sanitary District, 325 Lake Avenue South, Duluth, MN, 55802). **Project number:** B624B-675. **Contract:** R806144. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$100,000.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to carry out a technical, economic, and environmental evaluation of the subsystems of a fluidized bed combustion unit co-firing sewage sludge and refuse derived fuel. To be evaluated are: (1) the solid waste fuel preparation system; (2) the sludge fuel preparation system; (3) the combustion system; and (4) the energy using system.
Keywords: fluidized-bed combustion; sewage sludge; feasibility studies; refuse derived fuels; economics; environmental effects; solid wastes; energy consumption; fluidized-bed combustors.

71086 Geopressured Geothermal Development Workshops. Westhusing, K. (Department of Energy, 20 Massachusetts Avenue North, Washington, DC, 20545). **Project number:** B624B-812. **Contract:** D8-X0258. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of this effort is to provide a forum for advice, evaluation, and plan formulation of geopressured development research. All development entities--government, academic, and industry--are represented. Information dissemination is an important aspect. Workshops are held approximately quarterly and a newsletter is distributed monthly. An overview group and four subgroups have been established. The subgroups are environmental, legal, and institutional site selection, and resource assessment. Approximately 4 to 6 workshops have been held for each subgroup, minutes have been published, and approximately 6 newsletters have been issued.
Keywords: meetings; geothermal energy; geothermal resources; environmental impacts; geothermal industry; us organizations; government policies; geopressured systems; site selection; well drilling; legal aspects.

71087 Environmental Research Needs in Solar Energy Technology. Anderson, L.B. (Acurex Corp., Aerotherm Division, 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-T4004. **Contract:** 68-03-2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$48,000.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to review, identify, evaluate, and prioritize research needed to define environmental consequences of widespread solar energy utilization. The approach will include a survey of available literature, including DOE solar environmental developmental plans to identify and define potential environmental consequences of solar energy utilization, and a definition and prioritization of research needs. This project is being modified to emphasize environmental issues of solar technologies.
Keywords: solar energy; environmental impacts; technology utilization; solar industry.

71088 Solar Energy for Pollution Control. Cooper, L. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-T4009. **Contract:** 68-03-2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to obtain information on the possible use of solar energy systems to supply energy needed by pollution control methods and equipment. Pollution control methods which make the best use of solar energy input will be identified and the potential of solar energy, when applied to pollution control, to displace fossil fuels currently used to supply the energy needs of these control methods will be qualifed. The project is nearly completed and the contractor has prepared the draft final reports for review.
Keywords: solar energy; air pollution control; net energy; fuel substitution.

71089 Analysis of EPA Regulatory Options for Solar Technologies. Cooper, L. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-T4010. **Contract:** 68-03-

2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to compile, evaluate, and recommend regulatory approaches which could be taken for control of environmental impacts of solar energy systems if warranted. Potential environmental impacts of developing solar energy systems will be identified and prioritized. EPA regulatory programs that have existing legislative authority for controlling the most significant potential impacts will be identified. The project is nearly completed and the contractor has prepared the draft of the final reports for review.
Keywords: us epa; regulations; solar industry; evaluation; government policies; environmental impacts.

71090 Containment of Geothermal Brines. Sung, R.D. (TRW, Inc., 1 Space Park, Redondo Beach, CA, 90278). **Project number:** B624B-T5003. **Contract:** 68-03-2560. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$14,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine necessity for, and type of, containment measurements for unplanned or accidental surface losses of geothermal fluids at geothermal energy conversion sites. Relevant processes and systems components, and causes and risk of failure resulting in spills, will be identified. Containment measures based upon frequency and magnitude risks will be defined.
Keywords: geothermal fluids; hot-water systems; brines; total flow systems; flashed steam systems; binary-fluid systems; corrosion; failures; containment; leaks; environmental impacts.

71091 Oil Shale Methods Manual. Wallace, J. (Denver Research Inst., University Park, Denver, CO, 80210). **Project number:** B825A-645. **Contract:** 68-03-2791. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

The objective of the contract is to develop a manual of recommended procedures for the chemical analysis of oil shale effluents. A literature survey will be conducted during the first year to identify acceptable oil shale methods. Those found to be unacceptable will be studied and developed during the second and third year. A final report consisting of a user manual will be developed as the end product.
Keywords: chemical analysis; oil shale processing plants; chemical effluents; manuals.

71092 In-Situ Gasification of Eastern Coal. Strickland, L.D. (Dept. of Energy, Morgantown, WV, 26505). **Project number:** B825A-858. **Contract:** D9X0550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to characterize the emissions that result from the underground gasification of eastern coal. Sampling and analysis for air pollutants will be conducted at DOE's underground coal gasification test site at Pricetown, WV. Hydrocarbons in the gas stream and trace metals in the coal seam will be studied. The field test has not started yet.
Keywords: coal gasification; in-situ gasification; air pollution; sampling; chemical analysis; hydrocarbons; fuel gas; coal; elements; trace amounts; planning; water pollution.

71093 Handling Toxic Strip Mine Spoils to Prevent Acid Mine Drainage. Thompson. (Pennsylvania Dept. of Natural Resources, P.O. Box 2063, Harrisburg, PA, 17120). **Project number:** B826B-508. **Contract:** R805598-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Sixteen reclaimed strip mine spoils with known acid-producing potential will be evaluated to correlate reclamation method with resulting effluent quality. Mine plans, water quality history, and reclamation reports will be evaluated to select potential acid producing sites. Sixteen of these will be drilled and the core samples physically and chemically characterized. The effluents will be analyzed and correlated to toxic material placement within the backfilled spoil. Eight sites of the sixteen have been chosen.
Keywords: surface mining; coal mines; land reclamation; acid mine drainage; spoil banks; water quality; sampling; toxicity; evaluation.

71094 Testing for SO2 at Old In-Situ Oil Shale Sites. Poulson, R. (DOE, Laramie Energy Research Center, University Station, P.O. Box 3395, Laramie, WY, 82070). **Project number:** B826B-896. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

This effort will survey SO2 and hydrocarbon emissions from old oil shale retorting operations (emphasis in-situ) mostly in the Piceance Basin. The program entails field sampling of soils and air at five sites of oil shale in-situ retorts and at one location away from any oil shale work. The latter location will act as a control. Soils will be tested for SO2, total organics, hydrocarbons, pH and soil atmosphere SO2. Air samples will be tested for SO2 and hydrocarbons.
Keywords: sulfur dioxide; hydrocarbons; oil shales; retorts; waste water; in-situ retorting; soils; air; sampling; ph value; atmospheric chemistry; soil chemistry; environmental effects; oil shale industry; pollution.

71095 Dents Run Mine Drainage Demonstration Project. Emerson, D.B. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** B826B-T3003. **Contract:** 68-03-2566. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of the Dents Run Mine Drainage Demonstration Project was to control mine drainage from abandoned and inactive mine workings through control of water infiltration to those workings. This effort summarizes the results of that project and discusses the effectiveness of applying this control technology to other mining-disturbed watersheds. The principal investigator was to visit the reclaimed areas of the Dents Run watershed to document the effectiveness of the reclamation, contact the principals involved in the project, and analyze all data that had been collected relative to the project. This effort has essentially been completed and the principal investigator is preparing a final report.
Keywords: demonstration programs; mine draining; coal mines; abandoned sites; water pollution; ground water; land reclamation; watersheds; runoff.

71096 Environmental, Economic, and Conservation Aspects of Cogeneration. Zimmer, R.P. (Georgia Inst. of Technology, 225 North Avenue, NW, Atlanta, GA, 30332). **Project number:** B827B-531. **Contract:** 68-03-2394. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives of this project are: to provide up-to-date analyses of the environmental, economic, and technical feasibility of alternatives for supplying total energy needs; to identify the technical feasibility of matching industrial processes to thermal outputs of power plants; and to make recommendations about future environmental research and development activities based on the project results. The general approach is a process of first identifying a large number of potential concepts and then eliminating all but the best by identifying those that are technically feasible, economical beneficial, environmentally acceptable, representative of significant energy savings, and not tightly bound by institutional and legal constraints.
Keywords: fossil-fuel power plants; co-generation; economic analysis; environmental effects; energy conservation; feasibility studies; process heat; technology transfer; industrial plants; district heating.

71097 Emissions Assessment for Refuse Derived Fuel Combustion. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** B827B-820. **Contract:** 68-03-2772. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this program is to identify exemplary fugitive emissions control technologies that can be used to control work place and atmospheric emissions of heavy metals and to promote the application of these technologies in the United States. Exemplary fugitive emissions control technology was identified through the literature and through plant visits. A coordinated sampling and analysis program utilizing EPA and NIOSH methods attempted to quantify the emissions rates from this exemplary technology and to evaluate their applicability to the United States. The results of the sampling study are complete and under review. The technologies show that very low levels of ambient lead can be obtained through use of washdowns, properly designed hoods, enclosed and isolated materials storage and handling and general attention to plant housekeeping.
Keywords: refuse derived fuels; combustion products; air pollution control; sampling; pollution control equipment; metals; lead.

71098 Waste to Energy Technology Conference. Smithson, R. (Battelle Memorial Inst., 505 King Ave., Columbus, OH, 43201). **Project number:** B827B-861. **Contract:** R806653-01. **Supported by:**

Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

The objective is to determine feasibility of electrochemical oxidation of hydrogen sulfide in geothermal brine. Bench-scale testing of electrochemical concept will be conducted and scale-up parameters will be determined.
Keywords: electrochemistry; oxidation; hydrogen sulfides; brines; geothermal fluids; waste product utilization; technology assessment; feasibility studies.

71099 Emissions Assessment from Refuse-Derived Fuel Combustion (Battelle). Allen, J. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** B827B-873. **Contract:** 68-03-2772. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); conservation(50) **R and D categories:** Pollutant monitoring.

The objective of this project is to characterize the emissions from cofiring three types of refuse-derived fuel with coal in a fluidized bed combustion unit. Fuels with CEA, Ames, Iowa, and Milwaukee are being burned with an Illinois coal. A source assessment sampling system (SASS) is being used to determine criteria pollutants, trace metals, and selected organics.
Keywords: refuse derived fuels; coal; co-generation; fluidized-bed combustion; combustion products; air pollution; environmental impacts; sampling; flue gas.

71100 Emissions Assessment from Refuse-Derived Fuel Combustion (KVB). Muzio, L. (KVB, Inc., 17332 Irvine Blvd., Tustin, CA, 92680). **Project number:** B827B-874. **Contract:** 68-03-2773. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to characterize the emissions from the cofiring of 3 types of refuse-derived fuel with coal in a suspension fired laboratory boiler. The fuels will be evaluated at several RDF/coal ratios, excess air levels, and with scaled combustion. Fuels from CEA, Ames, Iowa, and Milwaukee are being burned with an Illinois coal. A source assessment sampling system (SASS) is being used to determine criteria pollutants, trace metals, and selected organics.
Keywords: refuse derived fuels; industrial wastes; combustion; coal; sampling; metals; organic compounds; combustion products; air pollution; environmental impacts.

71101 Emissions Assessment from Refuse-Derived Fuel Combustion. Derham, R. (Energy Resources Co., Inc., 185 Alewife Brook Pkwy., Cambridge, MA, 02138). **Project number:** B827B-875. **Contract:** 68-03-2771. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to characterize the emissions from cofiring 3 types of refuse-derived fuel with coal in a fluidized-bed combustion unit. Fuels from CEA, Ames, Iowa, and Milwaukee are being burned with an Illinois coal. A source assessment sampling system is being used to determine criteria pollutants, trace metals, and selected organics.
Keywords: coal; fluidized-bed combustion; iowa; illinois; wisconsin; refuse derived fuels; stack disposal; gaseous wastes; air pollution; trace amounts; metals; organic compounds; monitoring; sampling; refuse-fueled power plants; fossil-fuel power plants; environmental impacts.

71102 Groundwater Monitoring for Geothermal Development. Hess, J.W. (Univ. of Nevada, Reno, NV, 89507). **Project number:** B827B-920. **Contract:** R806457-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

The purpose of this investigation is to validate and improve a methodology for detecting, monitoring, and predicting the long-term effects of geothermal development on the groundwater environment. The objective will be accomplished by designing, implementing, operating, and modifying a monitoring plan at the Roosevelt Hot Springs geothermal resource area in Beaver County, Utah.
Keywords: ground water; geothermal industry; environmental effects; monitoring; utah.

71103 Workshop on Energy Development Issues Affecting Appalachia. Waldman, M. (Enviro Control, Inc., 1130 Rockville Pike, Rockville, MD, 20852). **Project number:** B827C-916. **Contract:** 68-03-2674. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

In preparation for an assessment of Appalachian energy development, we intend to: (1) identify energy issues that would affect Appalachia over the next 25 years, (2) learn why those issues arise, and (3) learn what a study of Appalachia could contribute to understanding those issues. Approximately 45 individuals from business, government, and special interest groups were invited to participate in the workshop. Each individual was asked to participate in one of three discussion sessions: energy extraction, conversion, or end-use. Based upon the roundtable discussions of these three groups the major energy issues affecting Appalachia are to be identified and clarified along with areas where further study is needed. Two introductory work papers were prepared and distributed to workshop participants in December 1978. The workshop was held on January 9 and 10, 1979, in Atlanta. There were 37 participants. The discussions in the workshop meetings were transcribed. Work is progressing on writing a workshop summary report.
Keywords: appalachia; energy source development; economic development; decision making; energy policy; environmental policy; economic policy; meetings; education.

71104 Energy Use and Pollution for Classes of Similar Energy Technologies. Corbett, W. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX). **Project number:** B827B-925. **Contract:** 68-01-4136. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

Extension of work done on other EPA projects is planned to provide a comprehensive inventory of current energy use and its environmental impacts, organized by process or equipment type. This inventory will enable easy estimation of nation-wide impacts for alternative energy. Literature sources will be examined for data and data will be organized and interpretive. Other EPA projects have covered industrial and utility boilers. The present process will focus on direct fired processes and process heaters.
Keywords: energy demand; inventories; environmental impacts; data compilation; technology transfer; industry; air pollution; water pollution; land pollution.

71105 Cogeneration: Status and Environmental Issues. Zuckerman, I. (TRW, Inc., 1 Space Park, Redondo Beach, CA, 90278). **Project number:** B827B-T5011. **Contract:** 68-03-2560. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a program for a comprehensive study of cogeneration from the viewpoint of environmental protection. Technological and environmental aspects of cogeneration will be defined including the various types of cogeneration systems and specific environmental and developmental needs. This project will be redirected to include more analytical data.
Keywords: co-generation; environmental impacts; technology assessment.

71106 Manual for Refuse Piles and Slurry Ponds. Connell, J.P. (W.A. Wahler and Associates, 1023 Corporation Way, Palo Alto, CA, 94303). **Project number:** B623B-325. **Contract:** 68-03-2344. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of this study is to develop pollution control guidelines for construction, operation, and reclamation of coal refuse disposal piles and slurry ponds. Eight active refuse pile sites and six slurry pond sites in the eastern coal-mining region, selected as representative of the best technology and operating procedures now in use for reducing water and air pollution hazards, were evaluated.
Keywords: coal mining; mineral wastes; spoil banks; slurries; ponds; construction; land reclamation; pollution control; air pollution; water pollution; manuals.

71107 Impacts of RCRA on Disposal of Hazardous and Non-Hazardous Wastes from Mining. Amick, R. (PEDCO-Environmental, Inc., 11499 Chester Rd., Cincinnati, OH, 45246). **Project number:** B818B-I0109. **Contract:** 68-03-2577. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The study will provide technological and cost information for the disposal of mining wastes which are both hazardous and non-hazardous wastes, as defined by Section 3001 of RCRA and subject to regulation under Subtitle C of the Act. The study will determine and identify the portions of the mining/milling industry which do not comply with criteria prescribed in Sections 3001 and 4004 of RCRA. Estimates of the quantities of wastes to be controlled will be

provided. Several disposal alteratives available to the mining/milling industry including at least one landfill and one surface impoundment will be identified. A full range of costs for the identified current and/or alternative treatment, storage and/or disposal technologies both on a model facility basis, and a total cost per unit basis will be presented.
Keywords: hazardous materials; waste management; coal mines; waste disposal; technology assessment; cost; regulations; compliance.

71108 Survey of Management Practices for Mining Solid Waste Management. Kemner, W.F. (PEDCO-Environmental, Inc., 11499 Chester Road, Cincinnati, OH, 45246). **Project number:** B818B-I0113. **Contract:** 68-03-2577. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

This program will survey techniques currently used in the managing of solid waste at mining operations throughout the United States. Operations upon which this work will focus relate to metallic ore, phosphate, and uranium mining. This will be accomplished by site visits to mining operations previously specified by the contractor. Evaluations and descriptions of the techniques will then be compiled and placed in a final report.
Keywords: mines; mineral wastes; waste disposal; management; solid wastes; phosphates; uranium mines; technology transfer.

71109 Petroleum Pipeline Leak Detection Study. Burghart, G.H. (Science Applications, Inc., 1200 Prospect St., La Jolla, CA, 92037). **Project number:** B826B-298. **Contract:** 68-03-2532. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is to define quantity of oil that could be lost based on minimum detector response capability; to recommend off-the-shelf detectors for existing pipeline systems; and to conceive and develop new ideas for detecting petroleum pipeline leaks. The approach is to have a contractor analyze existing petroleum pipeline systems and leak detector equipment through open and manufacturers' literature and through industry and government agency personnel.
Keywords: pipelines; leaks; petroleum; monitoring; transport.

71110 H2S/SO2 Control Technology Study. Lovell, R.J. (Hydroscience, inc., 9041 Executive Park Drive, Knoxville, TN, 37919). **Project number:** B825B-T7012. **Contract:** 68-03-2568. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

The objective is to design a pilot plant(s) for the control of sulfur emission from oil shale retorting operations. All available data on sulfur emissions from oil shale processing plants will be reviewed and evaluated. The best type of control technology will be recommended for the design of slip stream pilot plants applicable to both surface and in situ units.
Keywords: hydrogen sulfides; sulfur dioxide; air pollution control; oil shales; in-situ retorting; emission; pilot plants; oil shale processing plants.

71111 Symposium on Thermal Conversion of Solid Wastes. Jones, J. (SRI International, Menlo Park, CA, 94025). **Project number:** B825B-00914. **Contract:** R806536. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The objective is to hold an international conference on the thermochemical conversion of solid waste into energy and energy products. The conference is intended as a follow-on to an American Chemical Society Symposium on the same topic that was held in California in March 1978 - it, though, was on a national-basis only. The approach will be to invite researchers from around the world (Europe, Japan, America, etc.) to author and present technical papers at an international symposium to be held in the U.S.
Keywords: meetings; thermochemical processes; solid wastes; conversion; synthetic fuels; synthesis.

71112 Evaluation of Selected Procedures for Using Dispersants on Oil Spills. Ackerman, R. (Mason and Hanger-Silas Mason Co., Inc., 200 West Vine Street, Lexington, KY, 40507). **Project number:** B826A-00496. **Contract:** 68-03-2642. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is to develop oil spill dispersant application systems for surface vessels and aircraft to combat open water oil spills. The state-of-the-art systems currently in use will be evaluated and adapted to domestic use.
Keywords: oil spills; surfactants; water pollution abatement; evaluation; oil pollution containment.

71113 Source Emissions Zone-of-Influence. Greenfield, S.; Mills, M. (Teknekron, Inc., 2118 Milvia St., Berkeley, CA, 94704). **Project number:** B827B-00886. **Contract:** 68-02-3092. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant monitoring.

The objective is to produce a handbook for preliminary analysis of zone-of-influence of air emissions. Meteorological data collected by a contractor during previous work for EPA will be presented in the form of a manual. An explanation of how to use data for zone-of-influence calculations under different source, meteorological, and emission rate conditions will be provided.
Keywords: pollution sources; air pollution; meteorology; manuals; environmental impacts; monitoring.

71500 Analytical Services for Leachate, Gas and Solid Waste. Elfers, L. (Pedco Environmental Inc., 11499 Chester Road, Suite 13, Cincinnati, OH). **Project number:** C818A-S1T03. **Contract:** 68-03-2551. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$39,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The Boone County field site, located in Walton, Kentucky, is used by the US EPA's Solid and Hazardous Waste Research Division (SHWRD) to evaluate the sanitary landfill method of disposal. Solid, aqueous (leachate, percolates, surface water, and groundwater) and gas samples are periodically collected for physical and chemical analyses. Standard methods of analysis are followed. Gas samples are analyzed for CO2, O2, CH4, and N content. The aqueous samples undergo the following analyses: acidity, alkalinity, pH, specific conductance, solids (TS, TDS, TVS), BOD, organic acids to C6, TOC, nitrogen (TKN, NH3, NO3), COD, Phenols, sulfate, chloride, Cn, F, P, and metals (K, Na, Ca, Mg, Mn, Fe, Al, Zn, Cu, Pb, Cd, Ni, Cr, As, Hg, Ba, Se, Ag). Outputs are task reports of sample analyses. An annual report of analytical quality performance is also submitted.
Keywords: leaching; gaseous wastes; solid wastes; chemical analysis; sanitary landfills; water pollution control; waste disposal; air pollution control; environmental impacts; waste management.

71501 Analytical Methods Evaluation for Applicability in Leachate Analysis. DeWalle, F.B. (Univ. of Washington, 4000 15th Ave. NE, Seattle, WA, 98105). **Project number:** C818A-S1T030. **Contract:** R805753. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

It is the purpose of the proposed research to evaluate thirty or more physical and chemical methods for their applicability in analyses of contaminated municipal and industrial leachate streams. This research is necessary, since existing analytical methods were primarily developed for analyses of water and wastewater, and their direct application to leachate analyses was found to lead to erroneous results. The accuracy of the methods will be tested with the standard addition technique, while the precision will be evaluated by twelve or more participating laboratories. Analyses of variance will determine the between-laboratory and the within-laboratory error. A draft final report has been received and reviewed by EPA and resubmitted for typing.
Keywords: municipal wastes; industrial wastes; leaching; chemical analysis; waste water; liquid wastes; comparative evaluations; physical properties; chemical properties.

71502 Effect of Moisture Regimen on Solid Waste Stabilization. Chian, E.S. (University of Illinois, Department of Civil Engineering, 2527 Hydrosystems Lab., Urbana, IL, 61801). **Project number:** C818A-S1T07. **Contract:** R803652-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$19,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to determine gas production rates and total quantities from municipal refuse maintained at different steady state moisture conditions, determine gas production rates and total quantity of gas produced from municipal refuse under transient conditions of moisture content, increase simulating net infiltration at landfill sites, and determine the quantity of organic matter in leachate draining from the municipal refuse. A series of modified 55-gallon drums containing shredded municipal refuse serve as the landfill models. Special features include provision for gas and leachate collection, temperature monitoring, uniform water

distribution, and self containment for weighing. Four different steady state moisture conditions and three different transient moisture loading rates are to be studied. Additionally, two different ambient temperatures are to be monitored. An interim report describing construction and initial refuse decomposition will be followed by a final report which summarizes the 2-year study. Results will be evaluated to determine the municipal refuse decomposition rates and to quantitatively establish the effect of moisture on the decomposition rate. This information, although obtained on bench scale, should provide valuable basic data for evaluating the performance of field landfills and for development of a model to predict the potential leachate and gas discharges from municipal refuse.
Keywords: solid wastes; waste management; stabilization; moisture; municipal wastes; leaching; sanitary landfills.

71503 Predicting Organic Contaminant Removal by Clay Minerals and Waste Materials. Griffin, R.A. (State Geological Survey, Natural Resources Building, Urbana, IL, 61801). **Project number:** C818A-S1T17. **Contract:** R804684-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$8,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The purpose of the proposed research is to measure the capacity of selected clay minerals and waste coal chars to adsorb hazardous organic compounds from pure aqueous solutions of the compounds and from manufacturing wastes that contain the compounds. The adsorption will be measured as a function of pH, concentration of adsorbate and adsorbent, and time. The adsorption of families of compounds will be measured to systematically determine the mechanisms responsible for adsorption. To aid in a systematic evaluation of mechanisms responsible for attenuation, a comprehensive critical review of literature will be undertaken. The various adsorbents tested will be evaluated as to their potential usefulness as liners for landfills accepting hazardous organic-bearing wastes. The results of this study should allow predictive models to be developed that will aid researchers and regulatory agencies in prediction of adsorption behavior and the relative pollution hazards of untested compounds with similar structures. A draft report on attenuation of water soluble PCB's has been completed.
Keywords: organic compounds; clays; removal; sorptive properties; minerals; waste product utilization; chars; coal; sanitary landfills; water pollution control.

71504 Fate of Heavy Metals During Landfill Stabilization of Solid Waste Materials with Leachate Cycle. Pohland, F.G. (Georgia Inst. of Tech., 225 North Ave. NW, Atlanta, GA, 30332). **Project number:** C818-S1T25A. **Contract:** R806498-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine if heavy metals are mobilized during acid fermentation of landfilled waste, and if they redeposit in the stabilized waste. Experimental landfills, 92 cm diameter, will be charged with refuse and industrial sludge to provide increasing levels of heavy metals. The landfills will be operated in a recycle mode to accelerate biological and chemical degradation processes. Waste materials, off-gases, and leachates will be assayed to obtain mass balances to verify the fate of heavy metals.
Keywords: metals; leaching; municipal wastes; industrial wastes; biodegradation; sanitary landfills; waste disposal; mass balance; environmental impacts.

71505 Neutralization of Inoperative Waste Disposal Sites. Emrich, G.H. (A.W. Martin Associates Inc., Environmental Science Division, 900 W. Valley Forge Road, King of Prussia, PA, 19406). **Project number:** C818A-S3T02. **Contract:** 68-03-2519. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$153,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the proposed study is to verify the effectiveness of existing technologies to neutralize/deactivate an industrial, hazardous and/or municipal solid waste disposal site. This study, to develop and implement a neutralization system at an inoperative waste disposal site, will be conducted in three phases. In Phase I, feasibility study, Martin will determine the present state-of-the-art for neutralization of waste disposal sites and investigate five candidate sites for neutralization. Three of these sites will be studied in detail. On the basis of the data collected in these studies, one site will be selected for further detailed work and implementation of a neutralization system. A detailed hydrogeologic investigation will be conducted at the selected site during which monitoring wells will be drilled, water samples will be collected and analyzed, and soil samples will be tested. The hydrologic setting of the site will be determined. Based on this information and development of the state-of-the-art for site neutralization, a neutralization technique will be selected. Martin will then design a neutralization system as well as a monitoring network. Monitoring will be conducted at the candidate site to supply data before, during, and after the installation of the neutralization system. In Phase II, a field verification study will be performed involving the implementation of the neutralization and monitoring systems, monitoring for a 28-month period, and evaluation of the results of the implementation. In Phase III of this study Martin will prepare a site neutralization guide which will define the strong and weak points of the neutralization operation and extrapolate their potential application to other waste disposal sites. It is anticipated that this report will provide local municipalities and others with the necessary data to make sound judgements on the selection of viable neutralization procedures. Currently under way on this project is the selection of five candidate sites for initial study and the preliminary collection of data pertaining to the five sites and potential methods of neutralization.
Keywords: waste disposal; municipal wastes; sanitary landfills; environmental effects; waste management; land reclamation; technology assessment; water pollution control; land pollution control; ph value.

71506 Air Pollution Sampling and Monitoring at Hazardous Waste Facilities. Ase, P.K. (IIT Research Inst., Chemistry and Chemical Engineering Research Division, 10 W. 35th Street, Chicago, IL, 60616). **Project number:** C818A-S4T012. **Contract:** 68-03-2654. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to measure and evaluate in an initial evaluation manner the amount and type of air pollution generated from typical hazardous waste management sites, including landfills, repackaging operations, waste treatment/storage lagoons, incineration sites, and other technologies. The approach will be to visit a number of sites (between 15 and 35) and make brief measurements of the upwind and downwind air in several places around the operation, and, through associations with the types of wastes handled, make observations of the levels of pollutants emitted with respect to what may be safe, reasonable, or otherwise. To date, several sites have been sampled; however the levels of measured pollutants have been low by comparison with available standards.
Keywords: air pollution; sampling; monitoring; hazardous materials; waste management; environmental impacts.

71507 Parametric Evaluations of a Field Scale Hazardous Waste Incinerator. Whitmore, F.C. (Versar, Inc., 6621 Electronics Drive, Springfield, VA, 22151). **Project number:** C818A-S4T013. **Contract:** 68-03-2679. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$75,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this contract is to provide EPA with necessary data to prescribe incinerator conditions that will completely destroy the influent waste stream. Experiments on the pilot scale will be conducted to determine such variables as feed rate, materials handling, combustion temperature, excess air requirements, efficiency of air pollution control devices, system turbulence, auxiliary fuel type and quantity, and any other parameters that may affect the system efficiency. Field verification will be an integral part of this research effort. The state permitting agency will be solicited for approval of the planned research activity within their jurisdiction. The product of this research will be a comprehensive report describing the technology design, its operating conditions, the waste streams selected, and the results of the experiments. One section of the report will deal specifically with the limitations of the selected technology regarding waste streams capable of being accepted, on-line air pollution control devices and potential alternatives and any design changes that may make the technology more adaptable to a variety of waste streams. Consideration will also be given to sizing of units, potential for portability and cost/benefits of such. The output of this effort will be directed toward the EPA establishing thermal degradation standards for hazardous wastes and the best way to achieve safe ultimate disposal.
Keywords: incinerators; hazardous materials; wastes; pyrolysis; aromatics; organic chlorine compounds; water pollution; environmental impacts; toxicity; air pollution.

71508 Laboratory and Field Evaluation of Processes and Materials for Encapsulating Containers Holding Hazardous Wastes. Lubowitz, H.R. (TRW, Inc., 1 Space Park, Redondo Beach, CA). **Project number:** C818A-S4T06. **Contract:** 68-03-2483. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: (1) demonstrate in the laboratory and field encapsulation techniques (Resin Fusion Process (RFP) and Atmospheric Temperature Resin Curing Process (ATRCP)); and (2) determine the United States inventory of 55-gallon drums holding hazardous wastes. Also, the work performed with use of cementi-

tious materials for encapsulation of small containers is to continue. The encapsulates produced by the RFP and ATRCP are characterized by tough, flexible plastic jackets reinforced by stiff, load bearing fiberglass casings. The RFP employs thermo-setting polyolefins, with a fiberglass matrix for strength, surrounded by 1/4" polyethylene (seamless). Special fusing equipment is required for thermosetting, and container size is pre-set by the size of this equipment. The ATRCP employs brushing (or eventually spraying) resin upon fiberglass encasements. The fiberglass is capable of being laid directly on the container, and no thermal curing is necessary. The ATRCP appears at this time to have distinct advantages over the RFP due to its atmospheric temperature curing, which should be beneficial in field operations or where different sizes of containers exist. The ATRCP withstands physical and chemical stresses above projections for landfill and is most promising for field applications, deteriorated containers, and varied sizes of containers, but requires specialty, higher priced resins. RFP withstands physical and chemical stresses above projections for landfill and employs mass-produced, well characterized, low cost resins. In cementitious encapsulation low shrinkage and water impermeability are desirable characteristics of the concrete mix. Corrosion by green concrete is avoidable.
Keywords: hazardous materials; encapsulation; containers; resins; polyethylenes; cements; performance.

71509 Priorities Assessment of Energy and Materials Recovery Technique. (National Academy of Sciences, 2101 Constitution Avenue, Washington, DC, 20037). **Project number:** C818A-S5T018. **Contract:** 68-03-2629. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$75,000.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The general objectives of the research are to identify research needs for energy and materials recovery, and to prioritize these needs relative to the type and extent of federal assistance required. A literature survey of the present state of the art and existing constraints (including economic) to resource recovery, will be conducted. The magnitude of the effect in relation to proportion of the population affected, market share involved, energy consumed, trade balance, and land use will be ascertained. The need for incentives to motivate the private and quasi-government sectors to conduct research and development will be considered. The NAS committee is being organized, and individuals are being screened for development of papers to be presented at symposia.
Keywords: energy conservation; materials recovery; technology assessment; sediments; pollution; environmental impacts; sludges.

71510 Fundamental Considerations in the Preparation of Refuse-Derived Fuels. Trezek, G.J. (University of California at Berkeley, Department of Mechanical Engineering, Berkeley, CA, 94720). **Project number:** C818A-S5T023. **Contract:** R805414-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$122,000.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The grantee has developed fundamental relationships involved in the size reduction of municipal solid waste (MSW). Additional research has been conducted on fine grinding of MSW. The objective of this research is to explore and develop the theoretical relationships involved in the production of densified refuse-derived fuels (DRDF). The important dependent and independent variables which will fully characterize DRDF formation will be identified. Experiments will then be performed to measure these variables. Basic relationships will then be developed to help design and predict the performance of a RDF densification process. An experimental unit has been installed and preliminary tests are proceeding. Detailed experiments will be pursued during the second year of work. Progress has been delayed because of major damage to the building. Grantee has requested a 12-month no-cost extension.
Keywords: refuse derived fuels; fabrication; municipal wastes; solid wastes; waste processing; density.

71511 Effects of Burning Densified Forms of Municipal Solid Waste Derived Fuels in Industrial Utility and Institutional Stoker. Degler, J. (Systems Research Lab., Inc., 245 N. Valley Rd., Xenia, OH, 45385). **Project number:** C818A-S5T040. **Contract:** 68-03-2426. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(80); conservation(20) **R and D categories:** Environmental transport and conversion of pollutants.

This contract will study the environmental and engineering aspects of using D-RDF as a supplementary fuel with coal in stoker boilers. The contractor will be responsible for conducting the combustion studies, as well as determining the engineering and other technical requirements of detailed experimental runs at selected boiler(s). Phase I of the study, i.e., experimental test burns, have been conducted in boilers near Hagerstown, Maryland. Phase II will involve additional runs and/or a demo type run at another location. In combustion tests near Hagerstown, Maryland, coal was used with 1/2 inch D-RDF pellets in ratios of 1:1 and 1:2. Few problems were evident with handling and feeding to the boiler. A second phase combustion test was conducted at the General Electric Plant, Erie, Pennsylvania. Approximately 2000 tons D-RDF from NCRR and Teledyne National were burned in ratios of up to 100% D-RDF. Differences were noted between materials handling and combustion of the more deteriorated NCRR pellets and the newer Teledyne pellets. Teledyne pellets were cleaner of inerts and fines. Emissions and other sample analyses and data reduction are in progress. The D-RDF concept appears to be feasible with possible exception of production costs.
Keywords: refuse derived fuels; coal; hybrid systems; boilers; maryland; pennsylvania; combustion; environmental impacts.

71512 Small Scale and Low Technology Study. Mitchell, G. (Stearns, Conrad and Schmidt Engineers, Inc., 11800 Sunrise Valley Drive, Herndon, VA, 22091). **Project number:** C818A-S5T16. **Contract:** 68-03-2653. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$6,000.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to examine available resource recovery technology at small-scale and low-technology; determine applications to small communities with populations of 100,000 or less; and determine which of any emerging techniques may be worthwhile R and D ventures. All available or emerging concepts were examined in terms of applicability to small towns, shopping centers, apartments, airports, etc., as specified by RCRA 1976. It was determined that two techniques, starved-air incineration with heat recovery and source separation at the collection point, were the top-priority methods in terms of state of development and feasibility of implementation.
Keywords: materials recovery; technology assessment; feasibility studies; environmental impacts; residential buildings; office buildings; energy balance; recycling; solid wastes.

71513 Comparative Study of Air Classifiers. White, R.M. (Midwest Research Institute, 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** C818A-S5T24B. **Contract:** 68-03-2730. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$194,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to evaluate the performance of various types of air classifers and compare their results. Test locations are to be five resource recovery facilities. The technical approach is to test five air classifiers at the operational plants where they are in use, evaluate each one for the same operational parameters, use test methods which are as nearly alike as possible, and compare the results of the parameters evaluations. A general test plan will be used to establish the number of tests to be performed, the length of the tests, the number and size of samples required, and the frequency of sampling. A site specific test plan will be developed from the general test plan, for each of the test sites, to accommodate the existing conditions at each site and provide comparable test data for all of the test sites. The project is just beginning and the current plans are to conduct negotiations with the first two locations selected for testing and proceed as soon as possible with those tests. While those tests are being set up and completed the negotiations will be conducted for the remaining sites. The period of performance, including the final report, is 24 months. Thus far, five test sites have been chosen. An IAG with the Navy for testing of small air classifiers has been processed.
Keywords: air quality; monitoring; site selection; measuring methods; measuring instruments; air pollution monitors; comparative evaluations.

71514 Refuse-Derived Fuel as a Supplemental Fuel in Cement Kilns. Willey, C.R. (Maryland State Environmental Service, 60 West Street, Annapolis, MD, 21401). **Project number:** C818A-S5T24D. **Contract:** R805613-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$135,000.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine optimal processing techniques for preparing MSW into a suitable fuel for adding to cement kiln coal fuel for the purpose of disposing of the wastes and reclaiming fuel value, thus saving on coal fuel costs. Single and multiple-stage shredding with different shredders and metal and glass removal in-between stages is being studied, coupled with burn-tests at production cement kilns. To date, it has been determined that double shredding to approximately 1 to 1-1/2 inch particle size is sufficient to burn the MSW/RDF efficiently in the kilns, using a vertical and horizontal hammermill to prepare the RDF.
Keywords: cement industry; energy sources; refuse derived fuels; combustion properties; economics; quality control; kilns; fuel substi-

tution; specifications; ashes; fly ash; waste processing plants; optimization; equipment.

71515 Production of 2000 Tons of Densified Refuse-Derived Fuel. Cramer, K. (Teledyne National, 117 Church Lane, Cockeysville, MD, 21031). **Project number:** C818A-S5T24E. **Contract:** 68-03-2760. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$127,000.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to produce 2000 tons of DRDF for use as supplementary fuel in coal/DRDF test burn at General Electric, Erie, Pennsylvania. One-thousand tons will be produced in four months, and an additional 1000 tons will be produced in another four months. All pellets will be 1/2 inch by 1 inch (nominal), produced with a California pellet mill. Thus far production rates have been much less than anticipated, the DRDF fuel has been of a higher quality than previous production, and transportation costs have been very high.
Keywords: refuse derived fuels; fabrication; density; combustion; waste management.

71516 Development of Data for Scale-Up for Continuous Processing or Pyrolytic Oils. Knight, J.A. (Georgia Inst. of Tech., 225 North Ave., NW, Atlanta, GA, 30332). **Project number:** C818A-05T13. **Contract:** R806403-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The broad objective of this program is to maximize the value of pyrolysis oils obtained by pyrolysis of agricultural, forestry, and municipal residues and wastes so that maximum resource recovery and commercial value can be realized from these materials. The specific objective of this phase of the program is to develop the data to design a pilot plant for continuous processing of pyrolytic oils for the production of oil fractions suitable for industrial chemical applications. Three separation schemes based on current results have been selected for more detailed investigation at the bench level. A single separation scheme will be devised then for intensive testing at the bench level and individual steps will be tested on a continuous basis. In the last phase of the program, a bench scale system will be tested on a continuous basis to develop the necessary data for scaling up the process. The final result will be the design of a pilot plant for testing the continuous processing of pyrolytic oils to produce oil fractions suitable for testing for industrial chemical applications. The lab scale studies for the processing of pyrolytic oils have been completed. The scale-up to continuous separation of pyrolytic oils is being accomplished currently.
Keywords: agricultural wastes; wood wastes; municipal wastes; pyrolysis; pyrolysis products; pyrolytic oils; fractionation; processing; bench-scale experiments; scaling laws.

71517 Hazardous Waste Sampling, Analysis and Compatibility Study. Stephens, R.O. (California State Dept. of Health, 714 D St., Sacramento, CA, 95814). **Project number:** C818A-7037. **Contract:** R804692. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The overall objectives of this research program are to investigate procedures for sampling, classifying, analyzing, and handling hazardous wastes. A series of procedural field manuals will result from this program that will be primarily directed to persons who are responsible for sampling, handling, and disposing of hazardous wastes. The information and knowledge generated by this program provide vitally needed guidelines for hazardous waste handlers and establish base-line data for the development and refinement of future state and federal hazardous waste management regulations. In addition to the aforementioned, a special area of investigation has been supported to develop a field testing kit for waste reactivity. This will support the need for better control over final disposition of waste streams and avoid accidents. Sampling procedures for hazardous waste streams is in final typing for publication. A method for determining hazardous waste compatibility draft is out for technical review.
Keywords: hazardous materials; industrial wastes; waste management; sampling; radioactive wastes; manuals.

71518 Role of Aquatic Communities in Evaluating Strategies, Establishing Standards and Monitoring Programs for Water Quality Management. Brigham, W.U. (Univ. of Illinois, 275 Natural Resources Bldg., Urbana, IL, 61801). **Project number:** C821A-S2TC14. **Contract:** R805614-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The purposes of this investigation are: (1) to investigate the role of aquatic communities in evaluating strategies for water quality management; (2) to define the term fishable in light of non-steady-state environmental effects; (3) to explore and recommend appropriate standards which account for these effects; and (4) to design and test a responsive monitoring program. The relationship between aquatic biological communities and their physical and chemical environment will be explored. The survival or demise of communities will be related to spatial and temporal patterns of physical and chemical events. If possible, survival will be related to such statistical measures as expected magnitude and duration, and reoccurrence of critical chemical characteristics will be related to natural and man-induced effects so that, in the end, causes and effects of management controls can be assessed. The methodology will be demonstrated in the Dupage (Illinois) River Basin. A literature review of other water quality indices has been completed. Preliminary stress function relationships have been developed and are being integrated into a comprehensive assessment model. Background water quality data on the Dupage River Basin has been assembled.
Keywords: aquatic organisms; management; standards; recommendations; monitoring; water quality; physical properties; chemical properties; mathematical models; rivers; illinois.

71519 Wastewater Research Program and Project Management. Bishop, O. (EPA, Municipal Environmental Research Lab., 26 W. St. Clair St., Cincinnati, OH, 45268). **Project number:** C821A-0130. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the program are to develop and demonstrate new and improved technology to control, treat, and/or prevent a wide variety of pollutants, including the wastewaters from sanitary sewage, storm and combined sewer flows, and runoff and industrial wastewaters discharged into municipal sewers. This program, implemented by the Wastewater Research Division, uses contracts, grants and interagency agreements to accomplish its mission. Approximately one-third of the program's intramural resources is devoted to in-house research. The remaining two-thirds is used for extramural project management and supporting program management. This data sheet represents the project and program management effort. In addition to the project officer complement, it supports the Branch, Division, and OD MERL staffs; approximately 10% of total in-house resources are devoted to technical assistance. Results of the management effort can be found in the technical outputs of the Wastewater Research Program.
Keywords: waste water; sewage; water pollution; industrial wastes; management; research programs; municipal wastes.

71520 Thermoradiation Treatment of Sewage Sludge Using Reactor Waste Fission Products. Sivinski, H.D. (Department of Energy, Albuquerque Operations Office, Albuqerque, NM). **Project number:** C821B-01TA28. **Contract:** D5-0675. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: nuclear fission(50); conservation(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the research program is to constructively couple two environmental problems, disinfection and treatment of sewage sludge and disposal of nuclear waste materials. Successful coupling could lead to a mutually beneficial solution, the utilization of nuclear waste products in the disinfection and treatment of municipal sludges. Gamma irradiation tests, using Cs 137 and Co 60, have been conducted on liquid sewage sludges, sludge cake, sludge compost, and dried sludges in batch and small bench scale dynamic test systems. Thermoradiated sewage sludges have also been fed to grazing animals as a food supplement, as a soil amendment and range supplement in experimental studies by New Mexico State University. Cost/benefit studies have been conducted by Battelle Pacific Northwest Labs. and Arthur D. Little Co., in conjunction with Sandia Laboratories. Health risk studies are also being conducted for HERL by BDM Corp. Irradiation at ambient temperatures at 1 mrad (or less at elevated temperatures) are effective in eliminating pathogenic organisms in sewage sludges. Thermoradiated undigested sewage sludge shows promise as a food supplement for grazing animals. Thermoradiated sewage sludge shows promise for soil amendment. Cost studies favor the use of gamma irradiation for disinfecting sludge cake (dewatered sludge), sludge compost, and dried sludge. Based on prior test results, a pilot scale irradiator (8 tons/day) was constructed. Emphasis in FY 1979 will be on investigating disinfection of sludge cake, sludge compost, and dried sludges with this pilot unit.
Keywords: sewage sludge; municipal wastes; disinfectants; radiosterilization; waste product utilization; radioactive wastes; gamma radiation; cobalt 60; cesium 137; liquid wastes; pilot plants.

71521 Technical, Environmental and Economic Co-Disposal System Research Evaluation. Boo, B. (Western Lake Superior Sanitary District, 325 Lake Avenue South, Duluth, MN, 55802). **Project number:** C821B-01TB13. **Contract:** R806144-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$200,000.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to evaluate the first fluidized bed municipal wastewater sludge incinerator that will use refuse-derived fuel instead of fossil fuels to burn the sludge. The plant is expected to be in operation by May 1979, when the evaluation can be started.
Keywords: economics; environmental effects; sewage sludge; solid wastes; combustion; waste disposal; energy consumption; feasibility studies; combustors; evaluation.

71522 Determine the Effect of Temperature and Oxidizing Conditions on Metals and Particulates When Sludge is Thermally Destroyed. Wall, H.O. (EPA, Environmental Research Lab., 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** C821B-01TB14. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The particulate emissions and ash composition of sludge heated in a small furnace will be determined. Sludge will be heated to temperatures ranging from 650 degrees C to 980 degrees C in a laboratory scale furnace. Separate tests using air and nitrogen will be conducted. The air and gas leaving the furnace will be captured in an impinger train containing water. Impinger water and ash will be analyzed for metals.
Keywords: temperature effects; sludges; emission; particles; ashes; chemical composition; high temperature; gaseous wastes.

71523 Effect of Soil Properties and Previous Metal Additions on the Solubility of Metals. Ryan, J.A. (EPA, Municipal Environmental Research Lab., 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C821B-01TC03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to determine the effect of soil properties on the solubility (plant availability) of selected heavy metals (Cd, Cu, Zn, Ni, Pb), and to determine the effect of previous metal additions upon the solubility of current metal additions. Matched pairs of soil samples from control and sludge amended soils are being collected. The samples will be utilized in metal fractionation and greenhouse experiments.
Keywords: soils; metals; solubility; sorptive properties; sludges; greenhouses; soil chemistry; soil mechanics; ground release; feasibility studies; recycling; waste product utilization.

71524 Beneficial Use of Sludge as a Fertilizer and Soil Conditioner on Agricultural Land. Larson, W.E. (Univ. of Minnesota, Agronomy Building, Room 316, St. Paul, MN). **Project number:** C821B-01TC14. **Contract:** D8-0058. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$150,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to identify safe, efficient, practical methods of applying sewage sludge to land in harmony with agricultural usage while controlling pollution of surface and groundwater by a program of soil and water management. A 40-acre watershed has been prepared with terraces, underdrains, and other conservation practices. Subwatersheds with various management systems are being compared to identify land management appropriate for sludge application sites. Corn silage grown on sludge-treatment fields will be fed to milk goats and lambs. Milk from the goats and tissues from the lambs will be analyzed to determine changes in concentrations of metals, etc., caused by using sludge on land. The health and efficiency of the animals will also be determined. Sludge addition to corn and grassland has produced good yields that are not significantly different from yields of fertilized control plots. Thirty-nine metric tons/hectare of corn and 43 mt/ha on grass of low Cd sludge have not increased Cd in corn grain. Effects of winter application of sludge on runoff water quality were negligible in 1978. No measureable effects on goats or their milk or on lambs have been detected from feeding.
Keywords: sludges; waste product utilization; fertilizers; economics; soils; agriculture; water pollution control; soil conservation; ground release; health hazards; biological effects; soil chemistry; soil mechanics.

71525 Studies of Existing Land Application Systems. Ryan, J.A. (EPA, Municipal Environmental Research Lab., 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C821B-01TC02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is the documentation of the impact of existing land application practices on the metals content of the soils and the quality of the crop produced. Samples of the current sewage sludge, sewage sludge amended soils, control soils, and crops produced on the systems have been sampled and are being analyzed. Information on the length of time the site has been used, amount of sludge applied/unit time, kinds of records kept, and methods of application has been accumulated. At selected sites field plots will be established on control and sewage sludge amended soils. Analysis of soil profiles from soils receiving sewage sludge for up to 35 years as compared to control soil profiles indicate no downward movement or accumulation in lower horizons of Zn, Cd, Cu, Ni, or Pb. The concentration of these metals in plant tissue is a function of site conditions as well as amounts of metals in the soil.
Keywords: ground release; land use; crops; metals; soils; sorptive properties; solubility; sewage sludge; productivity; plant growth; zinc; cadmium; copper; nickel; lead; biological accumulation.

71526 Demonstrate/Evaluate Reclamation, Stabilization and Erosion Control of Strip-Mined Land for Agricultural Use with Municipal Sewage. Sopper, W. (Pennsylvania State Univ., 102 Ferguson Bldg., University Park, PA, 16802). **Project number:** C821B-01TC15. **Contract:** S804511. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are: (1) to determine the feasibility of using municipal sewage sludge to reclaim and vegetate land disturbed by mining activities; (2) to evaluate methods for the processing, transportation, spreading and incorporation of the sludge into the land; (3) to demonstrate application rates that will maximize benefits to soils, improve water quality, and make lands agriculturally productive; (4) to evaluate the effect of varied sludge applications on vegetation establishment and growth (grass, legume and tree species), including folier analysis to determine nutrient uptake and potential heavy metal toxicity; (5) to evaluate the effect of the sludge applications on the chemical quality of percolating recharge water; (6) to determine the degree of site amelioration resulting from the sludge application by monitoring physical and chemical changes of the surface spoil or refuse material; and (7) to evaluate the effect of the sludge application on the quality of the groundwater and/or the quality of the nearest receiving stream and/or surface water runoff by a monitoring program. Previously unrevegetated strongly acid spoils have been revegetated with sludge applied at rates varying from 3 to 82 dry tons per acre. Sludge was applied as a liquid and dewatered. Preliminary analyses have not indicated environmental pollution of soil, surface or groundwater, or of vegetation from sludge application.
Keywords: land reclamation; surface mining; erosion; municipal wastes; sewage; stabilization; erosion; land pollution control; soils; water quality; sludges; monitoring; ground water; revegetation.

71527 Heavy Metal Bioavailability in Sludge-Amended Soils. Keeney, D.R. (University of Wisconsin, Dept. of Soil Science, Agriculture Hall, Madison, WI, 53706). **Project number:** C821B-01TC25. **Contract:** R804614. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$85,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: evaluate soil and sewage sludge factors which affect plant uptake of heavy metals (cadmium, zinc, copper and nickel); elucidate mechanisms of sorption and release of these metals in sludge-amended soils; and develop laboratory methods of determining heavy metal bioavailability. Greenhouse and field trials are being conducted to evaluate plant uptake of metals. Laboratory research using chelating resins and isotopes are being conducted to evaluate retention mechanisms and develop laboratory tests. Greenhouse experiments utilizing sludges and soils as major variables indicate that sludge is the more dominant variable in determining Cd bioavailability. From field experiments on a sand and a silt loam there appear to be relatively greater increases in the concentration of Cd and Mn in corn grown on the sand, whereas for Zn the reverse is true. Samples of earthworms and their casts collected from field plots indicate that earthworms efficiently accumulate Cd or that it is preferentially associated with the material ingested by earthworms.
Keywords: metals; solubility; soil chemistry; ground release; waste product utilization; health hazards; root absorption; food chains; greenhouses; cadmium; zinc; copper; nickel; intestinal absorption; metabolism.

71528 Data Base Location and Evaluation for Heavy Metals Discharge into Municipal Wastewater Collection and Treatment Sys-

tems. Minear, R.A. (University of Tennessee, Dept. of Civil Engineering, W. Cumberland Avenue SW, Knoxville, TN, 37916). **Project number:** C821B-05AE01. **Contract:** R805606-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$94,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to locate, survey, tabulate and generally evaluate the data bases available that relate to assessment of relative source contribution of heavy metals to publicly owned wastewater treatment systems. The project will be conducted in two phases. Phase I will be directed at an intensive and comprehensive search for data bases resulting in tabulation according to geographical location, population, and industrialization classification and expressed in terms of extent of data base existence. Phase II will be directed at qualification of data base usefulness in terms of inclusiveness, quantity of data, quality of data and ability to assess total metal dynamics in a given system. Visits have been made to collect data from 58 of the 121 POTW laboratories having influent metals analysis programs. Completion of visits is expected by May 1, 1979. A computer data storage format has been worked out and raw data entry is in progress. The grantee received approximately 50% return on requests for metals data from 293 cities previously identified as having metals data, but much of the information was in the form of monthly or yearly averages. A number of the plants with significant data sets will be visited or otherwise contacted to insure data acquisition.
Keywords: metals; municipal wastes; water treatment plants; environmental impacts; ecological concentration.

71529 Removal of Toxic Substances by Physical-Chemical Processes. Westrick, J.J. (EPA, Municipal Environmental Research Lab., P C Treatment Section, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** C821B-5TAI02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to examine the removability of toxic substances from municipal wastewaters by physical-chemical processes and also by conventional process. Laboratory and pilot scale data on model compound removal indicate potential for real-world treatability. Laboratory carbon adsorption equilibrium tests are performed on clean solutions of toxic organics. Continuous flow pilot plants are used to measure removal of toxic compounds in wastewater by various treatment processes and process combinations. The results of equilibrium tests on 50 organic compounds have been collected in a manual and made available to the public. Pilot plant removability data on five specific organic compounds have been collected and will be published. Eight more organic compounds will be studied in the pilot plant. Completion of the data collection on these eight compounds is expected in May 1979. All results will be published.
Keywords: toxicity; copper; toxic materials; organic compounds; separation processes; removal; lead; mercury; cadmium; carbon tetrachloride; nitrobenzene; phthalates; water pollution control.

71530 Research on Ozone Contacting Devices. Venosa, A. (EPA, Office of Research and Development, Municipal Environmental Research, 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** C822B-03TA02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$180,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Pilot plant development work on ozone disinfection to provide an environmentally safe and cost effective alternative to chlorine for achieving water quality standards is being conducted. The objective is to develop the most cost-effective gas-liquid contractor for achieving desired bacteriological reductions in wastewater and optimum ozone utilization. Work involves a comparative study of a minimum of five different contacting devices in parallel on the same wastewater effluent. Interim reports will be published to announce the findings from each phase of the study. A comprehensive final report with specific design guidelines will be prepared at termination of the study. Five contactors have been evaluated: jet scrubber (JS), packed column (PC), positive pressure injector (PPI), bubble diffuser (BD), and turbine reactor (TR). The BD has been found to be significantly superior to all other contactors with respect to mass transfer efficiency and coliform reduction efficiency. Filtration appears to be necessary for ozone disinfection to be reliable.
Keywords: ozone; disinfectants; water quality; infectivity; bacteria; pilot plants; waste water; chlorination; chemical properties; sewage; parasites.

71531 Application of Adsorption Theory Towards Virus Decontamination. Parks, G.A. (Stanford University, Department of Applied Earth Science, Stanford, CA, 94305). **Project number:** C822B-03TA14. **Contract:** R805016-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$4,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Fundamental adsorption and colloid stability theory, physicochemical and mass transport concepts, and economic considerations will be employed to select optimum solids and conditions for an adsorption-denaturation virus removal process to be used in water treatment or wastewater treatment operations. Apparent free energies of adsorption of 3H, 14C labeled poliovirus Type 1 will be measured by batch experiments on solid phases expected to have high total adsorption potentials. These values will be compared to those previously measured on low reactivity solids such as alpha SiO2. Denaturation will be evaluated by looking at ratios of infectivity to counts per minute in unadsorbed and desorbed virus preparations and by using rate zonal sedimentation analysis to check for viral degradation products. A bench scale adsorption-filtration process will be designed to accommodate solid phases which appear to have the best overall applicability. This process will be tested with poliovirus Type 1 using dechlorinated tap water and secondary effluent, under sterile and non-sterile conditions. Metals and metal oxide surfaces tested included SiO2, Fe2O3, MnO2, Al2O3, and Al metal. The Al metal (filings) proved to be the best virus adsorber. Viruses were not only tightly adsorped to the Al filings, but also were degraded by denaturation of the protein coat. The mechanism of adsorption was a combination of double layer interaction and Van der Waals forces. The draft final report has been submitted and is being edited now. Grant close-out procedures have been initiated.
Keywords: viruses; absorption; colloids; decontamination; infectivity; economics; waste water; health hazards; recycling; removal.

71532 Guidelines for Implementing a Program for the Reuse of Municipal Wastewater Effluents. Woodward, R.L. (Camp Dresser and McKee, Inc., 1 Center Plaza, Boston, MA, 02108). **Project number:** C822B-04T14. **Contract:** 68-03-2686. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$63,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to prepare a guideline for municipalities that details a technique for implementing the reuse of municipal wastewater for non-potable purposes. The guideline will include: (1) locating sources of reusable wastewater; (2) locating potential users; (3) determining transport methods, costs, etc.; (4) entering into agreements with potential users; (5) determining present water usage and associated costs; (6) determining reclaimed water quality requirements and additional treatment needs; (7) identifying health and/or other agencies that should be consulted; (8) identifying sources of potential financing; and (9) identifying social, legal, political, or other aspects that affect implementation of a viable reuse program.
Keywords: recycling; municipal wastes; waste water; ground release; biological effects; decision making; feasibility studies; sociology; economics.

71533 Removal of Organics Using Oxidants. Love, O.T. (EPA, Municipal Environmental Research Lab., Water Supply Research Division, 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C824A-S1T026. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$29,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this project are to study the use of oxidants (principally ozone and chlorine dioxide) to remove or reduce the concentrations of general organic parameters and specific organic compounds in drinking water and to identify the oxidation products resulting from the use of such oxidants. Both bench and pilot-scale research are being used to achieve the project's objectives. To date, the ability of both ozone and chlorine and dioxide to remove trihalomethanes and/or their precursors has been studied and reported. Current efforts involve the use of ozone in combination with a granular activated carbon filter to promote increased bed life for the removal of total organic carbon and trihalomethane formation potential from drinking water. Hydrogen peroxide is also being evaluated in combination with granular activated carbon.
Keywords: removal; oxidation; ozone; chlorine oxides; drinking water; purification; organic compounds; hydrogen peroxide.

71534 Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Hertzler, B.L. (Lockheed Missiles and Space Co., Palo Alto, CA). **Project number:** C8214A-S 4T05. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to develop the MWP process for destruction/detoxification of very hazardous wastes which cannot be safely handled with more conventional methods. The process development

and laboratory demonstration through about 10 to 30 lbs/h is sought. A plasma is generated in an oxygen stream by using a 2450 megahertz power source into which hazardous wastes are added. The plasma creates high temperature reactions in a quartz reactor tube, and the effluent is quenched and analyzed for completeness of reaction. Excellent results have been obtained with gases and some liquids at 5 to 10 lb/h rates and in some instances up to 20 lb/h. However, higher flow rates with liquids and solids are a problem which may only be solved by going to a 915 megahertz source for which larger equipment is available commercially. The R and D effort required to go further with this technology is being evaluated in comparison to the potential field application.
Keywords: hazardous materials; toxic materials; microwave equipment; waste disposal; plasma; feasibility studies; industrial wastes.

71535 Granular Activated Carbon Studies. Brodtmann, N.V. (Jefferson Water Dept., Jefferson, LA). **Project number:** C824A-01T41. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

Because of growing public concern over the occurrence of trace amounts of various organic chemicals in the area potable water supply, the Jefferson Parish Water Department has recognized the need for a more efficient and reliable treatment process designed to remove such contaminants. The Mississippi River is the sole raw source available to Jefferson Parish water system. Therefore, since the use of another less polluted source is impossible, the department is faced only with seeking out new methods for removal of trace levels of organic contaminants. One such method offers the most promise of effecting trace organic compound removal. It is the use of granular activated carbon (GAC) filtration. GAC filtration will be thoroughly studied in quantitative terms and in terms of cost effectiveness during the course of this study. Performance of filter/adsorbers compared to adsorbers has been completed. A preliminary comparison of pilot carbon column with full-scale carbon bed performance indicates a good correlation between the units for most parameters investigated to date which inlude TOC, THMFP, RFM, chloroform, and 1,2 dichloroethane.
Keywords: activated carbon; drinking water; water treatment; water resources; mississippi river; organic compounds; trace amounts; filtration; sorptive properties; adsorption.

71536 Removing Organic Contaminants from Drinking Water: A Pilot Plant Study. Wood, P.R. (Dade County, Dept. of Public Health, Miami, FL). **Project number:** C824A-01T42. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

This project includes a 100 gpm pilot plant study to devise feasible and economic methodology for full scale plant removal of existing organic contaminants from ground water and/or prevention of the development of potential carcinogens in the public water supplies in Dade County, FL. The findings will also be applicable to other areas. Various types of granular activated carbon will be studied for effectiveness in removing precursor substances which react with chlorine to: (1) produce potential carcinogens, (2) remove existing contaminants present in the ground water, and (3) remove contaminants formed in the plant process. Optimum placement of carbon adsorbers, carbon life and regeneration, and the effects of ozone, ultraviolet light, and bacteria will be studied. In addition, lower cost methods of minimizing contaminants by coagulation and disinfection modifications will be studied. Investigation of four activated carbons using parallel pilot columns has been completed. These carbons were compared for adsorption of TOC, THMFP, and halogenated and non-halogenated purgeables. Based on results from these comparisons a carbon was selected for the next phase of pilot column studies.
Keywords: drinking water; water treatment; pilot plants; organic compounds; ground water; florida; activated carbon; chlorine.

71537 Prevention of Formation and/or Removal of Halogenated Organics Using Chlorine Dioxide and Granular Carbon. Mills, D.B. (Evansville City Government, Evansville, IN). **Project number:** C824A-01T43. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

A 100 gpm pilot plant will be used to evaluate various treatment schemes using chlorine and chlorine dioxide disinfection to compare resultant trihalomethane and other organic by-product formation. Removal efficiencies by granular activated carbon contactors of organic compounds existing in the raw water supply or formed during disinfection will also be evaluated. The project is divided into two phases: phase 1 (optimization phase) consists of four short-term (2 to 3 week) runs using either chlorine or chlorine dioxide disinfection in conjunction with granular activated carbon to select a mode of operation for long-term (21 month) evaluation; and phase 2 (operating phase) will evaluate chlorine dioxide using virgin and subsequent regenerated granular activated carbon. Phase 1 has been completed with Phase 2 starting shortly whereby chlorine dioxide will be added after coagulation/settling and at the clearwell.
Keywords: pilot plants; chlorine; chlorine oxides; halogenated aliphatic hydrocarbons; water treatment; activated carbon; removal; drinking water; chemical reactions.

71538 Removal of Trace Organic Compounds by Biologically Activated Carbon. Guarino, C.F. (Philadelphia Water Dept., Philadelphia, PA). **Project number:** C824A-01T51. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Health effects assessments.

National concern is focused on the presence of trace organic chemicals in surface water supplies and their potential health impacts on public drinking water. The Environmental Protection Agency has determined that granular activated carbon (GAC) is the best available treatment technology to date for treating water to remove a broad spectrum of organic contaminants. Active life of GAC, however, is somewhat limited, and the need for frequent regeneration with the associated loss of carbon is one of the significant cost burdens of the process. For this reason alternative methods of organic removal are currently under investigation. This proposal researches a promising treatment process which combines oxidation of macromolecules of organics by ozonation followed by adsorption and decomposition of these organics by biologically enhanced granular activated carbon. The combined process called biologically activated carbon (BAC) has shown promise in European plants when evaluated by surrogate organic measurements. The proposed research consists of bench scale and pilot scale studies to demonstrate the effectiveness of BAC in removing trace organics of health concern in the United States. An economic analysis will be conducted to evaluate the cost effectiveness of BAC as compared to conventional GAC treatment.
Keywords: organic compounds; trace amounts; activated carbon; surface waters; drinking water; health hazards; oxidation; ozone; sorptive properties; economic analysis; water treatment; chemical reactions.

71539 Removal of Nitrate from Contaminated Water Supplies for Public Use. Guter, G.A. (McFarland Mutual Water Co., 406 2nd Street, McFarland, CA, 93250). **Project number:** C824A-01T57. **Contract:** R805900-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$188,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The purpose of the proposed work is to objectively evaluate the general applicability of three treatment processes for removal of nitrate from public water supplies. The processes are ion exchange, reverse osmosis, and a combination process. The evaluation will consist of using laboratory size and field-test equipment to establish design criteria and operating experience useful for designing a full-scale plant of approximately 1 mgd capacity. Reverse osmosis and ion exchange equipment will be designed and assembled for the purpose of conducting a number of experiments and engineering tests to determine the technical and economic feasibility of well site treatment of water for nitrate and arsenic removal. Experiments will be conducted on natural and simulated waters.
Keywords: nitrates; removal; drinking water; contamination.

71540 Demonstration of the Thermophilic Aerobic-Anaerobic Digestion Process at the City of Hagerstown. McGauhey, M.G. (Hagerstown City Department of Water Pollution, 1040 Frederick Street, Hagerstown, MD, 21740). **Project number:** C824B-S1TA49. **Contract:** S805823-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$332,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The Water Pollution Control Unit proposes to make available its anaerobic digesters and sludge handling facilities in a research study to improve sludge digestion and increase gas production. The unique feature of the research study is the combining of an aerobic digester of new design with an existing anaerobic digester, operating both as a unit process. Raw sludge will be fed the aerobic digester, producing excess heat which can be used to heat the sludge digesting in the anaerobic digester. Several advantages will occur: shorter retention times, production of a pasteurized sludge, greater gas production, and the achievement of better stabilization of the sludge. The units are still under construction.
Keywords: maryland; municipal wastes; anaerobic digestion; thermophilic conditions; manpower; methane; production; aerobic digestion; disinfectants; viruses; parasites; waste water; water pollution

control; waste management; process control; optimization; demonstration plants.

71541 Preparation, Use and Cost of Densified Refuse-Derived Fuel (DRDF) as a Supplementary Fuel in Stoker Fired Boilers. Alter, H. (National Center for Resource Recovery,, 1211 Connecticut Avenue North, Washington, DC, 20036). **Project number:** C827-CS253. **Contract:** R804150-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$36,000.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

This research grant involves the study of the technical and economic aspects of preparing and using densified forms of municipal solid waste as a supplementary fuel in industrial and institutional stoker coal-fired boilers. Investigations are being conducted to establish methodology for preparing densified refuse derived fuel (DRDF). Process and product characterizations are being developed to enable establishment of specifications for DRDF. Densification forms will include pellets, briquettes, and cubettes. Independent boiler burn tests and operations are being conducted in conjunction with this research to fully characterize the concept. A total of 1200 to 1500 tons of pellet DRDF has been produced and combusted in stoker-fed boilers. Production rates were less than machine design capacity; die wear may have caused production problems after 1000 tons. Excess moisture caused poor pellet formation.
Keywords: refuse derived fuels; density; combustion properties; fabrication; cost; boiler fuel; economics; municipal wastes; solid wastes; specifications; pellets; briquets.

71542 Field Test Evaluation of Shredders for Waste-to-Energy Systems. Bendersky, D. (Midwest Research Institute, Technoeconomics Section, 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** C827-CWT51B. **Contract:** 68-03-2589. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$79,000.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objective is to evaluate hammer wear, life, power characteristics, and overall MSW particle size performance of several types and brands of shredders for solid waste to improve state-of-the-art of understanding and selecting these machines. Several in-field service shredders were tested for electric draw, weight change with time, and other factors as well as measurements of size distribution and analysis of waste input and output streams. A report was made on the results of this study. One result was that the number of hammers used has a significant effect on the power required. Also data is available on each shredder design for comparison of types against each other.
Keywords: solid wastes; waste product utilization; materials recovery; energy consumption; separation processes.

71543 Engineering Design Considerations in Selecting Conveyors for Resource Recovery Systems. Campbell, J. (National Center for Resource Recovery, Inc., 1211 Connecticut Ave. NW, Washington, DC, 20036). **Project number:** C818A-55T24C. **Contract:** R806709-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The objective of this project is to develop engineering and scientific data to enable the proper design for conveyors and other materials handling equipment for processing municipal solid waste, especially for resource recovery. Test rigs will be set up with available equipment to systematically study, through experimentation, the basic variables important in the materials handling of solid waste. Information will be used to supplement existing design data for conveyors used in other applications.
Keywords: resource recovery facilities; design; conveyors; municipal wastes; solid wastes; materials handling equipment.

71544 Determine Physical and Chemical Characteristics of Synthetic Asphalt Produced from Liquefaction of Sewage Sludge. Law, C.L. (Honolulu City and County Government, 650 S. King, City Hall, Honolulu, HI, 96813). **Project number:** C821B-SITB23. **Contract:** R806790. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

Sewage sludge will be converted into synthetic asphalt by thermochemical aqueous liquefaction. The physical and chemical properties of the synthetic asphalt with regard to application and durability will be determined. Samples of sewage sludge will be liquefied by addition of alkali and reaction at temperatures of 280 to 360 degrees C. The liquid samples will be recovered and distilled, leaving a synthetic asphalt. This material will be examined as a replacement or extender for petroleum asphalt in road paving applications.
Keywords: sewage sludge; liquefaction; asphalts; physical properties; chemical properties; roads; pavements; thermochemical processes; synthesis.

71545 Evaluation and Development of Temperature Control Strategies to Minimize Organic Matter Degradation in Static Pile Sewage Sludge Composting. Finstein, M.S. (Rutgers Univ., New Brunswick, NJ, 08903). **Project number:** C821B-SITB28. **Contract:** R806829-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The main objective of this proposal is to demonstrate that the composting process can be hastened by using temperature control as a primary process control parameter. Benefits expected from the successful completion of this demonstration are: (a) more rapid stabilization, thereby decreasing space and facility requirements; (b) insuring a well-stablized end-product; and (c) minimizing the amount of process residue needing final disposition. The above objectives will be accomplished by evaluating various temperature control strategies while being mindful of the interrelatedness of temperature, moisture, and aeration. The field experiments will be performed at the Camden, New Jersey, treatment plant site using compost piles specifically operated for this research.
Keywords: temperature control; sewage sludge; biodegradation; composting; optimization; waste processing; pilot plants; new jersey.

71546 Treatability of Carcinogenic and Other Hazardous Organic Compounds by Biodegradation and Activated Carbon Adsorption. Fochtman, E.G. (IIT Research Inst., 10 W. 35th St., Chicago, IL, 60616). **Project number:** C822B-S5AE02. **Contract:** Z806559. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The research objective is to determine the capability of biological and physical-chemical processes to remove carcinogenic and other hazardous organic compounds from aqueous solution. Biodegradation will be investigated in continuous flow reactors on a laboratory scale, and activated carbon adsorption characteristics will be determined by isotherm testing of the selected compounds. Protocols for evaluation of treatability will be applied in a systematic manner for the compounds studied.
Keywords: hazardous materials; carcinogens; biodegradation; water chemistry; water pollution; removal; water treatment.

71547 Multiple Process Approach for Removal of Organic Substances from Drinking Water. Brodtmann, N.V. (Jefferson Parish Water Dept., 3600 Jefferson Hwy., Jefferson, LA, 70121). **Project number:** C824A-SIT91. **Contract:** S806925-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The project will evaluate operational modes of granular activated carbon contactors for organic removal, byproduct formation from oxonation, operational and maintenance costs and environmental emissions from on-site carbon reactivation. The project involves construction and long term operation of a multi-modal, pilot and large scale granular activated carbon system designed specifically for removal of organic substances. Intensive analysis of the effluent of each process will provide definitive information regarding the fate of many organic and certain metal inorganics in addition to microbiological data. Operational experiences and cost data will be collected.
Keywords: drinking water; water treatment; organic compounds; activated carbon; by-products; cost; sorptive properties; adsorption; pilot plants; environmental impacts.

72000 Program Management of Technical Support for Renovated Water Program. Pahren, H.P. (EPA, Health Effects Research Lab., 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** D823B-001E. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The purpose of the research is the management of an extramural program on reuse of renovated wastewater for potable purposes. A final report was completed on direct and indirect reuse. Several projects were continued and several initiated.
Keywords: waste water; drinking water; recycling; purification.

72001 Organic and Organotin Compounds Leached from PVC and CPVC Water Pipes. Boettner, E.A. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** D823B-012C. **Contract:** R806275-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine whether organotin compounds are introduced into potable water supplies when using polyvinyl chloride and chlorinated polyvinyl chloride pipe containing tin compounds as stabilizers. A secondary objective is to determine what chemicals other than tin compounds are leached from such piping into the water supply. A two-step approach is being used. First, the analytical methodology, capable of determining the extracted chemicals in their compound form at the levels at which they are expected to be present will be established. This methodology will then be incorporated in a system to determine the amounts of organotins and other compounds in water supplies using PVC and CPVC piping. Accomplishments during the first three months of this effort include a literature search for appropriate methodology, communication with PVC and CPVC and stabilizer formulators, preparation of appropriate extracts of plastic samples, and characterization of five tin compounds used as stabilizers.
Keywords: pvc; pipes; drinking water; leaching; tin compounds; organometallic compounds; quantitative chemical analysis; water quality.

72002 Tumor Initiating Potential of RO and XAD Concentrate Fractions from a Five-City Survey. Robinson, M. (EPA, 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** D823B-013B. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine the tumor initiating potential of the RO and XAD concentrate fractions from a five-city survey (Miami, Ottumwa, Seattle, Philadelphia, and New Orleans) using the sencar mouse model. In this initiation/promotion study the concentrates are given subcutaneously on the back of the skin tumor susceptible mice at 25 mg/kg three days a week for two weeks for a total dose of 150 mg/kg. Two weeks after the final dose of the concentrates the promoter applications are started. Phorbol myristate acetate is used as the promoter. It will be applied topically on the shaved area of the back of the mice three times a week for 30 weeks. The dose of the promoter (PMA) is 1.0 microgram in 0.1 ml of acetone for each application. Endpoints are: number of tumors, number of tumor bearers, time to first tumor, time to 50% animals with tumors, and histology. After 16 weeks of promotion, there is a 10% tumor incidence in the RO treated animals for Miami and Ottumwa and the XAD treated animals for Miami. There is an 8% tumor incidence in the XAD/New Orleans and the RO/New Orleans; 5% tumor incidence in the RO/Philadelphia, XAD/Ottumwa, and XAD/Philadelphia. The vehicle control group has 5% of mice with tumors. No significance can be made of the results yet.
Keywords: mice; neoplasms; drinking water; testing; carcinogenesis; urban areas; subcutaneous injection.

72003 Develop and Evaluate Methods for Isolation and Identification of Gastroenteritis Bacteria from Environmental and Clinical SAM. Ericksen, T.H. (EPA, 555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** D823B-014A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The research objective is to develop selective and differential methods for the isolation, detection, enumeration, and identification of pathogenic bacteria associated with outbreaks and endemic gastroenteritis. Laboratory experiments involving modification of temperature, pH, concentration technics, nutrient type, and level will be performed. Specific agents to be investigated initially will be Campylobacter, Yersinia, and enterotoxigenic E. coli. Draft protocols for isolation and detection of Salmonella, Shigella, Campylobacter, Yersina, and enterotoxigenic E. coli from water samples have been prepared. The protocols are undergoing review and will be used as a basis for studies under this task.
Keywords: bacteria; purification; enteritis; measuring methods; sample preparation.

72004 Non-Confirming Virus Plaques from Samples. Brashear, D.A. (EPA, 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** D823B-016A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The research objective is to investigate the possible causes for the non-confirmation of apparent viral plaques produced from environmental samples. In order to determine the extent of this problem, a questionnaire was prepared covering pertinent aspects of tissue culture used, laboratory protocols for determining a viral plaque, and types of environmental samples studied. Analysis of replies will be used to formulate a cause for non-confirmation. Subsequently, tests will be performed to test any hypothesis as a basis for the phenomenon of non-confirmation.
Keywords: plaque formation; viruses; tissue cultures; testing.

72005 Effects of Halogenated Aromatic Hydrocarbons on the Metabolism of Foreign Organic Compounds. Carlson, G.P. (Purdue University, Dept. of Pharmacology and Toxicology, Life Sciences Bldg., West Lafayette, IN, 47907). **Project number:** D823B-0165. **Contract:** R805070-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental effects assessment.

The objective of this research is to determine what effects halogenated aromatic compounds have on the metabolism of foreign compounds. The project consists of eight different studies. Taken as a whole these studies, outlined below, will allow for an assessment of the hepatotoxicity, porphyrinogenicity and microsomal enzyme inducing capacity of a number of halogenated compounds. Studies include: (1) distribution and storage of 1,2,4-trichlorobenzene and 1,2,4-tribromobenzene related to enhanced xenobiotic metabolism; (2) distribution and storage of PCBs related to enhanced xenobiotic metabolism; (3) metabolism of 1,2,4-tribromobenzene; (4) effect of 1,2,4-tribromobenzene metabolites on xenobiotic metabolism; (5) effect of chlorinated and methylated benzoquinones on xenobiotic metabolism; (6) effect of halogenated benzenes on esterase activity; (7) porphyria induced by halogenated benzenes; and (8) effect of benzofurans on xenobiotic metabolism. Five of the eight studies under this project have been completed.
Keywords: organic halogen compounds; metabolism; response modifying factors; aromatics; biochemical reaction kinetics; bromine compounds; toxicity; furans; liver; hydrocarbons.

72006 Survival of Naturally Occurring Viruses in Environmental Samples. Brashear, D.A. (EPA, 5555 Ridge Ave., Cincinnati, OH, 45268). **Project number:** D823B-917A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The research objective is to ascertain the extent or degree of survival of enteroviruses on land following sewage or sludge disposal. A land disposal site for activated sludge has been selected for the study. A longitudinal study of various time spans will be initiated in order to determine the rate of inactivation, varying with seasonal fluctuations of temperature, rainfall, and sunlight. Virus content of sludge is also expected to vary with the seasons.
Keywords: viruses; survival curves; sewage sludge; ground disposal; seasonal variations.

72007 Detection of Unculturable Enteric Viruses. Akin, E.W. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D823B-018A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The research objective is to detect in human specimens the viral etiological agents (and specific antibody) of waterborne gastroenteritis and hepatitis A that cannot be cultivated, and thereby identified, in vitro. The approach is to establish serological tests such as RIA, ELISA, and IEM, and then apply these tests to specimen collected in HERL-sponsored waterborne outbreak investigations. IEM of rotavirus in infant diarrheal stools has been accomplished.
Keywords: enteritis; hepatitis; man; viruses; detection; bioassay; blood serum.

72008 Methods for Concentrating Enteric Viruses. Williams, F.P. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D823B-019A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The research objective is to develop and evaluate methods for concentrating and detecting animal viruses in large volumes of water. Modifications to the tentative standard methodology or development of new methodology reported in the world literature are evaluated with an experimental design involving monodispersed virus, replicate samples, and large volumes of drinking water (100 to 500 gal). Promising candidate methodologies will be field tested. A tentative standard method for drinking water was written and appears in the 14th edition of Standard Methods. The method was based upon evaluation of candidate procedures and results have been published in peer reviewed literature. The organic flocculation technique has been found superior to glycine in certain instances. An in-sample bacteriophage marker system for recovery efficiency has been evaluated.
Keywords: viruses; detection; drinking water; evaluation; measuring methods.

72009 Assay of the Capability of Six City Concentrates to Potential Chloroform Hepatotoxicity. Bull, R.J. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D823B-020B. **Sup-**

ported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA.
Related energy source: general science(100) R and D categories: Health effects assessments.

The objective of this study is to determine if the toxicity of chloroform is potentiated by RC and NAD concentrate fractions from a 5-city survey using the Cd-1 mouse. Alteration of the chloroform toxicity is to be determined by exposed Cd-1 mice to the RO and XAD concentrates from Miami, Philadelphia, Ottumwa, Seattle, and New Orleans, ip, in emulphor for three daily injections totaling 300 mg/kg. On the fourth day animals were challenged with 500 mg/kg chloroform and sacrificed two hours later. The chloroform toxicity is measured by the depletion of glutathione in the liver. In addition to the chloroform toxicity, five other parameters will be looked at using the same dose level but without chloroform challenge: sleep-time assay, cytochrome-P-450, cytochrome-C-reductase, and protein binding of 14ChCl3.
Keywords: chloroform; toxicity; mice; liver; synergism.

72010 Retrospective Epidemiologic Study of Hepatitis A and Water Quality. Batik, D. (EPA, Cincinnati, OH, 45268). Project number: D823B-022A. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA.
Related energy source: general science(100) R and D categories: Epidemiological studies.

The research objective is to determine the existence of correlation between hepatitis A disease and drinking water source and quality. The approach is to conduct retrospective epidemiological studies in two areas of country where good hepatitis A case reporting occurs. The initial study did not reveal an association between water quality and hepatitis A cases.
Keywords: epidemiology; hepatitis; drinking water; water quality; correlations; public health.

72011 Study of the Health Effects of Sodium in Drinking Water. Tuthill, R.W. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). Project number: D823B-023C. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA.
Related energy source: general science(100) R and D categories: Health effects assessments.

The objectives of the study are to replicate, under identical circumstances, a recent study reported from University of Massachusetts, Amherst. In that study the distribution of blood pressure of school children in a high sodium community (108 ppM) was significantly upshifted when compared to the children of a low sodium community (8 ppM). The current study will compare two communities with 22 and 376 ppM sodium, respectively, to replicate the earlier findings and to ascertain a possible dose response as a basis for a sodium drinking water standard. The blood pressure of 7th grade pupils will be taken by carefully standardized individuals in the schools of both communities. A 24-hour dietary diary, home water samples, and first morning urine samples will be obtained on a sub-set of approximately 100 children in each community and analyzed for sodium and potassium.
Keywords: sodium; diet; children; trace amounts; comparative evaluations; blood pressure; potassium; biological effects.

72012 Study of Dental Effects in a Population Exposed to H2O Fluoride Levels in Critical Zone. Smith, C.T. (Univ. of Texas, San Antonio, TX, 78284). Project number: D823B-024C. Contract: R806238-01. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA.
Related energy source: general science(100) R and D categories: Health effects assessments.

In the proposed study, information regarding mottling and discoloration of teeth will be compared to fluoride levels in the public water supplies of several communities. Volunteer participants will be recruited through public schools in eight communities having naturally occurring high fluoride levels. Students from grades 1 to 4 (6 to 9 y of age) and whose families utilize water delivered by the community water system will serve as a source of volunteers. An oral examination to determine level of mottling, discoloration of teeth and a DMFS survey will be administered to each participant and a urine sample will be collected for fluoride analysis. Information regarding personal and health background will be obtained with specially designed questionnaire forms. An opinion survey regarding perception of problems related to teeth mottling and discoloration will also be administered by use of a second questionnaire form. Data resulting from oral examinations, analyses of urine samples, background health and personal indicators, and opinions regarding the problems of mottling and discoloration will be compared to fluoride levels in the various community water supplies to determine the specific level of fluoride at which problems occur.
Keywords: fluorides; biological effects; human populations; teeth; children; drinking water.

72013 Assessment of Asbestos Exposure to U.S. Public from Drinking Water. Millette, J.R. (EPA, Office of Research and Development, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). Project number: D823B-031C. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA-$30,000.
Related energy source: Coal(50); oil shale(50) R and D categories: Health effects assessments.

The purpose of this task is to gather information by in-house analyses of correspondence with other researchers on the extent of asbestos fiber in the drinking waters of the United States. The output of this task will be an ORD research report which will list the asbestos data compiled by water supply and state and classified as to analyzing laboratory and type of analysis method used. Results to date include in-house analyses of nearly 500 samples and compilation of data on over 700 water supplies in 32 states. A computer data base of all available waterborne asbestos data has been initiated, and a report is being prepared.
Keywords: asbestos; drinking water; qualitative chemical analysis; quantitative chemical analysis; water quality; usa; human populations; health hazards; data compilation.

72014 Health Consequences of Benzene Contamination of Drinking Water. Miday, R. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). Project number: D823B-032B. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA.
Related energy source: Coal(100) R and D categories: Health effects assessments.

A small population (35) of persons exposed to well water contaminated with benzene (9 ppM) will be studied to determine the incidence of adverse health effects. Combined environmental, epidemiologic, and clinical pathological studies utilizing an appropriate unexposed control group will be used.
Keywords: wells; ground water; benzene; trace amounts; biological effects; epidemiology; pathological changes; man; contamination.

72015 Cancer Incidence in Relation to Asbestos in Drinking Water in the Puget Sound Region. Polissar, L. (Fred Hutchinson Cancer Research Center, 1102 Columbia St., Seattle, WA, 98104). Project number: D823B-038C. Contract: R805846-02. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA.
Related energy source: Coal(50); oil and gas(50) R and D categories: Health effects assessments.

Cancer mortality and incidence data will be used to determine if there is an elevated cancer risk for those persons living in Puget Sound region with a high concentration of asbestos in the water supply. Data will include death certificates, incidence records from SEER population-based tumor registry, census tabulations, and water analyses. Statistical methods will include calculations of rates and relative risks. A case-control study will be undertaken.
Keywords: asbestos; carcinogenesis; risk assessment; drinking water; mortality; stochastic processes; puget sound; washington; human populations.

72016 Investigation of Effects of Prolonged Inhalation of Nickel-Enriched Fly Ash in Syrian Golden Hamsters. Wehner, A.P. (Battelle Pacific Northwest Lab., Department of Biology, P.O. Box 999, Richland, WA, 99352). Project number: D834-011. Contract: 68-03-2457. Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. Funding: EPA-$28,000.
Related energy source: Coal(100) R and D categories: Biological effects of pollutants in experimental systems.

The objective of this study is to evaluate the toxicologic and carcinogenic effects of long-term inhalation exposure to fly ash enriched with nickel. By comparing enriched and non-enriched fly ash, it will be possible to assess the relative contribution of nickel to the toxicity and carcinogenicity of fly ash. The study is divided into three phases. During the 12 months of Phase I, fly ash enriched up to 12% with nickel was produced and the respirable particle fraction collected. Methods of aerosolizing the fly ash were perfected. Acute and subacute toxicity studies were conducted during Phase II. Phase III consists of lifetime exposure (20 months) of Syrian golden hamsters to either nickel enriched or non-enriched fly ash. Two fly ash concentrations, 15 mg/cubic m and 75 mg/cubic m, are being used. Phases I and II have been completed. Two months exposure to fly ash concentration of approximately 18.5 mg/cubic m indicated that the subacute toxicity of both enriched and non-enriched fly ash was quite low. Phase III began in January 1978. Groups of animals will be sacrificed every 4 months up to 20 months. Body weights and spontaneous mortality have thus far not been greatly affected by fly ash inhalation.
Keywords: fly ash; biological effects; nickel; inhalation; toxicity; chemical composition; quantity ratio; hamsters; mortality; epidemiology; males; pathological changes; biological models.

72017 Recovery of Asbestos Fibers from Baboon Tissues. Hallenbeck, W.H. (Univ. of Illinois, Box 4348, Chicago, IL, 60680). Project

number: D823B-040C. **Contract:** R806256-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The research objective is to determine fiber size and distribution of ingested asbestos fibers in lung, urine, and tissues which show the migratory pathway of fibers through the body. Juvenile baboons will be used for control and test. A concentrated suspension of chrysotile and amphibole asbestos of the types found in drinking water will be used. Collection of urine and blood will be followed by sacrificing of the animals. The following tissues will be examined for the presence of fibers: urine, blood, lung, pleura, urinary bladder, pancreas, and peritoneum.
Keywords: apes; asbestos; ingestion; biological pathways; tissue distribution.

72018 Co-carcinogenic Potential of Arsenic in Drinking Water. Shirachi, D.Y. (Univ. of the Pacific, 3601 Pacific, Stockton, CA, 95204). **Project number:** D823B-044C. **Contract:** R804610-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Our principal objective is to determine if the link between arsenic and cancer could occur if arsenic were to act as a cocarcinogen, concurrent with the biochemical cocarcinogenicity of the following arsenic species. We have developed a method for quantitatively measuring the four arsenic species which are commonly found in drinking water - arsenite (AS+3), arsenate (AS+5), methylarsenic acid (MA), and dimethylarsenic acid (DMA). With this new method we have been noting the changes AS+3 and AS+5 undergo when added to liver enzyme fractions. We have found that AS+5 becomes methylated. We are presently mapping the metabolic route and reaction conditions required for methylation. During the first phase of method development we determined the cytotoxicity of the above arsenic compounds and a known carcinogen, benzpyrene. These chemicals were tested separately and in combination so appropriate concentrations were selected for the second or cell transformation phase of the study. During this phase we are combining the benzpyrene (non-carcinogenic concentrations) with the above forms of arsenic (non-lethal concentrations) and observing if cell transformation occurs. In the third phase, we will inject the transformed cells into athymic and/or dexamethasone treated mice to observe if tumorigenesis occurrs.
Keywords: arsenic compounds; carcinogenesis; synergism; benzopyrene; metabolism; toxicity; liver; mice; oncogenic transformations.

72019 Effect of Diesel Exhaust and Diesel Exhaust Components on Rat Lung Determined by the Alveolar Protein Accumulation in the Lung. Finelli, V. (University of Cincinnati, Department of Environmental Health, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** D815-014. **Contract:** 68-03-2637. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$30,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The main goal of the proposed research is to assess the pulmonary effects of diesel exhaust emissions. More specifically, we wish to determine the relative toxicity of some components of diesel exhaust emissions such as sulfuric acid and sulfates. The overall objective of this research is to assess the contribution of sulfuric acid mist on the toxicity of air pollutants. Regardless of the source of atmospheric sulfuric acid, be it the diesel engine, the catalytic converter equippped automobile, or the emission of coal-fired power plants, we want to determine if increased levels of sulfuric acid add to the toxicity of airborne metal pollutants by changing these toxicants from the usually less soluble and ubiquitous metal oxides to the more soluble sulfates. The increased solubility of metal sulfates as compared with their respective oxides is generally true for most of the metals of the periodic tables, especially for those metals which are abundant in the ambient atmosphere due to man-made pollution or to natural occurrence, e.g., Fe, Ni, Mn, Zn, Cd, Cu, Pb, etc. Some of these metals are known to be toxic to living organisms but the proposed study is necessary to elucidate whether the sulfate salts are more toxic than the corresponding oxides. The inhalation exposure condition specified includes exposure of rats to sulfuric acid, aluminum sulfate and calcium sulfate. Levels of these compounds in the exposure chambers must not exceed 5 mg/cubic m and a substantial portion of the particles must be less than 0.1 micron in diameter. Exposure will last for 60 days. In the exposed rats immediately after termination of exposure, we will assess the following parameters: (1) determination of number, viability and morphology of PAM; (2) determination of extracellular lysozyme activity and total protein in the lung lavage; and (3) assessment of alveolar wall permeability to proteins.
Keywords: diesel fuels; exhaust gases; combustion products; air pollution; rats; lungs; proteins; pathological changes; health hazards; diesel engines; sulfates; sulfuric acid; automobiles; environmental impacts; toxicity; iron; nickel; manganese; zinc; cadmium; copper; lead.

72020 Mechanisms of Intestinal Cadmium Absorption in Rats. Foulkes, E.C. (University of Cincinnati, Dept. of Environmental Health, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** D607-012. **Contract:** R805840-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$50,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The main objective is to provide information to help in the evaluation of potential risks from oral exposure to cadmium. One specific aim is to determine whether or not the kinetics of the transport system for cadmium and calcium between the intestinal lumen and wall are competitive in nature. A second objective is to characterize cadmium transport variations between the duodenum, jejunum, and ileum. An attempt will be made to determine whether differences in activity can be attributed to change in vmax and/or km of the transport system. Intestinal absorption of cadmium in rats will be ascertained by using a preparation involving isolated segments of duodenum, jejunum, and in situ under conditions of a steady-state single passage technique. For these studies cadmium tracer (109-Cd) is added to the luminal perfusate together with a volume marker and disappearance of the label from the lumen is measured. Results to date are preliminary in nature, having spent a significant amount of time working out optimum conditions for measurement of cadmium transport out of the gut. Conclusions on cadmium transport thus far are that under experimental conditions, transport represents almost entirely uptake of cadmium by mucosal and submucosal portions of the gut wall, and, in addition, the work suggested that with high gut cadmium concentrations, cadmium saturates a membrane site rather than some intracellular site.
Keywords: intestinal absorption; biochemical reaction kinetics; metabolism; cadmium; toxicity; diet; rats; physiology.

72021 Chronic Toxicity and Carcinogenicity to Rats of Chloroform in Drinking Water. Jorgenson, T. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** D614B-010F. **Contract:** 68-03-2616. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This study has been modified to include a similar study using B6C3F1 mice. The numbers and dose levels have also been changed for the rats. Also the doses and numbers of animals per group will be based on linear extrapolation rather than the originally proposed Mandel--Bryan assumption. The dose levels of chloroform and number of animals have been set for the chronic rat and mouse studies. Phase I, the subchronic study, has been completed, and the final report on that is forthcoming from SRI. This will be included in the next update. The project summary contained formulas, drawings, tables, or nonkeyable data which are not shown above.
Keywords: toxicity; carcinogenesis; chloroform; drinking water; rats; water pollution; health hazards; pathological changes; biological models.

72022 Comparative Assessment of Fly Ash from Western Versus Eastern Coals. Ulrich, C. (Huntingdon Research Center, Inc., Falls Rd. and Coppermine Terr., P.O. Box 527, Brooklandville, MD, 21022). **Project number:** D834-012. **Contract:** 68-03-2390. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this study was to compare the relative toxicity of fly ash from electric power generating plants burning coal from eastern (Appalachian Region) versus western (Powder River) coal fields. Analysis of coal and fly ash will also be carried out to relate composition differences in toxicity. Rats, guinea pigs, and monkeys were exposed 9 months to either low (5 mg/cubic m), medium (7 mg/cubic m) or high (60 mg/cubic m) concentrations of fly ash from power plants burning either eastern or western coal. Measurements included pulmonary function, clinical chemistry, hematology, pulmonary histopathology, and tissue deposition. Preliminary range finding studies were conducted in which animals were exposed up to 500 mg/cubic m fly ash for five weeks. No definite toxic effects were noted following the five week exposures. The 9 month exposures have been completed and preliminary statistical analysis carried out. Some effects were noted. However, further statistical analysis is required before any definitive conclusions can be made.
Keywords: fly ash; toxicity; rats; guinea pigs; macacus; inhalation.

72023 Rapid Testing In Vivo of Chemicals for Carcinogenicity. Lombardi, B.; Shinozuka, H. (Univ. of Pittsburgh, 3550 Terrace Street, Pittsburgh, PA, 15261). **Project number:** D834-019. **Supported**

by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Under this grant the short-term initiation/promotion assay in rat liver for chemical carcinogens will be further developed and applied to environmental samples. As part of the validation of this assay, the initiating potency of various known environmental chemicals will be determined. The carcinogenic potency of concentrated drinking water and other environmental samples supplied by the EPA will be tested in attempts to define the carcinogenic risk to man of water supply pollutants. The carcinogenic progression in rat liver resulting from administering an environmental carcinogen is promoted by dietary choline deficiency in order to accelerate the appearance of preneoplastic lesions. The appearance of neoplastic transformation is determined by the induction of gamma glutamyl transferase.
Keywords: drinking water; biological effects; oncogenic transformations; carcinogenesis; in vivo; bioassay; liver; rats.

72024 Program Management of Health Effects from Aerosols. Pahren, H.R. (EPA, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607A-001A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$80,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to manage extramural program on health effects from aerosols from wastewater treatment. Results show little problem to date.
Keywords: aerosols; health hazards; waste water; waste processing; particles.

72025 Program Management of Health Effects Regarding Municipal Sludges. Pahren, H.R. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607A-001B. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The objective is to manage an extramural program on reuse of renovated sludge on agricultural lands. A number of new starts were accomplished and many others were continued.
Keywords: waste water; ground disposal; sludges; uses; agriculture; biological effects.

72026 Program Management of Health Effects Regarding Wastewater. Pahren, H.R. (EPA, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607A-001C. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

The objective is to manage an extramural program on land application of treated wastewater and associated health effects. A number of new starts were accomplished and many others continued.
Keywords: waste water; biological effects; ground disposal.

72027 Demonstration Program to Show Ohio Landowners and Municipalities Acceptable Systems for Applying Sludge on Land. Hamparian, V.V. (Ohio State University, Dept. of Medical Microbiology, 370 W. 9th Avenue, Columbus, OH, 43212). **Project number:** D607A-003B. **Contract:** S805189-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$150,000.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

Health effects in humans and animals resulting from the application of municipal sewage sludge to farms in Ohio will be evaluated. Subjects covered include: (1) monitoring of pathogens in stools, sludge, and soil; (2) monitoring farm family health status and serology; (3) relating sludge virus to viral infections; (4) investigating viability of soil pathogens; (5) monitoring health status of farm animals; (6) monitoring trace element accumulation of cattle; (7) measuring parasite survival and infection rate of cattle; (8) monitoring animals for tuberculosis and Salmonella infection; and (9) monitoring cadmium content in stools and relating that to cadmium intake.
Keywords: ohio; municipal wastes; recycling; sludges; ground release; waste processing; demonstration programs; waste product utilization; biological effects; soil chemistry; soil mechanics; agriculture; human populations; biological pathways; health hazards; parasites; infectivity; tuberculosis; salmonella; viruses; water pollution control; solid wastes; ownership; cadmium; metabolism.

72028 Virus--Soil Interactions. Fuhs, G.W. (Health Research, Inc., Empire State Plaza, Albany, NY, 12237). **Project number:** D607A-004C. **Contract:** R804743-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The parameters affecting retention and inactivation of virus in soils will be further defined and evaluated. Guidelines for the prediction of virus pollution of groundwater and other drinking water from recharge will be developed as functions of virus and soil types, the composition of percolation medium, and a variety of organic components, coatings, and biological films. Viruses representative of the important basic types of animal viruses (glycoprotein-containing and icosahedral types) will be utilized in adsorption experiments of the batch and column types with radioactive measurements of labeled viruses and tests for infectivity as indicators of virus movement and inactivation, respectively. Experiments will be conducted with pure reference minerals, reference minerals with organic coatings, biological films mostly consisting of bacterial exopolymer, and sterile and natural soils of several characteristic types. A number of related factors such as adsorption to organic particulates prior to soil percolation and complex biological interactions will also be studied. Results indicate the interaction of radiolabeled poliovirus 2 with five soil substrates produced maximum adsorption under acidic conditions. Silt and montmorillonite exhibited the greatest adsorption with 97% of viral infectivity lost in the range of pH 4 to 9. Based upon the experimental results, these substrates would remove poliovirus from water in the following order: montmorillonite, silt, sandy loam, Ottawa sand, then muck.
Keywords: montmorillonite; sorptive properties; viruses; soils; ground water; water pollution; drinking water; tracer techniques; labelled compounds; silt; sand; monitoring; removal.

72029 Symposium on Wastewater Aerosols. Pahren, H.R. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607A-007B. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the research are to transfer technology from the EPA research program on the relationship between wastewater aerosols and disease and to assess the practical implications. Plans are underway for an international symposium in Cincinnati on September 19--21, 1979, bringing together the investigators of research projects to discuss their results and to assess the problem. Results to date indicate that the potential for disease is present, but it is no significant problem.
Keywords: technology transfer; us epa; research programs; waste water; meetings; diseases; biological effects.

72030 Appraisal of Health Aspects of Land Application of Wastewater. Kowal, N.E. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607A-011A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the research is to prepare an assessment of the potential health effects of the land treatment of wastewater. The approach is to organize by agents of concern and routes of human exposure, select relevant information from recent literature, and synthesize into a health assessment. A revision is planned every 2 to 3 years as new research results come in. To date, the organization has been prepared and literature review has begun.
Keywords: waste water; public health; land pollution; water pollution; health hazards; ground disposal.

72031 Fate of Organic Pollutants in a Wastewater Land Treatment System Using Lagoon Impoundment and Spray Irrigation. Demirjian, Y.A. (Muskegon County, Dept of Public Works, 8301 White Rd., County Bldg., Muskegon, MI, 49442). **Project number:** D607A-013A. **Contract:** R805865-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The research objectives are: (1) assessment of organic pollutants in wastewater using qualitative and quantitative analyses; (2) identification of organic compound variability along the treatment continuum; (3) development of local industry regulatory program; (4) study of effects of aeration cells, storage lagoons, and soil profile on the degradation of organics; (5) study of the fate of organics in the subsurface environment; (6) kinetic study of selected organic pollutants under impoundment conditions; and (7) determination of the effect of transmission of organics in wastewater.
Keywords: organic compounds; waste water; chemical analysis; biodegradation; waste processing; environmental effects; ground disposal.

72032 Evaluation of the Health Risks Associated with the Treatment and Disposal of Municipal Wastewater and Sludge. Clark, C.S.

(Univ. of Cincinnati, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** D607A-013C. **Contract:** R805865-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

This three part study is intended to be the first phase of a long-term effort to prepare guidelines to minimize the health effects from the land application of municipal wastewater and sludges and from other treatment processes. Population groups to be considered are those occupationally exposed to all aspects of the waste-handling operations, those exposed by way of their living, working, or having recreational pursuits nearby, and those who consume or otherwise come into contact with any crops or other products of the treatment system. The first part consists of an evaluation of current information on the health risks utilizing existing reviews and assessments as well as supplemental literature search. This evaluation will also result in detailed plans for additional studies that are needed. A pilot study of workers exposed to heat dried municipal sewage sludge that is ultimately applied to the land comprises the second part of the project. Included in the pilot study is a determination of the chemical and biological properties of the sludge and examination of the workers for possible effects of the sludge constituents. The third part is a cause of death study of former employees of a large wastewater treatment system to determine if any causes of death occur more frequently than expected. The results of this mortality study will be used to help define the need for additional research.
Keywords: sewage sludge; ground disposal; health hazards; personnel; public health; waste processing; man.

72033 Reoviruses in Water Pollution Testing. Spendlove, R.S. (Utah State Univ., Office of Engineering, Room L50, Logan, UT, 84321). **Project number:** D607A-015A. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The research objectives are: (1) the development of a sensitive procedure for concentrating, isolating and assaying infectious and potentially infectious (enzyme enhanceable) reoviruses and rotaviruses from raw sewage, treated sewage (effluents) and raw sludge; (2) determination of the occurrence (by using the above procedure) of reoviruses/rotaviruses in raw sewage, sewage effluents, sludge and feedlot runoff; and (3) comparison for the occurrence (concentration and frequency) of reoviruses/rotaviruses with the occurrence of human enteroviruses in sewage and sludge. The protamine sulfate precipitation method will be used (and modified) to concentrate the viruses. The fluorescent antibody procedure and the plaque assay procedure will be used to compare various cell lines for reovirus and rotavirus recovery sensitivity. Enzyme activation techniques will be used to recover potentially infectious viruses. The developed procedures will then be used to evaluate the occurrence of these viruses in environmental samples.
Keywords: viruses; purification; separation processes; sewage; sewage sludge; bioassay; water pollution.

72034 Development of a Tissue-Selective In Vivo Bioassay for Environmental Agents Producing DNA Damage. Hart, R.W. (Ohio State Univ., 370 West 9th Avenue, Columbus, OH). **Project number:** D607B-002. **Contract:** R805337-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Health effects assessments.

The overall objective of this program is the development and quantitation of a rapid, inexpensive, tissue specific in vivo bioassay for DNA damage induced by environmental agents. Since most carcinogens and mutagens damage DNA in vivo, this assay is aimed at the direct detection and quantitation of such damage in nonradiolabelled DNA. By use of microanalytical chemical procedures being developed within this program, DNA damage can be detected using punch biopsies of as few as 4 x 10 to the 4th power cells at near sublethal levels of carcinogen exposure. Detection of DNA damage is being carried out by the application of a combination of techniques including: endonuclease sensitive site recognition, sucrose gradient sedimentation, agarose gel electrophoresis, and immunofluorescence. Quantitation is being accomplished by the use of 14C-labelled carcinogens of high specific activity, direct measurement of radiolabelled carcinogen binding in vivo using Sephadex LH-20 chromatography, high pressure liquid chromatography, and high resolution GC/MS. Prediction is being evaluated in the rodent system by standard histochemical and pathobiological procedures. Studies during the first year have indicated that the present direction is a rational approach to the fulfillment of our ultimate objective.
Keywords: carcinogens; mutagens; bioassay; dna; genetic effects; in vivo; damage; strand breaks.

72035 Investigation of the Use of Sperm as In Vivo Indicator of Genetic Damage from Chlorinated Hydrocarbons. Ford, J. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607B-006. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The induction of abnormal sperm containing alterations in head morphology has been proposed as an assay for chemical carcinogens. The assay can also be used as a dose monitor for the testicular uptake of heritable mutagens and their activation. We are developing the assay to use with environmental samples. Mice and rats will be treated by sperm abnormality assay with known environmental mutagens in order to validate the assay. Environmental samples including drinking water concentrates and diesel emission will be tested. The sperm abnormality assay has been set up and mice are being exposed to diesel emission to be tested.
Keywords: spermatozoa; carcinogens; genetic effects; oncogenic transformations; bioassay; mice; rats; mutagens; dose-response relationships.

72036 Development of Short-Term In Vivo Assays for Chemical Carcinogenesis. Ford, J. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D607B-008. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

A short-term in vivo test for chemical carcinogen is being developed in rat liver. This initiation/promotion assay will determine the carcinogenic potency of environmental samples while taking into account pharmacokinetic parameters. The carcinogenic process is promoted with partial hepatectomy and phenobarbital. The induction of cellular transformation is determined by the focal indication of gamma glytamyl transferase as measured histochemically. The adoptation of the procedure to other organs is also to be attempted. A short-term assay employing partial hepatectomy and phenobarbital has been developed in rat liver. The dose-response and temporal parameters of the assay have been determined for diethylnitrosamine.
Keywords: rats; carcinogens; bioassay; liver; oncogenic transformations; dose-response relationships; in vivo.

72037 Chemistry of Renovated Wastewater. Chappell, W.R. (Univ. of Colorado, Arts and Sciences, Boulder, CO, 80302). **Project number:** D607D-013. **Contract:** R806517-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The primary purpose of the proposed study is to develop concentration techniques for organics in treated and untreated wastewater. Chemical methods will be used to focus on the chemicals of greatest health concern. Samples of treated and untreated wastewater will be concentrated and fractionated by liquid chromatography. The various fractions will be intensively studied to determine their chemical constituents.
Keywords: waste water; liquid column chromatography; water treatment; water chemistry; chemical composition.

72038 Development of Alkylate Hemoglobin as a Dose Monitor for Carcinogens. Chang, L. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D629-007. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to determine whether the covalent binding of chemical carcinogens to hemoglobin can be used as a dose monitor for the systemic dose. The stability of the circulating hemoglobin should result in a dose monitor capable of integrating low level chronic exposure. This dose monitor, since it measures the formation of the active metabolite of carcinogens, should be applicable to the determination of species variation in metabolism and susceptibility of the carcinogen. The binding of orally administered carcinogens to hemoglobin will be determined in mice and rats. The dose and temporal relationships will also be determined. The isolation of various carcinogen adducts in hemoglobin will be performed by an amino acid analyzer and the sensitivity of the procedure for non-radiolabeled adduct determined. Finally we will determine the formation of adducts resulting for environmental exposures to laboratory animals and humans. The binding parameters of dose and time have been determined for various carcinogens, i.e., benzene, benzo(a)pyrene, chloroform, etc., in rats.
Keywords: carcinogens; adducts; chemical bonds; hemoglobin; biological effects; dose-response relationships; ingestion; mice; rats; monitoring.

72039 Inhalation Oncogenicity and Ocogenic Promotion Potential of Diesel Exhaust Using Strain A Mice. Orthoefer, J. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D815-007.

Supported by: Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine if diesel exhaust increases the lung tumor incidence in strain A mice. The animals are placed in a diesel exhaust contaminated atmosphere for approximately 9 months. After the exposure the animals are euthanized and the lung nodules (tumors) are counted.
Keywords: diesel fuels; exhaust gases; mice; inhalation; neoplasms; carcinogenesis; lungs; biological effects.

72040 Inhalation Incogenicity Test of Diesel Exhaust Using Hamsters. Orthoefer, J. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D815-008. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Hamsters will be exposed to diesel exhaust contaminated atmospheres to determine if the incidence of cancer is increased. Lifetime studies of hamsters exposed to diesel exhaust will be undertaken to determine if the incidence of tumors will be affected by the exposure.
Keywords: hamsters; diesel fuels; exhaust gases; biological effects; inhalation; neoplasms; carcinogenesis; lungs.

72041 Comparative Oncogenicity Test of Diesel Soot and Other Environmental Materials. Orthoefer, J. (EPA, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D815-009. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The research objective is to study the comparative oncogenicity in strain A mice of diesel particulate material, coke oven emissions, cigarette smoke condensate and roofing tar particulates. Animals will be exposed to one of the above materials by intraperitoneal injection. After 9 months animals will be killed and the pulmonary nodules (tumors) counted. Comparisons will be made for each group as to the relative potency.
Keywords: diesel fuels; exhaust gases; particles; soot; bitumens; coal gas; coke ovens; tobacco smokes; lungs; mice; neoplasms; carcinogenesis; inhalation.

72042 Chromosomal/Genetic Alteration in Animals Exposed by Inhalation of Diesel Exhaust. Orthoefer, J. (EPA, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D815-010. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to determine if inhalation of diesel exhaust causes chromosomal aberrations in lung cells of hamsters. The approach is to expose hamsters to diesel exhaust for 3 months. The animals' lungs will then be grown in tissue culture, and sister chromatid exchange studies will be done on them.
Keywords: chromosomal aberrations; genetic effects; hamsters; respiratory tract cells; diesel fuels; exhaust gases; biological effects.

72043 Chemical Analysis and Bioassay of Diesel Emission Particulates. Pitts, J.N. (Univ. of California, Statewide Air Pollution Research Center, Riverside, CA, 92502). **Project number:** D815-013. **Contract:** 68-03-2726. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this contract is to perform the chemical analysis and mutagenic testing for three emission particulate samples provided by HERL-CI. The approach is to perform qualitative and quantitative chemical analysis by extraction and to perform bioassays on the three extracted fractions (neutral, acidic, and basic) for mutagenic activity according to Ames Salmonella typhimurium reversion test.
Keywords: diesel fuels; combustion products; aerosols; quantitative chemical analysis; qualitative chemical analysis; mutagen screening; salmonella typhimurium.

72044 Effects of Endogenous Ammonia Upon the Neutralization of Inspired Sulfuric Acid. Loscutoff, S.M. (Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** D815-030. **Contract:** 68-03-2665. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

High concentration of sulfuric acid in the atmosphere has been associated with increased incidence of respiratory infections in children and increased morbidity in adults. Ammonium sulfate is much less toxic than sulfuric acid. The objectives of the present experiment are to determine the degree of neutralization of inhaled H2SO4 aerosols by endogenous or exogenous ammonia and the effect of neutralization on toxicity and to estimate minimal levels of H2SO4 required to alter pulmonary function with no ammonia present in the lung. Male beagle dogs will be exposed acutely to H2SO4 aerosols (6 or 12 MG/cubic M) alone, and in combination with increased levels of either endogenous or exogenous ammonia. Inspired and expired sulfuric acid, ammonia, ammonium sulfate and ammonium bisulfate will be measured as well as a variety of pulmonary function measurements designed to detect airway constricton. Methods for generating sulfuric acid, measuring sulfuric acid, ammonia, ammonium sulfate and bisulfate in the air and ammonia in the blood have been completed. Exposure of dogs is underway and will be completed by June 1979.
Keywords: sulfuric acid; ammonia; biological effects; lungs; dogs; ph value; toxicity; air pollution; aerosols; inhalation.

72045 Effect of Diesel Exhaust on Resistance to Microbial Infection. Pepelko, W. (EPA, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D815-019. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To assess effects of exposure to mobile emissions or single pollutants on susceptibility to respiratory infection by pathogenic microbes, mice are exposed to purified air or to test-pollutant atmosphere, then exposed to atmosphere containing aerosolized culture of pathogenic microbe and observed for comparative mortality and morbidity. In recent initial study of automotive diesel exhaust diluted 1:14 and using streptococcal pathogen, susceptibility to infection was enhanced (greater mortality) in mice exposed to irradiated or non-irradiated exhaust for periods of 6 hrs or 2 weeks (20 h/d, 7 d/wk). Similar effects were previously noted in mice exposed to catalytically treated exhaust of gasoline automotive engine and to aerosols of sulfuric acid and platinic sulfate. A follow-up study of short- and long-term exposure to more dilute diesel exhaust (1:30 or more, 8 h/d) using both bacterial and viral pathogens is expected to begin in August, 1978. Tests of manganese oxide and ultrafine sulfuric acid aerosols were proposed but have been tabled in favor of higher priority demands. Several experiments were conducted involving exposure of mice to diluted automotive diesel exhaust for acute and subchronic periods, followed by exposure to infectious aerosols. Mortality in diesel-exposed compared to control mice has been consistently enhanced, indicating a diesel exhaust induced impairment of resistance to infection. Bacterial-pathogen response has so far been greater than that for the recently incorporated viral pathogen, and excess mortality has been generally greater thus far in diesel tests than in catalytic gasoline exhaust tests performed previously.
Keywords: diesel fuels; exhaust gases; infectivity; microorganisms; mice; biological effects; toxicity; mortality; viruses; bacteria; gasoline; comparative evaluations; irradiation.

72046 Validation of Methods for Identification of Health-Related Organics in Tap Water. Coleman, W.E. (EPA, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D823B-002B. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective of this task is to evaluate various methods of chemical characterization and identification of organics from tap water and concentrates thereof in order to study the occurrence and effects of organic contaminants of drinking water. The research approach is to validate such methods in-house while having a contractor carry out the actual identification and quantification work of the organics from selected water supplies. This task is in support of the HERL's research project on the occurrence and effects of organic contaminants in drinking water. The use of Grob closed-looped stripping analysis (CLSA) which requires the use of glass capillary GC columns on the GC/MS has proven to be the most informative method for the evaluation of concentration methods used to obtain organic concentrates for biological testing. The Grob CLSA is sensitive for most intermediate molecular weight organs present in drinking water at the parts per trillion.
Keywords: drinking water; organic compounds; chemical composition; qualitative chemical analysis; quantitative chemical analysis; water quality; water pollution; water.

72047 Comparative Metabolism of Selected Halogenated Organic Compounds. Lingg, R.D. (EPA, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D823B-005B. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this research are to provide comparative pharmacokinetic data for selected organic chemical contaminants of water supplies and to identify their metabolites. It is a recognized fact that the toxic effects of most organic chemicals is due to their metabolic activation, in vivo, to reactive intermediates. Pharmacokinetic and metabolic studies lead to an understanding of these processes, and enable a relationship between chemical structure and biological activity to be drawn. A publication presenting the pharmacokinetic and metabolite data represents the final output.
Keywords: organic compounds; metabolism; in vivo; biochemical reaction kinetics; ethers; organic chlorine compounds; alcohols; cysteine; metabolites; rats; monkeys; biological effects.

72048 Maintenance of a List of Organics Identified in U.S. Drinking Water Supplies. Webster, R. (Systems Research Co., 3508 Market St., Philadelphia, PA, 19104). **Project number:** D823B-006B. **Contract:** 68-02-2744. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is the development of a computerized data base on organic chemicals identified in U.S. drinking water supplies. This data base will be a subfile of the larger master data base now being organized under EPA contract and known as the Chemical Information System (CIS). All chemical data pertinent to those organics identified in water supplies will be entered into this data base and be made available to researchers through a computerized network. The final output will be the data base. A list of greater than 700 organic chemicals identified in U.S. drinking water supplies has been gathered. A contract for entering this list and gathering data has been awarded to Systems Research Company of Philadelphia.
Keywords: organic compounds; drinking water; data compilation; information systems.

72049 In Vitro Assessment of Mutagenic/Carcinogenic Potential of Mixtures of Organic Substances in Renovated Wastewater. Saxena, J. (Syracuse Research Corp., Merrill Lane, University Heights, Syracuse, NY, 13210). **Project number:** D823B-007D. **Contract:** R804813-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the three year study are to assess in vitro mutagenic/carcinogenic potential of organic substances in renovated wastewaters, and to attempt to identify the fractions/chemicals responsible for the action. Wastewater renovation plants representing a wide variety of treatment methods--natural sand beds, physical-chemical, and biological--are selected to enable correlation of the data on mutagenicity/carcinogenicity to the treatment technology. The study will provide information on health hazards from reclaimed wastewater for potable use and assist in setting priorities for in-depth toxicological testing.
Keywords: mutagenesis; mutagen screening; carcinogenesis; waste water; health hazards; water treatment; research programs; bioassay; enzymatic hydrolysis; acid hydrolysis; carcinogens; mutagens; salmonella; organic compounds; solvent extraction; in vitro; removal; mixtures.

72050 Effects of Selected Organic Contaminants in Drinking Water on the Functions of the Reproductive, Nervous and Immune Systems. Borzelleca, J.F. (Virginia Commonwealth Univ.,1200 E. Broad St., Richmond, VA, 23298). **Project number:** D823B-012B. **Contract:** R806481-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The research activities ongoing and proposed in this project address the need for determining the toxicities of organic water contaminants using a holistic approach. The Swiss albino neonate and adult male and female mouse provides the main experimental animal. In addition, attention will be focused on evaluating the sensitivity of several systems that have not been adequately evaluated by those engaged in safety evaluation programs. A major effort is and will be made to develop in vitro assays that will predict subchronic and chronic toxicological behavior. These studies will also provide insight into toxicological mechanisms.
Keywords: water pollution; organic compounds; toxicity; mice; bioassay; reproduction; nervous system; immunity.

72051 GC/MS of Organics in Drinking Water Concentrates and Advanced Waste Treatment Concentrates. Lin, D.C. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** D823B-004C. **Contract:** 68-03-2458. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this project are to identify and quantitate the components of organic concentrates obtained from drinking water from U.S. cities representing different types of raw water supplies. These organic concentrates have been previously tested for mutagenic activity using the Ames Salmonella/microsome assay procedure. The approach is to develop a comprehensive analytical scheme which combines separation of the concentrates into analytically manageable fractions with gas chromatographic/mass spectrometric (GC/MS) analysis using high resolution glass capillary columns. The analytical scheme incorporates extensive quality assurance procedures in order to permit meaningful comparison of the results obtained over the 3-year period of this project. Analysis results of 10 concentrates from 2 advanced waste treatment sites (Lake Tahoe and Pomona, CA) have shown 447 different organics in the effluent from the Lake Tahoe plant and 495 organics in the effluent from Pomona.
Keywords: gas chromatography; mass spectroscopy; drinking water; water quality; organic compounds; quantitative chemical analysis; lakes; california; water treatment.

72052 Effects of Lead and Organo-Tin Compounds on Energy Metabolism and Ion Transport. Van Rossum, G.D. (Temple Univ., 3322 Broad St., Philadelphia, PA, 19122). **Project number:** D823B-007C. **Contract:** R806616-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine the following aspects of lead (Pb) toxicity in kidneys: (1) the point at which oxidative phosphorylation is inhibited in mitochondria; (2) the effects on ion transport, especially calcium ion transport in kidney cortex inner mitochondrial membrane; and (3) the ultrastructural consequences. The project will also determine the same parameters using di- and tri-butyltin chloride in liver, and will develop a programmed plating procedure for anodic stripping voltammetry to assay Pb. In vivo and in vitro exposure to the toxins will accompany isolated mitochondria and tissue slice analysis of ion transport (radiolabeled tracer technology) and oxidative phosphorylation analysis (by comparison to and use of specific inhibiting agents).
Keywords: lead; tin; organic compounds; toxicity; metabolism; kidneys; mitochondria; membrane transport; tracer techniques.

72053 Health Impacts of Altered Geochemistry Associated with Mine Drainage from Western Interior Coals. Wixson, B.G. (Univ. of Missouri, Rolla, MO, 65401). **Project number:** D834-021. **Contract:** R807133-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Epidemiological studies.

This study is designed to determine the existence of a relationship between acid mine drainage contamination of potable water supplies and human health. This is to be done in the western interior coal region encompassing the states of Missouri, Iowa, Oklahoma, and Kansas. The approach is through an ecologic study looking for relationships between epidemiologic data and water quality data. The epidemiologic data include county cancer mortality rates on 30 causes of death from NCI and census information. Water quality data include surface and ground water quality data and data obtained from samples of tap water.
Keywords: coal mining; acid mine drainage; health hazards; drinking water; water pollution; missouri; iowa; oklahoma; kansas; water quality; epidemiology; surface waters; ground water; neoplasms; mortality; human populations.

72054 Evaluation of the Use of Respiratory Movements of Fish for Monitoring Drinking Water Quality. Neiheisel, T.W. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** D607B-012. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The general objectives of the project are to develop and evaluate the usefulness of a biological monitoring system in which the respiratory response of fish, principally the gill purge response, will be used to detect toxic materials in finished drinking water. Respiratory movements of bluegill sunfish, which are held in chambers that receive a continuous supply of dechlorinated tap water, will be recorded. External electrodes will monitor changes in gill purge rates as an indication of the contamination of the water with potential toxicants. Initial experiments will define the optimal monitoring conditions and the period of time a fish can be used as a sensor, and will yield background data indicating the response of the fish to the dechlorinated tap-water supply. A second series of experiments will be conducted during which time the fish will be exposed to selected chemicals to simulate contamination of the tap-water supply. The chemicals will be representative of classes of compounds that are known hazards to human health and are poten-

tial contaminants in water supplies. Hardware and software necessary to automate the monitoring system will be developed during the course of the project. The initial series of experiments defining optimal monitoring conditions and a substantial portion of the second series of experiments simulating contamination should be complete in the first year of the project. Continuation of the project for a second year will depend on the results of the first year's work.
Keywords: drinking water; water quality; quality assurance; fishes; respiration; biological indicators.

72055 Evaluation of the Use of Trout to Detect Carcinogens in Drinking Water. Neiheisel, T.W. (EPA, 3411 Church St., Newtown, OH, 45244). **Project number:** D607B-014. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine if rainbow trout can be used as a sensitive animal-model test system to detect carcinogenic materials in drinking water. The approach is to expose rainbow trout to finished drinking water, to control (spring) water prior to exposure, to control (spring) water after the fish embryos have been exposed to a known carcinogen (positive control), and to determine if there is an increase in tumors in the treatment and positive controls versus the controls.
Keywords: trout; biological indicators; drinking water; water quality; carcinogens; quality assurance; physiology.

72056 Mutagenic Potential of Diesel Exhaust. Russell, L.B. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** D815-031. **Contract:** D9-X0526. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A battery of tests on the mouse are used to determine if whole diesel exhaust exposure is capable of inducing inheritable effects. These tests are extensions of in vitro mutagenic tests to mammalian models. Three approaches are being used: (1) test for induction of heritable point mutations by inhaled diesel exhaust; (2) test for induction of dominant lethals by inhaled diesel exhaust; and (3) test for induction of heritable translocation by diesel exhaust.
Keywords: diesel engines; exhaust gases; toxicity; mutagenesis; biological models; mammals; inhalation.

72057 Effects of Diesel Exhaust on Pulmonary Fibrosis. Bhatnagar, R.S. (Univ. of California, 551 Parnassus Ave., San Francisco, CA, 94122). **Project number:** D815-032. **Contract:** 68-03-2626. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to study the effects of diesel exhaust on pulmonary fibrosis in experimental animals. The approach is to investigate in-vitro the toxic effects of diesel exhaust condensate on neonatal lung organ cultures by determining collagen, RNA, and DNA synthesis in these organ cultures. The in-vitro morphological effects of the same diesel condensate on neonatal rat lung organ and cell cultures are being investigated and correlated with the effects. Investigation is being made on the in-vivo toxic effects of diesel exhaust on rat lung by determining the collagen, RNA and DNA synthesis in the lungs exposed to the exhaust.
Keywords: diesel engines; exhaust gases; toxicity; lungs; pathological changes; inhalation; air pollution; fibrosis.

72500 National Forest Ozone Study. Daughtridge, J.V. (EPA, Washington, DC). **Project number:** E606A-10. **Contract:** D8-F0101. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$15,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to measure continuously background ozone and meteorological data in remote regions. These data will be used to determine background concentrations of ozone and transport characteristics of ambient ozone. The data are obtained using continuous chemiluminescent ozone analyzers and modern meteorological systems. The data are recorded continuously on strip chart recorders. The results are reported in hourly averages. Study was initiated in 1976 at 3 national forest sites. One additional site has been added this FY. Two additional sites will be established toward the end of this FY. Data in hourly averages for each site in available from the National Aerometric Data Bank. Bi-monthly calibrations are performed with periodic external audits.
Keywords: forests; biological models; ozone; ecological concentration; meteorology; air pollution; environmental transport.

72501 Evaluation of Ambient Methodology. Wesolowski. (California State Dept. of Health, 714 P Street, Sacramento, CA, 95814). **Project number:** E621A-14. **Contract:** R805447-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives of this work include: (1) optimizing a simple analytical procedure for sulfate determination and evaluating it for ruggedness; (2) evaluating a series of sulfate methods; and (3) evaluating two techniques for extracting sulfate from atmospheric samples. Methods evaluation will involve determining the practical working range, precision, accuracy, comparability between methods and the influence of potential interferents. For this study, the practical working range of the methods will be defined as the concentration range of analyte yielding constant variance and accuracy. The barium sulfate turbidimetric procedure is the method to be optimized. The sulfate methods to be evaluated are the optimized turbidimetric method, the Colovos and Midwest Research versions of the automated methlthymol blue method, and the Dionex ion chromatography method.
Keywords: sulfates; quantitative chemical analysis; turbidity; optimization; quality assurance; aerosol monitoring; air quality; measuring methods.

72502 Standardization, and Quality Assurance of Stationary Source Emission Methodology. Hamil, H.F. (Southwest Research Inst., Chemistry and Chemical Engineering Division, 8500 Culebra Road, San Antonio, TX, 78228). **Project number:** E621A-15. **Contract:** 68-02-2489. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$400,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to: (1) conduct stationary source emission measurement methodology evaluation and standardization; and (2) evaluate the performance of organizations making stationary source emission measurements. Single and multiple laboratory examination will be used for methodology evaluation and standardization. Independent standards and on-site assessments will be used for performance evaluations. The outputs will be reports on each of the above activities and air quality data of improved quality.
Keywords: standards; stationary pollutant sources; quality assurance; monitoring; measuring methods; emission; air pollution control; air pollution.

72503 Ambient Air Monitoring Reference and Equivalent Methods Programs. Purdue, L.J. (EPA, Research Triangle Park, NC, 27711). **Project number:** E621A-16. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide for EPA-designation (as either a reference or equivalent method) those models of ambient air monitoring analyzers (or other methods) which have been shown to meet certain prescribed minimum performance specifications. Designation of these analyzer models allows states and other users to more easily specify and obtain air monitoring analyzers which are adequate for their monitoring requirements under the Clean Air Act. Minimum performance specifications applicable to ambient air monitoring analyzers and other methods for SO2, O3, CO, NO2, and lead, together with detailed test procedures to measure each performance parameter, are set forth in EPA regulations in 40 CFR Part 53. Also contained in that part are instructions for submitting an application for designation. The ambient air monitoring reference and equivalent program receives applications for designation, technically evaluates the submitted test data and other information to determine compliance with all requirements, and also (1) reviews the minimum performance specifications to reassess the tradeoffs between practicality of the methods, (2) enforces compliance with designated method requirements, (3) evaluates new measurement principles applicable to reference methods, and (4) develops and tests calibration procedures for ambient monitoring instruments. As of June 30, 1978, 28 methods have been designated with several additional methods under evaluation. A new calibration procedure for ozone reference methods has been proposed. Procedures for designating reference and equivalent methods for lead have been developed. Future plans call for developmental work on methodologies for TSP.
Keywords: earth atmosphere; surface air; air pollution monitors; performance testing; specifications; sulfur dioxide; ozone; carbon monoxide; lead.

72504 Quality Assurance in Support of Energy-Related Monitoring Activities in the Western USA. Cher, M. (Rockwell International Corp., Air Monitoring Center, 2421 W. Hillcrest Avenue, Thousand Oaks, CA, 91320). **Project number:** E625C-11. **Contract:** 68-02-2412. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$200,000.

Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are to develop and implement a quality assurance program for air pollution monitoring in the vicinity of present and proposed energy development projects in the western USA. Approaches include: (1) providing on-site systems reviews and assessments for agencies monitoring for air pollutants in eight western states; (2) conducting quarterly performance evaluation using blind samples; and (3) providing technical assistance as required.

Keywords: quality assurance; monitoring; environmental impacts; energy source development; air pollution; western region; pacific northwest region.

72505 Quality Assurance for Environmental Pollutant Monitoring, I. Decker, C.E. (Research Triangle Inst., P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** E621A-13. **Contract:** 68-02-2725. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to provide quality assurance technical support to the Office of Air Quality Planning and Standards, EPA regional offices, Office of Research and Development Laboratories, and Office of Enforcement. Technical support is provided in five technical service areas as follows: (1) measurement methods evaluation and standardization; (2) quality assurance guideline development; (3) quality assurance plan review and program development consultation; (4) external audits of environmental pollutant sampling and analysis; and (5) audit test material development. The final output of technical support are reports on the technical services completed. External audits on 11 air monitoring projects and 14 audits of organic analysis during stationary source tests have been completed.

Keywords: air quality; planning; standards; air pollution; monitoring; quality assurance; air samplers; data analysis; optimization; quantitative chemical analysis; pollution regulations; enforcement.

72506 Standards for and Methods of Analysis of Rainwater for Acidity. Tyree, S.Y. (College of William and Mary, Dept. of Chemistry, Ewell Hall, Williamsburg, VA, 23185). **Project number:** E601B-03. **Contract:** R804998-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$2,000.

Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

Standards and methods of concentration of precipitation components and analysis will be investigated with routine implementation as the objective. Prior accomplishments include development of specifications (for use by the NBS) for precipitation reference materials and investigations of methodologies for routine determination of acidity of collected rain samples. Expected final outcome should include feasibility assessment of routes to concentration and analysis of precipitation components for possible prototype instrument development. A draft of the final report includes: (1) directions for preparation of standards; (2) a procedure for titration of precipitation samples; and (3) recommendation for the use of ion chromatography for measurement of the chemical constituents of rain water.

Keywords: rain; ph value; acid rain; measuring methods; standards; feasibility studies; measuring instruments; titration; quantitative chemical analysis; ion exchange chromatography.

72507 Aerosol Characterization of Ambient Particulate Samplers Used in Environmental Monitoring Studies. McFarland, A.R. (Texas A and M University, Dept. of Civil Engineering, P.O. Box F E 44, College Station, TX, 77843). **Project number:** E601B-07. **Contract:** 68-02-2720. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$30,000.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objective is to characterize behavior of particulate collectors through controlled studies in wind tunnel. A technical paper, Wind Tunnerl Studies of the Hi-Vol and Membrane Samplers, has been written and submitted to APCA for publication. The hi-vol membrane sampler was tested and evaluated and sampler collection efficiencies were found to be wind-speed dependent. A size selection (less than 15 microns) head for a hi-vol whose collection efficiency is not wind speed dependent has been designed and fabricated.

Keywords: aerosols; particles; air samplers; air pollution; monitoring; cascade impactors; design.

72508 Los Angeles Catalyst Study (LACS). Rodes, C.E. (EPA; Research Triangle Park, NC, 27711). **Project number:** E601B-20. **Contract:** 68-02-2792. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are to gather data in support of evaluating the existing primary ambient particulate standard, and to assist in implementation plan preparation for control strategies to meet the standard. An extensive particulate study will be implemented in three phases using dichotomous samplers in various locations throughout the U.S. to gather particulate data for comparison of the EPA hi-vol method with respirable sampler: (1) pilot study for a period of 1 month to determine sampler precision and reliability; (2) research study in five selected areas which represent different sources and expected ambient loadings (sites will be located in urban and nonurban locations); and (3) full scale network at approximately 100 sites to assess ambient air quality standard. Validated results through 1977 are summarized in 1978 LACS report.

Keywords: aerosols; particles; sampling; air samplers; air quality; usa; data compilation; standards; evaluation; los angeles; monitoring.

72509 Improved Characterization of Human Exposures to Air Pollutants. (Research Corp. of New England, 125 Silas Dean Highway, Weatherfield, CT, 06109). **Project number:** E601C-30. **Contract:** 68-02-2743. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The overall program objective is to develop a methodology for improving the characterization of human exposure to pollutants in selected communities. The methodology is intended for application to four communities in the Los Angeles Basin: Garden Grove, Glendora, Upland, and West Los Angeles. The pollutants to be considered are CO, NO2, O3, SO2, and particulates. The approach consists of seven tasks: (1) devise a method of obtaining data on mobility patterns of people; (2) estimate outdoor ambient air quality for pollutants of interest; (3) estimate in-vehicle air quality for different vehicle types; (4) estimate indoor air quality based on outdoor air quality and indoor sources; (5) design sampling programs to provide monitoring data for validation of indoor and outdoor quality estimates and of individual exposure estimates; (6) provide a methodology for combining mobility and air quality information to estimate exposure; and (7) test the validity of air quality and exposure predictions. The first and fifth tasks have been completed. The field measurement study is being completed by EPA in April. Work on Tasks 2, 3, 4, 6, and 7 will begin in May 1979.

Keywords: human populations; risk assessment; health hazards; carbon monoxide; nitrogen dioxide; ozone; sulfur dioxide; particles; aerosols; behavior; air quality; indoor air pollution; vehicles; sampling; dose rates; air pollution; measuring methods; optimization.

72510 Neutron Activation Analysis of Fuel and Fuel Additives Samples. Rancitelli, L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** E606A-40. **Contract:** D7-0473. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to provide control analysis and assistance in monitoring of fuel, fuel combustion products, and fuel additive samples for elements by neutron activation analysis. Samples will be analyzed for specific elements in fuel, fuel combustion products, and fuel additives as specified by the EPA project officer. Confirmatory studies of selected probable precursors of biological activity will be conducted. Diesel fuel combustion particulate matter has been submitted for in depth analysis of organic bound nitrogen products.

Keywords: fuels; fuel additives; activation analysis; neutron reactions; elements; trace amounts.

72511 Matrix Evaluation and Control Analysis of Fuel and Fuel Additive Samples. Carter J. (Oak Ridge National Laboratory, Division of Analytical Chemistry, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** E606A-41. **Contract:** D6-0466. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$310,000.

Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to: (1) screen organics, fractionate by selective solvent extraction followed by HPLC, and identify components which show biological activity; (2) conduct precursor studies of fuels and emissions; (3) perform QA for organic analysis of toxic pollutants; (4) conduct QA fenceline monitoring and industrial sites; and (5) confirm precision of new levels of red organic analytical schemes. Appropriate analytical, biological, and combustion engineering techniques and methodology for application to combustion and biological materials will be provided.

Keywords: fuels; fuel additives; evaluation; biological materials; combustion; mass spectroscopy; isotope dilution; gas chromatography; ion microprobe analysis; electron scanning; chemical analysis.

72512 Criteria Pollutant Studies. Martin, B.E. (EPA, Research Triangle Park, NC, 27711). **Project number:** E606A-42. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA. **Related energy source:** Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to: (1) provide OAQPS (MDAD) with monitoring data for air quality assessments and in support of standard revisions; (2) provide equipment for contractor to operate oxidant transport study in Philadelphia, PA; (3) measure background ozone and meteorological data in remote regions; and (4) provide equipment for contractor to operate an oxidant study to determine the areas of representatives of ozone monitors (National Forest Ozone Study - NFOS). Six sites are operational in remote areas (national forests). Equipment has been maintained and calibrated for contractor's use.

Keywords: photochemical oxidants; ozone; meteorology; pennsylvania; air quality; air pollution; monitoring; mathematical models; atmospheric chemistry; pollution sources.

72513 Neutron Activation Analysis of Fuel and Fuel Additive Samples. Rancitelli, L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** E6066-17. **Contract:** D7-0473. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide control analysis and developmental optimization in monitoring of fuel and fuel additives for trace elements by neutron activation analysis and related analytical techniques. Fuel and fuel byproducts are submitted to the nuclear reactor at Washington State University for neutron activation analysis for trace elements. Samples are analyzed for 30 elements.

Keywords: fuel additives; fuels; activation analysis; neutron reactions; trace amounts; metals; quantitative chemical analysis; monitoring.

72514 Sulfur Budget in Power Plant Plumes: Processing, Management, and Analysis of Project State Data. Gillant, N. (Washington Univ., 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G603A-AA-015. **Contract:** R805918-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to provide centralized data processing and data base management of aircraft and selected meteorological data collected in the field programs of state and to analyze the field data in order to develop, calibrate, and validate a sulfur plume model applicable to mesoscale and long-range transport of sulfur. On-site data processing will be performed with 24-hour turnaround yielding graphical output of all aircraft data to ensure data quality and feedback to field crew. After each field program, complete data volumes and data tapes will be prepared for permanent storage and distribution. Parameterization schemes will be used in a diagnostic plume model to determine plume sulfur budgets. Aircraft data has been collected and is being reduced for distribution and analysis.

Keywords: sulfur dioxide; aerial monitoring; aerosol monitoring; data processing; meteorology; plumes; atmospheric chemistry; mathematical models; data acquisition; data base management.

72515 Rural Oxidant Studies and the Role of NOx in Rural Oxidation Formation. Westberg, H. (Washington State Univ., Pullman, WA, 99163). **Project number:** G603A-AA-017. **Contract:** R805343. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

Ambient air measurements will be made for the detailed hydrocarbons, oxides of nitrogen, ozone, halocarbons, and other pollutants by an aircraft and ground level sampling program at several locations throughout the United States. The purpose of these studies is to investigate the transport and the transformation processes of pollutants in urban and rural areas. Sophisticated state-of-the-art instrumentation is utilized in these studies for pollutant measurement. Both ground level and aircraft sampling programs are utilized to investigate the transport of pollutants from an urban area to downwind rural or other urban areas. Several reports are available from past field study efforts by Washington State University. These reports in general identify the relationship between upwind urban transport to downwind high rural ozone levels. High rural ozone is associated with higher concentrations of transported O3 precursor compounds from anthropogenic sources.

Keywords: rural areas; nitrogen oxides; photochemical oxidants; atmospheric chemistry; mathematical models; ecological concentration; aerial monitoring; aerosol monitoring; hydrocarbons; organic halogen compounds; ozone; sampling.

72516 LBL Computer Services for LIRAQ Verification. Beals, E. (Lawrence Berkeley Labs., Berkeley, CA, 94720). **Project number:** G603A-AA-048. **Contract:** D7-01201. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

This IAG allows EPA access to the LBL computers for the purpose of testing the Livermore Air Quality Model (LIRAQ). Computing services are available via telephone hook-up and resulting output is mailed to the user. Initial test run of the LIRAQ model is completed.

Keywords: air quality; mathematical models; performance testing; sulfur; photochemical oxidants; atmospheric chemistry.

72517 Fate of NOx in the Atmosphere. Spicer, C. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** G603A-AA-070. **Contract:** 68-02-2957. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

Nitrogen oxide (NOx) compounds in the ambient air of several urban areas were measured over the past five years. The purpose of these studies was to measure the lifetimes and/or formation rates of the various NOx species in urban plumes as they are transported to downwind locations. Several urban areas were studied to determine the effect of meteorological and terrain variables. Ground and aircraft measurements of the NOx species were made using chemiluminescent and wet chemical procedures. The NOx species included NO, NOx, PAN, HNO3, and particulate nitrate. Samples were collected in both urban and downwind locations. Battelle has completed final reports for studies conducted from 1973 to 1977. Reports of studies conducted in 1977 and 1978 are in preparation. Using tracer techniques NOx species levels have been observed to decrease in concentration as the plume is transported downwind due primarily to surface deposition.

Keywords: nitrogen oxides; atmospheric chemistry; earth atmosphere; mathematical models; air pollution; urban areas; plumes.

72518 Incremental Funding Study of the Impact of Primary Sulfate Emission Sources. Laube, A.H. (York Research Corp., 1 Research Drive, Stamford, CT, 06906). **Project number:** G603A-AA-091. **Contract:** 68-02-2065. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of the contract is to investigate the relationship between the emissions of sulfate from an oil-fired utility source in the northeastern United States and the concurrent ground level concentration of sulfate in the vicinity of the point source. A one month study is to be conducted at an isolated oil-fired power plant. Concurrent source and ambient air measurements are to be taken. The field effort was completed in October 1978. Analysis of the data indicates a positive relationship between sulfate emissions and downwind levels measured over the study period.

Keywords: sulfates; pollution sources; fossil-fuel power plants; petroleum; wind; meteorology; environmental effects.

72519 Aircraft Measurement of Plume Dispersion and Chemistry. Blumenthal, D. (Meteorology Research, Inc., 3401 Mendocino Avenue, Santa Rosa, CA, 95401). **Project number:** G603A-AA-107. **Contract:** 68-02-2713. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to acquire a data base necessary for the development of control strategies for the reduction of ambient air concentrations of sulfates and nitrates. Large scale, discrete, intensive experimental field studies will be conducted. Aircraft measurements of SO2, O3, BSCAT, NO, and NO2 will be made and integrated samples will be collected for aerosol size distribution and composition. Field collection is completed. Samples are being analyzed and data reduced.

Keywords: aerial monitoring; plumes; environmental transport; atmospheric chemistry; diffusion; sulfates; nitrates; aerosols; sulfur dioxide; nitric oxide; nitrogen dioxide; ozone.

72520 Sulfur Budget in Large Plumes: Sulfuric Acid Measurements. Husar, R.B. (Washington Univ., 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G603A-AA-117. **Contract:** R803896-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Sulfuric acid and related pollutant data will be analyzed in terms of long-range transport, transformation and deposition of sulfur compounds. A particulate sulfur monitor (FPD with scrubber) will be used with a heated inlet to measure total particulate sulfur and sulfuric acid in St. Louis where other measurements are available. Samples have been collected. They are being analyzed and the data evaluated.
Keywords: sulfur; sulfuric acid; plumes; ecological concentration; atmospheric chemistry; missouri; air quality; air pollution.

72521 Analysis of the Relationships Between Haze, Ozone, Sulfate, and Transport-Host. Lioy, P.J. (New York University Medical Center, 550 First Avenue, New York, NY, 10016). **Project number:** G603A-AA-121. **Contract:** R806593-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to further develop understanding of the relationships between pollutant sources, long-range transport and transformation and the resultant effects on air quality, with emphasis on episodic conditions of high ozone and sulfate values over the greater New York region. Existent data will be collected and analyzed to better describe effects of SOx, NOx, and HC emissions and concurrent transport on haze, sulfate, and ozone levels during episodic conditions over the New York area, where an extensive set of monitoring data is available.
Keywords: ozone; sulfates; visibility; atmospheric chemistry; environmental transport; nitrogen oxides; hydrocarbons; pollution sources; sulfur dioxide.

72522 Field Studies of the Oxidation of SO2 in Clouds. Hobbs, P. (Univ. of Washington, Seattle, WA, 98105). **Project number:** G603A-AA-123. **Contract:** R805263-0151. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A field study will be conducted to investigate the oxidation of sulfur dioxide in natural wave clouds. A twin-engine aircraft equipped with sophisticated aerosol and cloud droplet instrumentation would be used to measure size distributions in the inflow and outflow of wave clouds. Pollutant gas concentration measurements would be made and aerosol samples collected for elemental analysis. Upwind of the cloud, known quantities of sulfur dioxide and ammonia would be released. Sampling would be performed downwind of the trailing edge of the wave cloud at the same potential temperature of the release.
Keywords: sulfur dioxide; atmospheric chemistry; clouds; oxidation; aerial monitoring; ammonia; air quality.

72523 Conduct Seminar/Workshop on Persistent Elevated Pollution Episodes. Worth, J. (Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** G603A-AA-132. **Contract:** 68-02-3000. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

To assess the state-of-the-art with respect to the scientific understanding of transformation/transport phenomena and the status of instruments and techniques for studying transformation/transport phenomena, the ESRL expects to conduct a number of intensive field studies over the next few years and this project will help in the planning process for these studies. A seminar/workshop will be held in which EPA management and outstanding scientists from industry, universities, and other government agencies will discuss the scientific justification, goals, and approach for specific research activities, especially large scale field studies. The seminar/workshop has been held and draft reports submitted.
Keywords: air pollution; air pollution monitors; sampling; measuring methods; atmospheric chemistry; measuring instruments; meetings; planning; air pollution control; technology assessment; sulfur dioxide; nitrogen oxides; aerosols; particles.

72524 Boundary Layer Model Improvement and Validation. Albrecht, B.A. (Pennsylvania State Univ., 116 Deike Building, University Park, PA, 16802). **Project number:** G603A-AA-134. **Contract:** R806048-0152. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine effects of ambient and plume aerosol upon radiant fluxes (solar and terrestrial) for Tennessee plume study. Radiant fluxes from aircraft along with aerosol data will be measured and analyzed. Measurements have been made and analyses have begun.
Keywords: boundary layers; aerosols; heat flux; mathematical models; plumes; air quality; sulfur compounds; meteorology.

72525 Field Study of Biogenic Sulfur Gases and Particulates in Inland Waters. Hitchcock, D.R. (Hitchcock Associates, Norton Lane, Farmington, CT, 06032). **Project number:** G603A-AA-145. **Contract:** R806628-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Atmospheric aerosols will be investigated, specifically the properties that may facilitate the oxidation of biogenic sulfur gases to acid sulfate particles. Previous studies have shown that bacterogenic sulfides are very rapidly oxidized to sulfuric acid aerosols in coastal locations. Biogenic sulfide concentration up to 20 to 30 microgram/m3 has been observed. The proposed work will center on an inland location.
Keywords: sulfur; atmospheric chemistry; air pollution; sulfates; aerosols; particles.

72526 Conference on Aerosols, Anthropogenic and Natural, Source and Transport. Lioy, D.J. (New York Univ., 550 First Avenue, New York, NY, 10016). **Project number:** G603A-AA-156. **Contract:** R806381. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to provide an exchange of current scientific information on sources and effects of atmospheric aerosols. A conference was organized by the New York Academy of Sciences, sponsored by the Academy, the Air Pollution Control Association, and EPA, and was held in New York in January 1979. The conference papers are to be edited and organized for publication in a proceedings publication.
Keywords: aerosols; atmospheric chemistry; environmental transport; pollution sources; air pollution; particles; air quality.

72527 Reduced Visibility Regions and Associated Large-Scale Weather Systems. Edinger, J.G. (Univ. of California, 905 Hilgard Ave., Los Angeles, CA, 90024). **Project number:** G603A-AA-161. **Contract:** R8060705-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to develop climatology of extensive areas of reduced visibility and the associated large-scale weather features, including the life history of their internal dynamics. Individual episodes of reduced visibility (in hand) and the associated meteorological conditions as derived from routine observations of the National Weather Service will be studied.
Keywords: visibility; weather; emergency plans; meteorology; climates; air quality; forecasting; particles; aerosols.

72528 Development and Testing of Meteorological Models Suitable for Air Quality Studies. Anthes, R.A. (Pennsylvania State University, Dept. of Meteorology, 116 Deike Building, University Park, PA, 16802). **Project number:** G603A-AB-018. **Contract:** R805654. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$90,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A general three-dimensional mesoscale model has been developed which is applicable for a wide variety of purposes. Emphasis during the next three years will be on developing more efficient initialization techniques and on verifying the model. The verification will include real data cases on the regional scale utilizing regular and special meteorological data and on small scale situations utilizing intermodel comparisons and comparisons with climatological data representative of small-scale circulations. If possible, some of the real data cases will be selected to coincide with field experiments relevant to air pollution studies.
Keywords: air quality; meteorology; mathematical models; air pollution; three-dimensional calculations; climates.

72529 Meteorological Analysis for the Application of RAPS AQSMS. Panofsky. (Pennsylvania State Univ., 116 Deike Building, University Park, PA, 16802). **Project number:** G603A-AB-045. **Contract:** R805640. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This proposal consists of three parts, all aimed at air quality modeling dealing with urban problems and to be verified with observations of T-6 St. Louis experiment (RAPS). In Part I, a simple

vertical 2-dimensional atmosphere model will be applied and tested using various formulations of heat flux and mixing coefficients in the boundary layer. Part II will concentrate on the development of the proper lower boundary conditions in urban situations, particularly St. Louis and Los Angeles. A new method will be tested for deriving the correct ground parameters necessary to yield the proper surface energy balance using satellite infrared measurements for these two cities. Surface heat fluxes will be computed and compared with independent estimates. In Part III, the observed distribution of NOx and perhaps CO will be used to test an air quality model developed for Los Angeles, making use of observed temperatures, mixing depths and heat fluxes as well as estimates of these quantities by a quasi-2D horizontal hydrodynamic model.
Keywords: meteorology; air quality; mathematical models; urban areas; heat flux; boundary layers; los angeles; mixing; air pollution; nitrogen dioxide.

72530 Reactions of Sulfur Dioxide in Aerosols. Himmelblau, J.L. (Univ. of Texas, 200 West 21st Street, Austin, TX, 78712). **Project number:** G603A-AC-008. **Contract:** R803814-352. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to measure the chemical reaction rate and extent of reaction of sulfur dioxide in air with aerosol droplets containing catalytic ions or oxidants. Aerosols are passed through a flow reactor in which they are contacted with sulfur dioxide labeled with S-35. From the aerosol residence time and S-35 transferred to the aerosol, the sulfur dioxide oxidation rate is deduced from mass transfer/chemical reaction models for reactive droplets. Experimental measurements of sulfur dioxide oxidation in manganeous sulfate solution aerosols indicate that the pseudo-first order reaction rate constant is approximately 0.01/sec. This result indicates that reaction rate constants obtained in bulk water systems may be combined with mass transport theory to yield the reaction rate for suspended aerosols.
Keywords: aerosols; sulfur dioxide; chemical reaction kinetics; oxidation; air pollution; manganese sulfates.

72531 Outdoor Simulation of Air Pollution Control Strategies. Jeffries, H.E. (University of North Carolina, Dept. of Environmental Sciences, Chapel Hill, NC, 27514). **Project number:** G603A-AC-017. **Contract:** R805726-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$90,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives of this grant are to define effects of day old smog, individual components of day old smog, and reactivity of hydrocarbons in multiday smog chamber irradiations which simulate long range pollutant transport conditions; and study the effects of natural hydrocarbons on urban hydrocarbon reactivity. Experiments will be conducted in dual teflon outdoor smog chambers using natural sunlight. Multiday irradiations will be carried out with and without addition of fresh emissions to determine the influence of spent smog systems on oxidant formation the next day. A series of experiments will be performed to quantify the effect of day old smog components by adding materials such as O3, NO2, aldehydes, and various nitrogen acids to new first day systems. Experiments have been performed which show the effect of day old, dilute smog on a fresh urban mix; effects of individual changes in the starting conditions for fresh urban mix systems, including the addition of simulated day old smog; and a comparison of the reactivity of the UNC urban hydrocarbon mix with the reactivity of the propylene/butane mixture.
Keywords: air pollution control; simulation; planning; smog; nitrogen dioxide; hydrocarbons; photochemical oxidants; atmospheric chemistry.

72532 Chemical Amplifiers as Odd Hydrogen Radical Detectors. Stedman, D.H. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** G603A-AC-025. **Contract:** R805721. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The project is designed to measure free radicals such as OH and HO2 in smog chambers and in the atmosphere. A radical amplification scheme is to be used that is capable of radical amplifications of 10 to the 3rd power to 10 to the 4th power. Carbon monoxide and nitric oxides are used as the chemical amplifiers. All of the instrumentation to value the measurements has been purchased. The system appears to work but no definite results have been obtained to date.
Keywords: radicals; hydroperoxy radicals; measuring instruments; carbon monoxide; nitric oxide; photochemical oxidants; air pollution; monitoring.

72533 Investigation of the Reactions of Aromatic Hydrocarbons in Photochemical Air Pollution. Obrien, R.J. (Portland State Univ., P.O. Box 751, Portland, OR, 97207). **Project number:** G603A-AC-026. **Contract:** R804764-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective of this study is to identify the intermediate and final products formed when aromatic hydrocarbons are irradiated with oxides of nitrogen under simulated atmospheric conditions. Reactions of several important aromatic constituents of gasoline under photochemical smog conditions will be studied. These hydrocarbons include benzene, toluene, xylene, and mesitylene. Reaction products will be identified and quantified. A computer model of the reactions of toluene will be developed and validated against experimental data. The goal of the model will be to explain the decomposition of toluene under atmospheric conditions, and to evaluate its contribution to photochemical oxidant production in urban atmospheres. Product yields have been determined for the following products of toluene oxidation: benzaldehyde, O-cresol, nitrotoluene, and benzyl nitrate.
Keywords: nitrogen oxides; aromatics; photochemical reactions; benzene; toluene; xylenes; mesitylene; photochemical oxidants; gasoline; computerized simulation; benzaldehyde; nitro compounds; cresols; nitrates; chemical reaction yield.

72534 Origins and Behavior of Pollution Aerosols. Friedlander, S.K. (Univ. of California, 405 Hilgard Ave., Los Angeles, CA, 90024). **Project number:** 6603A-AC-048. **Contract:** R806404-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to investigate the formation of nitrate and organic compound containing aerosols in an experimental laboratory situation and to test the aerosol theory developed by the principal investigator for the nitrate and organic aerosols. Balloon reactor studies will be carried out for nitrates and organics. Atmospheric air will be spiked with ppM levels of NOx, propylene, and ammonia. Size distribution of aerosols will be formed and the nitrate aerosol formation rate will be determined. Laboratory equipment has been assembled and experimental studies will begin in May 1979.
Keywords: air pollution; aerosols; nitrates; organic compounds; nitrogen oxides; ammonia; propylene; mathematical models; atmospheric chemistry.

72535 Kinetic Study of Simulated Atmospheres Containing Common Sulfur, Nitrogen, and Carbon-Compound Pollutants. Calvert, J.C. (Ohio State Univ., 164 West 17th Avenue, Columbus, OH, 43210). **Project number:** G603A-AC-51. **Contract:** R806479-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this study are to: (1) study the homogeneous removal processes for SO2 within polluted atmospheres; (2) study the photooxidation of aldehydes in the atmosphere; and (3) study the fate of nitrogenous compounds in the atmosphere. The oxidation of SO2 will be studied with OH radicals and with hydrocarbon--NO--SOx reactions. The aldehydes will be photodissociated in a long path ir cell and products will be studied with an FTS system. The nitrosamines will be studied by reacting the amine with NO, NO2, alkanes both with FTS and kinetic flash spectroscopy.
Keywords: sulfur dioxide; aldehydes; photochemistry; nitrogen compounds; oxidation; hydroxyl radicals; nitrogen dioxide; nitroso compounds; alkanes; absorption spectroscopy; atmospheric chemistry; hydrocarbons.

72536 Atmospheric Measurements of Formaldehyde and Hydrogen Peroxide. Kok, G. (Claremont Colleges, Harvey Mudd College, Claremont, CA, 91711). **Project number:** G603A-AD-023. **Contract:** R806629-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to measure formaldehyde hydrogen peroxide, and other pollutants in the ambient atmosphere; (2) to improve the detection sensitivity of a chemiluminescent technique for formaldehyde, and carry out a comparison study of formaldehyde measurements using LPIR and wet chemical methods; and (3) to measure formaldehyde and hydrogen peroxide in hydrogen and gasohol fueled vehicles. Ambient air measurements of hydrogen peroxide and formaldehyde will be made with the recently developed chemiluminescent methods. Comparisons of formaldehyde measurements will be made with chemiluminescent, wet chemical,

and LPIR methods. A chemiluminescence method has been developed that measures formaldehyde but its sensitivity needs to be increased to measure low ambient air concentrations.
Keywords: formaldehyde; air pollution monitors; hydrogen peroxide; air; gasohol; exhaust gases; hydrogen; chemiluminescence; measuring methods; comparative evaluations; aerosols.

72537 PAN Concentration in Ambient Air in New Jersey. Brennan, E.G. (Rutgers--The State University of New Jersey, Dept. of Plant Pathology, Old Queens Bldg., New Brunswick, NJ, 08903). **Project number:** G603A-AD-025. **Contract:** R805827-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$29,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

Ambient air will be monitored for peroxyacetyl nitrate from April 1979, to April 1980. The PAN concentration will be examined with respect to wind speed and direction. Plants sensitive to PAN will also be studied for plant damage. Ambient air is either trapped in a cryogenic container and later introduced into a gas chromatograph or the air sample is introduced directly into the GC. PAN-sensitive plants are placed out and exposed to the ambient air. Leaf damage is observed. PAN and O3 have been studied from August 1978 to present. The PAN maximum was observed to be 10.5 ppB in August. The PAN/O3 ratio was observed to be high, suggesting a malfunctioning O3 detector.
Keywords: ecological concentration; new jersey; air quality; pan; nitrogen oxides; hydrocarbons; smog; photochemical oxidants; mathematical models.

72538 Measurement of Halogenated Pollutants and Other Trace Gases in the Troposphere by Long-Path In-Situ Infrared Absorption Spectroscopy. Pitts, J. (Univ. of California, Riverside, CA, 92502). **Project number:** G603A-AD-026. **Contract:** R804546. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

This grant will permit the long path infrared study of the Los Angeles atmosphere. The ambient air of Los Angeles will be monitored for HNO3, HCOOH, H2CO, NH3, and PAN. Ambient air is monitored with a long-path ir cell equipped with a FTS spectrometer. Results for the past nine months have shown that O3, PAN, HNO3, HCOOH, and CH2O can be monitored on a routine basis with the FTS-ir system.
Keywords: troposphere; absorption spectroscopy; nitric acid; formaldehyde; ammonia; pan; formic acid; ozone; monitoring; air pollution; los angeles; ambient temperature; photochemical oxidants.

72539 Rural Oxidant Studies and the Role of NOx in Rural Oxidant Formation. Westberg, H.H. (Washington State Univ., Pullman, WA, 99163). **Project number:** G603A-AD-037. **Contract:** R806683-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

Aircraft and ground level measurements of ozone and its precursers will be made in the northeast United States with the intent of regional scale model validation. Because of the magnitude of the study, other government funded research groups will also participate in the meteorological and pollutant data collection program. Estimates of natural hydrocarbon emissions in this area of the United States will be made. WSU will use an aircraft equipped with O3, NOx, and SO2 instrumentation to measure pollutant levels over large geographic areas of the northeastern United States. Grab samples for detailed hydrocarbons will be collected at strategic points along the flight path. These grab samples will be analyzed by sophisticated gas chromatographic techniques at a ground base site. The ground base site will also be fully equipped to make several pollutant and meteorological measurements. WSU has performed several similar studies in past years. EPA reports of these activities are available. This study will not involve the use of any new measurement procedures but will collect more useful data for mathematic model validation.
Keywords: nitrogen dioxide; rural areas; oxidizers; ozone; usa; coordinated research programs; sulfur dioxide; air pollution; sampling; data compilation; hydrocarbons; gas chromatography; meteorology; mathematical models; atmospheric chemistry.

72540 Determination of Natural Pollutant Flux and Dry Deposition Rates. Robinson, E. (Washington State Univ., Pullman, WA, 99163). **Project number:** G603A-AD-039. **Contract:** R805342-0251. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

Vertical profile measurements for natural hydrocarbons, ozone, and other pollutants will be made to determine flux values for these compounds. The flux values for natural hydrocarbons will be used to determine emission rates of these compounds from natural forested vegetation. The flux values from ozone and the other pollutants will be used to determine velocity deposition (or removal) rates. This study will be conducted in cooperation with the 1979 Northeast Regional Ozone Study. A vertical sampling tower will be situated in a selected forested area of the northeast. Measurements of vertical profiles for the natural hydrocarbons, ozone, and other pollutants will be made using modern gas chromatographic, and chemiluminescent techniques. From these vertical profile measurements of pollutant, temperature, windspeed, and dewpoint, vertical fluxes of the pollutants will be determined. WSU has utilized this technique in other field study activities during the years 1977 and 1978. From their measurement they have determined velocity deposition (VD) for ozone and SO2 over several types of soil and agricultural surfaces. This year forested (tree) surfaces will be investigated. Reports of these results have not yet been received.
Keywords: hydrocarbons; ozone; air pollution; sampling; gas chromatography; chemiluminescence; temperature measurement; wind; dew point; spatial distribution; soils; terrestrial ecosystems.

72541 Chemical Amplifiers as Odd Hydrogen Radical Detectors. Stedman, J.J. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** G603A-AD-046. **Contract:** R805721-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective of this grant supplement is to measure 03 and NOx by a very fast detection system. The work will be done as part of an oxidant field study in the northeast and part of an NOx study in the midwest. Chemiluminescent detectors employing either NO or 03 to detect either 03 or NO respectively will be modified for quick response. Such quick responses are required if eddy correlation techniques are to be employed in order to obtain deposition velocities. Instrumentation is being ordered.
Keywords: ozone; nitrogen oxides; quantitative chemical analysis; air pollution monitors; chemiluminescence; air pollution.

72542 Precipitation as a Scavenger of Atmospheric Pollutants. Robertson, J.K. (Dept. of Defense, West Point, NY, 10996). **Project number:** G603A-AE-008. **Contract:** D9-F112. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the task is to estimate the pollutant scavenging efficiency of convective and frontal storms. Precipitation samples will be collected using a sequential sampler, the pH measured, and samples analyzed for chemical composition. This data will be analyzed to estimate the removal rate of pollutants by precipitation. Preliminary results confirm the viability of the sequential sampling technique; complete chemical data is needed from individual storms to evaluate intensity related scavenging; and, in the West Point area, dry deposition is important and highly acidic.
Keywords: precipitation scavenging; precipitation; rain; ph value; chemical composition; sampling; coal; petroleum; photochemical oxidants; aerosols; particles; air pollution.

72543 Refinement, Verification, and Application of a Long-Range Transport Model of SO2 and Sulfate. Reiter, E.R. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** G603A-AE-009. **Contract:** R806658-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to improve the investigators' earlier work on this model by optimizing computer programs, validating the model, developing an algorithm for acidity of precipitation, and applying the model to projected SO2 emissions. The approach will be to utilize literature for model physics and chemistry, and to use EPA emissions and air quality data for validation of model runs. Model has been run but not validated.
Keywords: sulfur dioxide; sulfates; mathematical models; computer codes; acid rain; air quality; environmental transport.

72544 Assessment of Turbidity Network Data. Robinson, E. (Washington State University, Dept. of Chemical Engineering, Pullman, WA, 99163). **Project number:** G603A-AE-27. **Contract:** R806124-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$20,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of the study are to determine the trends in atmospheric turbidity and to relate these trends to other meteoro-

logical and air quality parameters. The turbidity data collected over the United States since 1966 will be evaluated and their quality assessed. The data will then be used to statistically determine any turbidity trends, and these trends will be correlated with other parameters to ascertain any relationships that may exist. The quality of the data has been assessed and the data classified and prepared for the statistical analyses procedures.
Keywords: earth atmosphere; monitoring; quality assurance; quality control; spatial distribution; mathematical models; air pollution; turbidity.

72545 Sulfur Dioxide and Sulfates Materials Damage Study. Harker, A.B. (Rockwell International Corp., Science Center, 2421 W. Hillcrest Avenue, Thousand Oaks, CA, 91320). **Project number:** G603A-AE-029. **Contract:** 68-02-2944. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$58,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

In this study a stable flow of air containing sulfate aerosols will be established in a reaction chamber, and the mechanism of the aerosol induced corrosion of zinc surfaces will be studied. In the study both sulfuric acid and ammonium-bisulfate aerosols in the size range 0.1 to 1 micron diameter will be used. In the experiments humidity, temperature, aerosol size distribution, and number concentration will be monitored as well as the velocity profile of the flow in the tube to establish the dependence of the aerosol flux and zinc corrosion rates upon these parameters. These parameters will be varied over the range normally observed in the atmosphere. The data will be interpreted and compared with the predictions of existing aerosol flux and zinc corrosion models.
Keywords: sulfur dioxide; sulfates; environmental effects; aerosols; air pollution; sulfuric acid; ammonium sulfates; zinc; corrosion; surface properties.

72546 Measurement of the Oxidizing Potential of the Troposphere for Solvent Emissions. Cronn, D.R. (Washington State Univ., Pullman, WA, 99163). **Project number:** G603A-AF-015. **Contract:** R806678-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purpose of this work is to measure methyl chloroform and other halogenated hydrocarbons present in the troposphere and also measure OH radicals that lead to the destruction of halocarbons in the troposphere. The halocarbons will be measured with the use of a gas chromatograph equipped with an electron capture detector. The OH radicals will be measured with tagged C14O. The C14O2 resulting from reaction of CO with OH will be measured with a low level counter. The mixing ratio of CH3:CCl3 has been measured and was found to be approximately 100 ppT in the northern hemisphere in 1978. The OH radical was found to be between 2 x 10 to the 5th power and 4 x 10 to the 6th power/cm.
Keywords: troposphere; halogen compounds; hydroxyl radicals; gas chromatography; carbon 14; carbon monoxide; monitoring; atmospheric chemistry.

72547 Stratospheric Ozone in Urban Air. Husain, L. (Health Research Inc., Empire State Plaza, Albany , NY, 12237). **Project number:** G603A-AH-18. **Contract:** R805913-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$39,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this work is to study the 7Be and 32P in particulates. Beryllium-7 has a half-life of 53 days while phosphorus-32 is only 14.3. By measuring these two compounds, the stratospheric contribution to O3 can be determined. Particulate samples were collected in the FY 1978 field study in Houston, Texas. These samples were then analyzed for 7Be and 32P with the use of low level counting techniques. Results to date show that O3 can contribute 20 to 40 ppB of O3 in Houston. Data interpretation was made difficult since an atomic blast had occurred during that time.
Keywords: stratosphere; ozone layer; urban areas; air quality; air pollution; aerosols; environmental effects; ozone; pollution sources.

72548 Development of Strategy for Stationary Source Single Point Stack Sampling for Representative Particulate Matter Samples. Decoursin, D.G. (FluiDyne Engineering Corp., 5900 Olson Memorial Drive, Minneapolis, MN, 55422). **Project number:** G712B-BA-008. **Contract:** 68-02-3205. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

A stationary source sampling strategy to allow a representative particulate matter sample to be obtained from a single point will be researched. The approach is to: perform literature survey; establish procedure(s); test procedures under laboratory and approximately 1/10 scale model conditions; and test procedures at full scale field sites. The literature survey has been completed.
Keywords: air samplers; testing; scale models; aerosols; particles; stacks; sampling; gaseous wastes; stack disposal.

72549 Construct Mobile Laser-Doppler Velocimeter System. Krause, M.C. (Raytheon Corp., 528 Boston Post Road, Sudbury, MA, 01776). **Project number:** G712B-BA-034. **Contract:** 68-02-2784. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

Emission standards for some point sources are based on a mass emission rate; fugitive emissions from extended area sources can only be determined by a remote mass emission rate measurement. The objective of this program is to obtain a system for remote measurement of plume or wind velocity. This system, coupled with remote measurements of pollutant concentration, allows determination of pollutant mass emission rate. In a laser-Doppler velocimeter (LDV) system, a collimated beam of CW CO2 laser radiation is focused in the area of interest. The backscatter signal is shifted in frequency due to the Doppler effect, and the frequency shift is measured by heterodyne techniques. Such a system is to be assembled in a van and evaluated for determination of both particulate and gaseous mass emission rates. Feasibility studies to determine the applicability of LDV for measurement of stack effluent velocity were conducted successfully in 1974 and 1975. In 1977, a procurement was prepared to obtain an LDV system for EPA needs. At present, the basic LDV system has been completed and has undergone initial evaluation. A procurement to obtain a real-time data processing system has been initiated.
Keywords: velocimeters; lasers; telemetry; air pollution; stacks; feasibility studies; velocity; exhaust gases.

72550 Evaluation of Gas Filter Correlation Techniques for the Single-Ended Measure of NO2. Chaney, L.W. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** G712B-BA-037. **Contract:** R805956-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives are to evaluate the longpath gas-filter correlation instrument for measurement of hf concentrations emitted from aluminum refinery potrooms and to test and calibrate an NO--NO2 gas-filter correlation instrument in the laboratory.
Keywords: nitric oxide; nitrogen dioxide; measuring instruments; hydrofluoric acid; industrial plants; gaseous wastes; air pollution.

72551 Provide GC/MS Support for In-House Source Program. Pellizzari, E.D. (Research Triangle Inst., Research Triangle Park, NC, 27709). **Project number:** G712B-BA-070. **Contract:** 68-02-2767. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide gas chromatographic--mass spectrographic services, especially for characterization of diesel exhaust organics, and to provide routine analysis for the carcinogenic chemical n-nitrosodimethylamine (DMN). Organic extracts from diesel exhaust particulates are prepared and partially fractioned in-house. Samples are then submitted to the contractor for characterization, especially high resolution mass spectroscopy. DMN samples are collected on Tenax sorbent traps and submitted for analysis. The organic constituents in 22 samples of fractionated diesel exhaust particulate extracts have been analyzed. More than 30 exhaust samples of various types have been analyzed for DMN and indicate DMN may be present in auto exhaust under certain conditions.
Keywords: diesel fuels; combustion products; gas chromatography; mass spectroscopy; nitroso compounds; amines; carcinogens; exhaust gases; chemical analysis; air pollution.

72552 Develop and Deliver Two Prototype Real-Time Continuous Sulfate Monitors for Mobile Source and Ambient Air Applications. Schetzle, D. (Ford Motor Co., The American Rd., Dearborn, MI, 48121). **Project number:** G712B-BA-071. **Contract:** 68-02-2787. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop real-time continuous monitors for measuring sulfates in mobile source emissions and in ambient air. A sample is taken through heated lines to a T and equally split. Sulfates are filtered out from half of the sample and SO2 is measured. The other half of the sample is passed through a catalyst to convert

sulfates to SO2. Total SO2 is measured. Difference between the SO2 values is sulfate. Another approach is to pass the sample through a denuter to remove SO2 while allowing the sulfate particulate to pass through. The sulfates are then passed through a catalyst for conversion to SO2 which is then measured. Detection system is based on an improved microcoulometric technique for SO2. Sampling parameters have been investigated. Catalytic conversion of sulfate to SO2 for microcoulometric measurement has been optimized. A simple denuter has been devised and found to be efficient in scrubbing SO2 from the sample stream. This makes possible direct measurement of sulfates as SO2.
Keywords: mobile pollutant sources; air pollution monitors; design; sulfates; sulfur dioxide; sampling; scrubbers; monitoring.

72553 Application of an Asbestos Analyzer to Environment Sampler. Birks, L.S. (Department of Defense, 4555 Overlook Avenue, Washington, DC, 20375). **Project number:** G712B-BA-099. **Contract:** D9-F0566. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are (1) to evaluate the performance of an x-ray diffraction asbestos analyzer (XRDAA), designed and built by NRL under a previous agreement (EPA-IAG-D5-0651), and (2) to determine operating costs and analysis time involved in the routine use of the XRDAA. Sample specimens will be prepared by EPA using separation techniques currently under development and fiber alignment as perfected in ESRL/RTP. NRL will furnish alignment grids, operate analyzer, and evaluate results.
Keywords: x-ray diffraction; asbestos; performance; x-ray diffractometers; operating cost; technology transfer; environmental materials; evaluation.

72554 Development of Glass Array Impactors for Separation of Fibrous Aerosols. Gentry, J.W. (Univ. of Maryland, College Park Campus, College Park, MD, 20742). **Project number:** G712B-BA-101. **Contract:** R806518-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop a means for sampling fibrous aerosols that will separate fibers from non-fibrous or isometric particles and thus facilitate the measurement of airborne fiber concentrations, e.g., of asbestos, by reducing interferences by background particles. The approach is based on previously reported observations that fibers are aligned by flow gradients as they approach and pass through parallel capillary arrays such as nucleopore filters and porous glass disks of sufficiently large pore size.
Keywords: aerosols; fibers; sampling; sorting; asbestos; filtration; air pollution monitors; air samplers; design; filters.

72555 Polynuclear Aromatic Compounds: Synthesis and Purification. Eisenbraun, E.J. (Oklahoma State Univ., Stillwater, OK, 74075). **Project number:** G712B-BB-005. **Contract:** R805419-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The synthesis and/or purification of a group of polynuclear aromatic (PNA) hydrocarbons commonly found as pollutants in the environment are described. These hydrocarbons are to be synthesized and purified in 10 g quantities with a purity goal of 99.9%. Synthesis and purification is considered a continuous process which is most efficient when more than one hydrocarbon is under study at the same time. We like to keep something going at each phase so that equipment bottlenecks do not develop. Exploratory studies are conducted to determine whether a reaction sequence will provide the desired hydrocarbon and to obtain a sample for purity studies. This information is required for estimation of the synthesis and/or purification of 27 compounds has been accomplished since the beginning of the project. Each of these compounds were supplied in 10 g amounts. These compounds have been distributed throughout EPA, the USA, and some foreign countries.
Keywords: polycyclic aromatic hydrocarbons; synthesis; purification; air pollution.

72556 Air Pollution Monitoring by Long Path Lasers. Chaney, L.W. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** G712B-BB-032. **Contract:** R806650-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to use ESRL's existing long path monitoring systems in field test to measure spatial (horizontal and vertical) averages of CO and O3 in the ambient air. The unique monitoring capabilities of long path monitors will be used to validate air quality models and to determine spatial variability of CO and O3. An optical transfer system will be designed to deflect diode and CO2 laser beams from a mobile van to a remote retro-reflector so that a capability for measuring slant height averages of O3 can be realized. O3 and CO spatial averages will be measured in EPA field studies.
Keywords: air pollution monitors; carbon dioxide lasers; spatial distribution; carbon monoxide; ozone; air quality; optical systems.

72557 Continuous Monitoring of Particulate Sulfur Compounds by Flame. Nuteicker, J.J. (Oregon Graduate Center, 19600 NW Walker Rd., Beaverton, OR, 97005). **Project number:** G712B-BB-082. **Contract:** R804750-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to develop an instrument capable of both continuously monitoring particulate sulfur and distinguishing among the different chemical compounds of sulfur. Sulfur is detected by the luminescence resulting from combustion of sulfur compounds in a hydrogen rich flame. Sulfur gases are removed from the sample stream by a diffusion tube scrubber. The principal constituents of atmospheric sulfur particulates, H2SO4 and ammonium (BI) sulfate, are individually removed from the sample stream by a thermal speciation. Thermal speciation employs a heated tube in which the particulates can be transferred to gases and removed at their vaporization temperatures. An automatic particulate sulfur monitor has been completed which uses sequential removal of sulfur compounds (as described above) and real-time data handling by micro-processor electronics. The instruments permit near real-time measurements of total sulfur particulate, total minus sulfuric acid, and total minus ammonium sulfate.
Keywords: sulfur dioxide; air pollution monitors; sulfur; particles; aerosols; scrubbers; sulfuric acid; ammonium sulfates; air quality; monitoring; design.

72558 Simplified Sampling Systems. Heinsohn, R.J. (Pennsylvania State University, Dept. of Mechanical Engineering, 101 Hammond Bldg., University Park, PA, 16802). **Project number:** G712B-BC-010. **Contract:** R805738-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$30,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of this task are to design, build, and test a simplified source sampling system. This system will be suitable for use as methods 5, 17, and the ip system. The system will have a dilution system which can collect particulate matter at ambient temperature and pressure. Ease of handling and use are also factors which are being evaluated. A dilution ejector pump is the heart of this system; it provides the pumping and the needed dilution air. The dilution ejector pump has been developed and evaluated, and a prototype system has been delivered to EPA. A second prototype is being evaluated at Pennsylvania State University.
Keywords: air pollution; sampling; aerosol monitoring; particles; aerosols; design; air samplers; optimization.

72559 In-Stack Diffusion Classifier for Aerosol Mass Distribution. Lundgren, D.N. (Univ. of Florida, 220 Black Hall, Gainesville, FL, 32611). **Project number:** G712B-BC-012. **Contract:** R805762-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective of this work is to develop, fabricate, and test an in-stack diffusion particle size classifer. An in-stack diffusion device with five sizing stages which use a different number of diffusion screens will be used. A laboratory prototype made of aluminum has been fabricated and tested. Two stainless steel prototypes are completed and will be field tested.
Keywords: particle size classifiers; stacks; design; fabrication; aluminium; testing; stainless steels; field tests; aerosols.

72560 In-Stack Particle Sizing Device Compatible with Samples Preparation Requirements of the Wavelength Dispersive X-Ray Fluorescence. McCail, J.D. (Southern Research Inst., 2000 9th Avenue S., Birmingham, AL, 35205). **Project number:** G712B-BC-015. **Contract:** 68-02-2992. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to design and develop an in-stack particle sizing device that will classify stationary source stack gas-borne particulate matter into six sized fractions. The first fraction is produced by a 15 micron cut point mechanism. The next five are successively smaller down to 0.5 micron and are produced by an

impactor and each of the five is deposited onto a separate substrate. The sample, consisting of the particulate matter deposited on the substrate, is compatible with no further processing with the analytical procedures of ESRL's wavelength dispersive x-ray fluorescence analyzer. The device will be designed to cause impaction onto a nonporous substrate. The aerosol passes through a slit and impacts onto a substrate on a rotating drum. This is the mechanism for the five fractions lower than 15 microns. The 15-micron mechanism may be a cyclonic impactor or other method. Preliminary design of the five stages, 10 microns to 0.5 micron, is completed. A breadboard device has been fabricated to simulate one stage. Tests of the breadboard are designed.
Keywords: stacks; aerosols; particle size; particle size classifiers; x-ray fluorescence analysis; design.

72561 Chemical Ionization Mass Spectrometry of Organics and Organometallic Compounds. Risby, T.H. (Pennsylvania State Univ., 226 Fenske Lab., University Park, PA, 16802). **Project number:** G712B-BC-037. **Contract:** R803651-02S3. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objective is a multi-part study which would determine possible applications of positive and negative chemical ionization mass spectrometry to mobile source analysis and then to apply it to the analysis of diesel particulate. A wide range of applications are surveyed from the analysis of lanthanide and noble metals; other metallic and nonmetallic compounds such as nickel carbonyl and sulfuric acid; and a wide range of organic materials. Techniques for each of the types of analysis (metal, gases, inorganics, and organics) were developed. These techniques are applied to mobile source emission analysis.
Keywords: mobile pollutant sources; diesel fuels; particles; rare earths; gold; platinum; sulfuric acid; nickel compounds; carbonyls; mass spectroscopy; organic compounds; organometallic compounds; chemical analysis; combustion products; exhaust gases; air pollution.

72562 Exhaust Emissions from a Diesel Engine. Risby, T.H. (Johns Hopkins Univ., 615 H. Wolfe St., Baltimore, MD, 21205). **Project number:** G712B-BC-080. **Contract:** R806558-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine basic data relating the impact of fuel and engine combustion parameters to diesel particulate composition, emissions rates, and biologic activity. Simple fuels will be utilized in a single cylinder engine and model combustion systems. Post combustion dilution effects will be measured as well as primary combustion phenomenon. Biological activity will be monitored using simple systems. Surface character of the particulate will be determined. This is a new study but extends previous work which indicates that fuel composition is not necessarily the controlling parameter on particulate character.
Keywords: diesel engines; exhaust gases; biological effects; aerosols; particles; chemical composition; diesel fuels; air pollution; air quality.

72563 Comparative Evaluation of GC/MS Data Analysis Processing. Pellizzari, E.D. (Research Triangle Inst., P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** G762B-DB-011. **Contract:** 68-02-2262. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall broad term objective of this program is to evaluate methodology encompassing the use of a solid sorbent collection device for the collection of vapor-phase organics in combination with gas chromatography/mass spectrometry/computer for their analysis. The aim of this program is to evaluate this methodology at ten different sites within the continental USA. The limitations and the overall analysis capability is to be documented with research improvements to be implemented to correct any uncovered deficiencies. A series of field samples will be investigated for artifact formations of class compounds during the collection process. Additionally, information will be collected on toxic organic compounds present in ambient air. Sites have been selected and initial sampling begun.
Keywords: gas chromatography; mass spectroscopy; organic compounds; adsorption; air samplers; air pollution; comparative evaluations; vapors.

72564 Portable Miniature Collection System for Exposure Assessment Within the Microenvironment for Carcinogens and Precarcinogens. Brooks, J. (Monsanto Research Corp., 1515 Nicholas Road, Dayton, OH, 45407). **Project number:** G775B-CD-004. **Contract:** 68-02-2774. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop a miniaturized personal sampler for the genotoxic vapors and develop a screening technique(s) for the important genotoxic families. The approach is to: evaluate several commercially available solid absorbents for the collection of organic carcinogenic vapors for collection efficiency, breakthrough times, etc; design and fabricate portable collection device using solid absorbents; develop analytical methodology for subsequent analysis of collected carcinogens; and test developed methodology under field conditions. Three solid absorbents have been selected - TENAX GC, PORAPAK R, and AMBERSORB SKC 340 - as the most effective absorbents. A capillary inlet system desorption chamber has been constructed and evaluated. This system is used to thermally desorb the collected vapors from the solid absorbent to the analytical finish.
Keywords: air samplers; mutagen screening; chemisorption; organic compounds; design; chemical analysis; desorption.

72565 Develop Multi-Residue Analysis for 20 Carcinogens and Screening Techniques for the Analysis of Chemical Class Categories. McMillin, C.R. (Monsanto Research Corp., Dayton Lab., 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** G775D-CD-005. **Contract:** 68-02-2773. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$75,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to identify 20 of the most significant suspected atmospheric carcinogens that are produced in high volume, develop analytical methodology for their analysis, and test methodology in the field. A literature survey will be performed of the high volume chemicals that are carcinogens or suspected carcinogens. From this survey, 20 chemicals are to be selected for development of methods for their subsequent collection and analysis. The 20 compounds have been selected from a compilation of 125 chemicals suspected of being carcinogens. They were selected to be representative of the broadest range of chemicals possible.
Keywords: multi-element analysis; carcinogens; mutagen screening; chemical effluents; risk assessment; air pollution; quantitative chemical analysis; optimization.

72566 Diesel Exhaust Chamber Studies: Incremental Funding. Anderson, R. (Calspan Corp., 1422 Genessees Avenue, Buffalo, NY, 14221). **Project number:** G815B-CA-045. **Contract:** 68-02-2987. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to study the aerosol formation and growth of SO2/diesel exhaust mixtures as a function of humidity, HC/NOx, primary aerosol levels, and ammonia under controlled smog chamber conditions. The 21,000 cubic feet Calspan smog chamber will be used. Parameters listed in the objective will be controlled, diesel auto exhaust introduced to the chamber, and aerosol size as a function of time measured. SO2, NOx, O3, and THC will be determined continuously. Filter samples for x-ray analysis and for bioassay studies will be taken. As of April 1, 1979, 28 chamber runs have been made. That data is being analyzed in preparation for planning the final series of runs to be done in July 1979.
Keywords: diesel engines; exhaust gases; air pollution abatement; aerosols; sulfur dioxide; nitrogen oxides; ozone; hydrocarbons; exhaust systems.

72567 Investigation of Filter Artifacts When Sampling Airborne Organic Particulates. Pitts, J.N. (Univ. of California, Riverside, CA, 92502). **Project number:** G832B-EA-083. **Contract:** R806042-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives of this grant are to substantiate the existence of sampling error (so-called filter artifacts) suspected in the analysis of the organic fraction of the particulate collected in polluted atmospheres, to determine the mechanism(s) by which such artifacts occur in particulate polycyclic organic matter (POM), and to provide collection methods which minimize artifact errors. The methods employed are: (1) design, construct, and test a sampling device which allows the collection of particulate onto several filtering media simultaneously from the same polluted atmosphere; (2) design, construct, and test a filter exposure apparatus and systematically investigate filter artifact formation on pre-collected filters using the exposure apparatus; and (3) study organic aerosol surrogate development and feasibility evaluation. Results include: (1) design and construction completed on the ultra high-volume four by four sam-

pler; (2) design, construction, and testing completed on a prototype diffusive sampler; (3) experimental design completed on artifact formation effects of filter media; and (4) ambient sampling site established in El Monte.
Keywords: air filters; organic compounds; aerosols; particles; sampling; aerosol monitoring; measuring instruments; reliability; air samplers; design; california.

72568 Ambient Aerosol Analysis Near Coal Gasification Plant, Yugoslavia. Winchester, J.W. (Florida State Univ., 205 Wilde Drive, Tallahassee, FL, 32306). **Project number:** G832B-EA-141. **Contract:** R806651-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are: (1) to supply size fractionating and time resolving sampling devices to the EPA for use in Yugoslavian gasifier study, (2) to determine elemental composition on selected samples collected by EPA in Yugoslavia, (3) to interpret analysis data from Yugoslavian samples, and (4) to supply elemental size distributions and time resolved elemental concentrations to EPA and to Yugoslavs. The approach is to analyze size fractionated and time resolved sampled collections using proton induced x-ray emission (PIXE) techniques and statistical data interpretation and analysis techniques. Required instrumentation and sample collection substrates have been delivered to the EPA. Field study in Pristina, Yugoslavia, is scheduled for May 1979.
Keywords: yugoslavia; coal gasification plants; aerosol monitoring; ambient temperature; air samplers; aerosols; chemical composition; x-ray emission analysis; air pollution.

72569 Kinetics and Mechanisms of Nitrate Formation in Photochemical Smog. Spicer, C.W. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** G832B-EA-161. **Contract:** R805812-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$60,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this work is to determine the fate of NOx in the atmosphere through the use of smog chambers that simulate actual atmospheric conditions. Experiments will be performed on HC/NOx mixtures for the specific purpose of identifying the chemical and physical removal processes of NOx. A series of runs have been performed in order to determine the background loss characteristics of the smog chamber.
Keywords: chemical reaction kinetics; nitrates; photochemical oxidants; photochemistry; smog; mathematical models; atmospheric chemistry.

72570 Incremental Funding: Reactions of SO2 with O2, O3, and NO2 in Catalytic Solutions. Martin, L.R. (Aerospace Corp., P.O. Box 95085, Los Angeles, CA, 90045). **Project number:** G832B-EA-170. **Contract:** 68-02-2702. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The intent is to study SO2 reactions in liquid droplets as a function of O3, NOx, organic vapors, and catalytic species such as Fe, Mn, V, Cu, Co, and Pb. A laboratory study involving a stopped flow reaction setup with uv absorption spectroscopy to follow the SO2 decay is being used. Reaction times of 1 sec to 1 day can be measured in this manner. The first year involved a literature review to determine which rates have been measured. The lab equipment was then assembled and rate measurements begun. Of the 179 reactions to be studied, 21 have been completed in the first 18 months of the program. The Fe/Mn mixed catalyst system is the only one studied thus far to exhibit synergism.
Keywords: sulfur dioxide; ozone; nitrogen dioxide; iron; manganese; vanadium; copper; cobalt; lead; absorption spectroscopy; catalysts; synergism; coal; atmospheric chemistry; air quality; catalytic effects.

72571 Role of Organic Peroxynitrates in Photochemical Smog. Hendry, D.G. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** G832B-EA-171. **Contract:** R806506-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective of the proposed study is to elucidate the role of organic peroxynitrates in photochemical smog formation. The decomposition of peroxynitrates, RO2NO2 yields RO2 + NO2, and the subsequent reactions of the peroxy radicals with NO and NO2 will be investigated. The following peroxynitrates will be studied: PPN, PFN, PNA, peroxyethyl nitrate, peroxy isopropyl nitrate, peroxy-t-butyl nitrate, and peroxypentyl nitrate.
Keywords: smog; photochemical oxidants; peroxy radicals; nitrogen dioxide; nitrates; atmospheric chemistry.

72572 Field Instrumentation for Real-Time Monitoring of Respirable and Non-Respirable Dust Concentration in the Air. Patashnick, H. (Dudley Observatory, 1202 Troy Schenectady Road, Latham, NY, 12110). **Project number:** G832B-EA-201. **Contract:** R805222-0251. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop an instrument for real-time measurement of ambient aerosol mass. The instrument is based on a newly developed device--tapered element oscillating microbalance--which is similar to classical quartz crystal microbalance but without many of the latter's problems. A satisfactory method for collecting aerosol on the microbalance has been demonstrated: filtration through a membrane filter cartridge attached to the end of the hollow tapered element position of the microbalance. A 5 liter/minute flow rate has been achieved. A series of ambient measurements at 15 minute intervals has been obtained.
Keywords: dusts; ecological concentration; aerosol monitoring; air pollution; air quality; aerosols; particles; air samplers; air pollution monitors.

72573 Mesoscale Sulfur Balance Studies. Winchester, J.W. (Florida State Univ., 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** G832B-FA-132. **Contract:** R803887-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

This is a comprehensive study to characterize the occurrence of sulfur in aerosol particles at sampling stations in locations between the mid-continent and eastern seaboard of continental USA. Additional remote stations in marine and continental areas are also being operated to provide important background information. Emphasis is being placed on the concentrations of sulfur in relation to other elements present in the aerosol and on the time variability of these concentrations with a time resolution of 2 hours. Sampling is being carried out continuously at heights from ground level to 30 meters by a unique time sequence filter sampler which has been developed at Florida State University. Additional samples are planned to be taken during intensive periods during the year by cascade impactors at about five of the filter sampling sites, using cascade impactors for determination of the particle size distribution of sulfur and related elements. Elemental analysis is performed using proton induced x-ray emission. All sampling is completed. Data reduction and evaluation is ongoing.
Keywords: aerosols; sulfur; sampling; baseline ecology; ecological concentration.

72574 Techniques for the Measurement of Aerosol Carbon Content. Macias, E.S. (Washington Univ., 4559 Scott Avenue, St. Louis, MO, 63136). **Project number:** G833D-EB-012. **Contract:** R806005. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The research is focused on the development of instruments and techniques for analyzing carbonaceous aerosols with high accuracy and in more detail than is presently possible. The research effort will concentrate on the study of atmospheric particles less than a few micrometers in diameter. The total carbon content will be determined by the Gamma-Ray Analysis of Light Elements (GRALE) technique. The elemental carbon fraction will be determined by reflectance analysis and alternatively differential heating followed by GRALE analysis, and the organic carbon by thermal evolution and alternatively solvent extraction of organics followed by a method for total organic carbon. The GRALE technique has been successfully used for the analysis of carbon and other light elements collected on tissuquartz filters and has shown promise in preliminary test for analyzing thin teflon filters.
Keywords: aerosols; particles; carbon; gamma spectroscopy; quantitative chemical analysis; solvent extraction; air quality; atmospheric chemistry.

72575 Laser Raman Monitoring of Sulfuric Acid, Sulfates, Sulfur Trioxides, and Sulfur Dioxide in Stack Emissions. Chanlo, R. (Yale Univ., 206 Elm, New Haven, CT, 06520). **Project number:** G833D-EB-016. **Contract:** R805458-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to obtain absolute Raman cross sections of gaseous H2SO4 and SO3 and their Raman spectral linewidth and

lineshifts and to demonstrate in the laboratory the viability of Raman spectroscopy in distinguishing the multiphases of sulfur oxides. Calibration of H2SO4 concentrations for cross section measurement will be accomplished by determining the partial pressure of H2SO4 as the difference between total pressure and the sum of partial pressures of SO3 and H2O. Raman scatter wavelengths for H2SO4 have been established at 1200/cm and 825/cm. Gases such as SO3, NO, CO2, and SO2 do not interfere. NO2 may interfere depending upon its concentration relative to H2SO4. Progress has been made in optimization of instrumentation in several areas relating to the measurement of the necessary Raman scattering cross section, linewidth, and lineshift.
Keywords: gases; raman spectra; sulfuric acid; sulfates; aerosol monitoring; stacks; emission; sulfur dioxide.

72576 Effect of Collisional Lifetime in Optoacoustic Detection of Pollutant Gases. Christian, W. (Allegheny Coll., Meadville, PA, 16335). **Project number:** G833D-EB-043. **Contract:** R806439-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine the relationship between optoacoustic signal, absorption coefficient, collisional lifetime, chopping frequency, and pressure in an optoacoustic cell. The optoacoustic cell will be calibrated using a piezoelectric crystal to induce pressure variations in the cell. Carbon dioxide, sulfur hexafluoride, nitrous oxide, ethylene, various fluorocarbons, and methylhalides will then be investigated. Particular attention will be given to gases which activate in a stepwise manner and to gases which exhibit kinetic cooling effects.
Keywords: photoacoustic spectrometers; carbon dioxide; sulfur fluorides; nitrogen dioxide; ethylene; organic compounds; photoacoustic spectroscopy; air pollution; gases.

72577 Design, Fabrication, and Testing of Ambient Aerosol Sampler Inlets. Wedding, J.B. (Colorado State Univ. Research Inst., Fort Collins, CO, 80571). **Project number:** G833D-EB-044. **Contract:** R806491-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to accomplish the design, fabrication, and testing of dichotomous sampler inlets having a 15 micrometer upper cutpoint and small dependence on wind speed. The new inlet will be designed through a combination of mathematical modeling and wind tunnel testing.
Keywords: air samplers; aerosols; particles; testing; design; mathematical models; wind tunnels.

72578 Preconcentration and Analysis of Ammonia and Amines in Air. Braman, R.S. (Univ. of South Florida, 4202 Fowler Avenue, Tampa, FL, 33620). **Project number:** G833D-EB-017. **Contract:** R806688-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to preconcentrate NH3 and amines from the ambient air and then to measure them individually as they are thermally desorbed from the preconcentrators. The objective is one of instrumental technique development. NH3 and amine standards will be established and laboratory experiments to test sorbent materials will be planned and executed. The best sorbent will be selected for extensive testing.
Keywords: ammonia; amines; air; separation processes; adsorbents; air pollution; air quality; sorptive properties.

72579 Standard Reference Materials (SRMs) for Toxic Organics in Air. Zielinski, U.L. (National Bureau of Standards, Washington, DC, 20234). **Project number:** E883A-100001. **Contract:** D9-0646. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Health effects assessments.

The Toxic Substances Control Act of 1976 focused attention to the need for a better understanding of the effects of chemicals on human health and the environment. It has been estimated that 70,000 chemicals are currently in use. While only a small number of these may be toxic, the risk to human health and the effect on the environment will be the subject of intensive study during the next 5 years. Of the many classes of compounds that will be scrutinized by EPA, one of the largest classes will be organics, widely used in industry as precursors in the manufacture of synthetics and as solvents. The immediate purpose of this task is the development of toxic organic gaseous standard materials by NBS for use by EPA in their monitoring and quality assurance programs. In conjunction with this, toxic gas analytical methods research will be carried out by NBS.
Keywords: air pollution; standards; toxic materials; organic compounds; quantitative chemical analysis; textiles; solvents; gaseous wastes.

72580 Standard Reference Material and Reference Method for Asbestos in Air. Zielinski, W.L. (National Bureau of Standards, Washington, DC, 20234). **Project number:** E883A-100002. **Contract:** D9-0646. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Reliability of measurements of asbestos fibers in air will be improved by providing standards for calibration and measurement and evaluating reference measurement technology. Calibration standards will be provided for the determination of relative sources of error in analytical electron microscopy (AEM) provisional reference methods for laboratory and field evaluation. A collaborative laboratory evaluation of key procedural variables in the EPA provisional reference AEM method will be provided and optimized procedural parameters recommended.
Keywords: air pollution; asbestos; quantitative chemical analysis; standards.

72581 Los Angeles Catalyst Study (LACS). Parry, E.P.; Colovos, G. (Rockwell International Corp., 1049 Camios Dos Rios, Thousand Oaks, CA, 91360). **Project number:** E601B-09. **Contract:** 68-02-2292. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

A study is being conducted to (1) determine the ambient air concentrations of carbon monoxide, lead, and sulfur dioxide, in order to predict the sulfuric acid (H2SO4) ambient levels resulting from catalyst automobile emissions on a heavily traveled freeway; and (2) evaluate and improve field methodology for detection of air quality changes attributable to catalyst emissions. Roadside air monitoring sites were set up in Los Angeles adjacent to the San Diego Freeway in June, 1974, and monitoring data generated. The first three years of data are summarized in the EPA technical document titled The Los Angeles Catalyst Study Symposium, EPA-600/4-77-034.
Keywords: catalytic converters; exhaust gases; automobiles; roads; air pollution; carbon monoxide; lead; sulfur dioxide; sulfuric acid; air pollution monitors; mathematical models; aerosol monitoring; california; air quality.

72582 Expand Organic Spectral Search System. Bumgarner, J.E. (EPA, Environmental Monitoring and Support Lab., Research Triangle Park, NC, 27711). **Project number:** E606-05. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to expand spectral search system to increase throughput of processed samples. Capabilities of recently purchased INCOS system will be developed and other potential systems explored.
Keywords: spectroscopy; research programs; optimization; fossil fuels; hydrocarbons; air pollution; chemical analysis; air quality.

72583 Fuel and Fuel Additive Analysis for Lead, Phosphorus, and Manganese. Quillian, R.; Lepera, M. (Department of Defense, Fort Belvoir, VA, 22060). **Project number:** E606-07. **Contract:** 08-F0352-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Meradcom will provide analytical services utilizing the appropriate techniques, instrumentation, and methodologies at the Southwest Research Institute facility to meet the analytical goals set by the EPA project officer. Analysis will be performed primarily on gasoline samples; however, diesel fuel, fuel additives, lubricants, and other fuel components may be substituted. Quality control data as specified will be provided.
Keywords: lead; phosphorus; manganese; gasoline; diesel fuels; fuel additives; lubricants; quality control; chemical analysis.

72584 Analyze Samples for Asbestos. (Midwest Research Inst., 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** E606-08. **Contract:** 68-02-2814. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objective is to obtain asbestos concentrations in the vicinity of emission sources. The data will be of value to OAQPS in setting an emission standard. Samples taken at selected emission sites will be analyzed for asbestos.
Keywords: asbestos; sampling; chemical analysis; air pollution; particles; aerosols.

72585 UHO Collaborating Center on Environmental Pollution Control. Burt, S. (Research Triangle Inst., P.O. Box 12194, Research Triangle Park, NC, 27009). **Project number:** E606A-01. **Contract:** 68-02-2471. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to maintain a data base on material contributed from a worldwide network of selected reporting stations on specified ambient pollutants. Annual reports of summarized data will be published by the World Health Organization. EPA provides frequency distributions, monthly plots, and contributes to the writing of these documents.
Keywords: air pollution; data acquisition; information systems.

72586 NASN Operations. Jungers, R.H.; Walling, J.E. (Environmental Protection Agency, Research Triangle Park, NC, 27711). **Project number:** E606A-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to generate valid data for particulate matter collected for ambient air to be used for long term trend assessment. The approach is to purchase and distribute nationally, filters of known background and analyze particulate matter taken at NASN (FY-80 NAMS) sites for selected parameters.
Keywords: aerosol monitoring; aerosols; sampling; filters; data acquisition; usa; sulfur compounds; nitrogen compounds; metals; inorganic compounds; monitoring.

72587 Matrix Evaluation and Control Analysis of Fuel and Fuel Additives. Rainey, W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** E606A-22. **Contract:** 09-X0690. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop analytical methodology and serve as a referee laboratory on matrixes of inorganic, organic, and biological nature. Several instruments are to be utilized including but not limited to spark source mass spectrometry, thermal mass spectrometry, isotopic dilution, gas chromatography/mass spectrometry (high and low resolution), high performance liquid chromatography, ion microprobe, scanning electron microscopy and bioassays. Appropriate analytical, biological, and combustion engineering techniques and methodology for application to combustion and biological materials are provided.
Keywords: mass spectroscopy; gas chromatography; liquid column chromatography; scanning electron microscopy; ion microprobe analysis; hydrocarbons; photochemical oxidants; aerosols; particles; nonmetals; petroleum; gasoline; additives; combustion products; quantitative chemical analysis.

72588 Fenceline Screening for Organic Species. Martin, B.E.; Baumgarner, J.E. (Environmental Protection Agency, Research Triangle Park, NC, 277111). **Project number:** E763-05. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to obtain qualitative data for organic compounds in air at selected fenceline sites. The approach is to collect air samples on TENAX and obtain and interpret GC/MS output.
Keywords: hydrocarbons; monitoring; air pollution; gas chromatography; mass spectroscopy; data acquisition; data analysis.

72589 Quality Assurance Methods Clearinghouse. Williamson, L. (Computer Sciences Corp., Chapel Hill Blvd., Chapel Hill, NC, 27514). **Project number:** E800-04. **Contract:** 68-01-3840. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to store, maintain, and retrieve ambient air sampling analysis methodology information of state, local, industrial, and other monitoring communities across the nation. The methodology information received from the monitoring community will be computerized.
Keywords: quality assurance; data acquisition; air quality; sampling; monitoring; mathematical models; information retrieval.

72590 Standardization and Quality Assurance of Stationary Source Emission. Ferguson, B.B. (Harmon Engineering and Test Co., Inc., Box 2249, Auburn, AL, 36830). **Project number:** E800-05. **Contract:** 68-02-3215. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is the evaluation and standardization of stationary source emission measurement methodology. Quality assurance procedures and specifications for continuous source emission monitors will be developed. Emission methodology will be evaluated at appropriate sources. Quality assurance procedures for continuous emission monitors will also be evaluated.
Keywords: stationary pollutant sources; quality assurance; monitoring; air pollution monitors; standardization; air pollution.

72591 Los Angeles Inhalable Particulate Pilot Study. Schwall, R. (Rockwell International Corp., 2421 W. Hillcrest Dr., Newbury Park, CA, 91320). **Project number:** E815-01. **Contract:** 68-02-2292. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to obtain reproducibility and reliability data from inhalable particulate monitors. The approach is to operate 8 types of monitors in triplicate for 20 days and perform mass, SO4 ion, NO3 ion, and Pb analyses.
Keywords: aerosols; aerosol monitoring; data acquisition; mass; sulfates; nitrates; lead; monitoring; inhalation; errors.

72592 Arizona SOx Study. Drago, R.J. (Environmental Protection Agency, Research Triangle Park, NC, 27711). **Project number:** E817-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to obtain data in support of health studies. Equipment will be supplied, maintained, and calibrated.
Keywords: sulfur oxides; biological effects; equipment; data acquisition.

72593 Philadelphia Inhalable Particulate Study. Himmelstein, L.; Hauptman, F. (City of Philadelphia, Philadelphia, PA, 19106). **Project number:** E883-01. **Contract:** A00-3045-790. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to gain an understanding of the spatial and temporal variations of inhalable particulate matter throughout a major urban area; (2) to characterize the ambient particulate matter and define the relation between total suspended particulate and inhalable particulate; and (3) to chemically characterize the particulate matter according to size distribution. Ten particulate monitoring stations will be established and with dichotomous samplers, size selective hi-vols, regular hi-vols, and meteorological instruments will measure particulate throughout the city in various areas representing varied land use characteristics. In addition, several intensive studies will be performed in areas of special interest such as vertical distribution, diurnal i.p., variations, fugitive dust concentrations, and other.
Keywords: particles; aerosols; inhalation; spatial distribution; monitoring; ecological concentration; land use.

72594 Inhaled Particulate Network. Rodes, C.E. (Environmental Protection Agency, Research Triangle Park, NC, 27711). **Project number:** E883-04. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objective is to develop an IP data base. A nationwide sampling network will be established to determine sample characteristics.
Keywords: usa; sampling; aerosols; aerosol monitoring; mathematical models.

72595 Ambient Particulate Sampling System. Lundgren, D. (Univ. of South Florida, 4202 Fowler Avenue, Tampa, FL, 33620). **Project number:** E883A-100003. **Contract:** R806714-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide an ambient particle sampling system for size selective measurement of atmospheric particulate matter in the approximate 10 to 100 microns aerodynamic diameter size range. The approach is to design, fabricate, and test a very large volume sampler operating at a very large flow rate capable of making a direct mass measurement based upon an inertial or aerodynamic size. The design will incorporate vertical aerosol flow downward into several parallel single state impactors, each with a different collection efficiency. By difference, the fraction by mass of particulate matter in each size range is determined. Cut points of 60, 30, 15, and 7.5 run together with total sample will be incorporated.
Keywords: particles; sampling; air samplers; particle size; flow rate; design; mass transfer; petroleum; combustion products; sulfur compounds; nitrogen compounds; elements; trace amounts; nonmetals; air quality.

73000 Assessment of Environmental Emissions from Oil Refining. Rosebrook, D.D. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** F604C-301. **Contract:** 68-02-2665. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$561,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to sample fugitive emission sources at eleven petroleum refineries to supply necessary data for the completion of Contract N68-02-2147, Source Assessment: Petroleum Refineries. Hydrocarbon Analysis is used with an enclosure on small sources and a material balance for large sources. Six of the eleven petroleum refineries have been sampled. No statistically significant differences have been observed among the refineries sampled.
Keywords: petroleum refineries; environmental impacts; air pollution; hydrocarbons; flue gas; quantitative chemical analysis; emission; monitoring; ecological concentration.

73001 Miniplant Studies in Support of the Fluidized-Bed Combustion Program. Bertrand, R.R.; Hoke, R.C.; Nutkis, M.S. (Exxon Research and Engineering Co., Government Research Labs., 1600 Linden Avenue, Linden, NJ, 07036). **Project number:** F623A-04. **Contract:** 68-02-1312. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$734,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to conduct comprehensive analysis of emissions from a pressurized fluidized-bed combustor; to identify the effects of process operating conditions on emissions; to study the potential and environmental impact of sorbent regeneration; and to study add-on devices for particulate control. A 480 lb/hr (218 kg/hr) pressurized fluidized-bed coal combustion miniplant, and a 25 lb coal/hr 813 kg/hr) bench-scale unit are being operated. The final output will show effects of operating conditions on emissions, and regeneration and particulate control performance.
Keywords: coal; fluidized-bed combustors; air pollution; adsorbents; environmental impacts; regeneration; sulfur dioxide; nitrogen oxides; air filters.

73002 Demetallization of Residual Oils, Phase V: Denitrogenation Catalyst Evaluation. Kang, C.C.; Gendler, J.; Maruhnic, P. (Hydrocarbon Research, Inc., P.O. Box 6047, Lawrenceville, NJ, 08648). **Project number:** F623A-16. **Contract:** 68-02-0293. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$4,000.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Phase V of this research program tested the relative worth of various metals used in current denitrogenation catalysts. Another aim was to examine the effects of increasing macropores in the catalysts. Specially manufactured catalysts were used in the series of experiments with coal liquids. Nitrogen oxide control is of concern to EPA in regulating air quality. The data which form the primary output from this study should help in establishing the extent to which catalytic denitrogenation can reduce fuel-bound nitrogen in liquid fuels. The study should also help the development of more effective catalysts for this task. Two commercial catalysts both failed to reduce nitrogen content of a petroleum vacuum residue from 0.67% to the target of 0.3%. The observed catalyst deactivation exists among catalysts with similar pore structures which are being used for hydrodesulfurization of petroleum residuals under another task. Attempts to denitrogenate heavy, coal-derived liquids with commercial Co--Mo catalysts pointed to the need for improved catalysts. Ni--Mo was identified as a better metal pair than Co--Mo or Ni--W for denitrogenation of coal liquids. Commerical preparation techniques and lower carbon deposition also increased denitrogenation activity. On the basis of catalyst weight, a bimodal pore distribution with some macropores improved denitrogenation activity over that with micropores only. The optimum pore distribution was sought, but lack of technology to enlarge macropores hampered the effort.
Keywords: demetallization; catalysts; coal liquids; residual fuels; evaluation; nitrogen; removal; purification.

73003 Environmental Assessment of Coal Liquefaction. Emerson, D.B.; Morris, W. (Hittman Associates, Inc., Department of Environmental Engineering, 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** F623A-17. **Contract:** 68-02-2162. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$419,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The overall technical objective of this program is the performance of a comprehensive multimedia environmental assessment of the technologies for converting coal into liquid fuels and of the utilization of these liquid fuels in stationary source applications. Technologies for conversion of coal to liquid fuels will be considered to encompass all methods of coal treatment in which the majority of the coal-like structure of the raw feed material is transformed to a liquid form, either at the treatment conditions of the process or at ambient conditions. Technologies which involve the production of liquid fuels from coal through the initial use of commercial gasification techniques will also be considered. Data and environmental reports will be issued for use by EPA, other regulatory groups, process developers, state agencies, and environmental/energy concerned groups. A Standards of Practice manual for SRC has been issued. This provides an integrated multimedia assessment of control/disposal options, emissions, and environmental requirements for a plant.
Keywords: coal liquefaction plants; environmental effects; coal liquids.

73004 Electrostatically Charged Fog for Control of Dust from Open Sources. Hoenig, S.A. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** F623-1-34. **Contract:** R805228. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this project are: (1) to continue the studies of industrial dusts and fumes and the development of apparatus for inducing these pollutants to agglomerate and fall out; and (2) to investigate the phenomena involved in dust/fume charging with the hope of providing better dust control systems. The studies will be primarily experimental and will generate the appropriate dusts and fumes under controlled conditions to determine the parameters involved in charging phenomena. The University of Arizona will make appropriate industrial measurements and studies to evaluate charging and dust control techniques in the factory environment. The charging behavior of a variety of dusts and fumes has been investigated. Most materials seem to have negative charges, at least for the respirable material, but there are some notable exceptions, i.e., magnetite. These dusts and fumes can be induced to agglomerate and fall out when exposed to properly charged water fog. A number of industrial tests are underway to test prototype fog generators as mechanisms for dust control. The University of Arizona has done some preliminary work on control of power plant fly ash and coal tar volatiles (from coke ovens). Here again it appears that the charged fog system has significant potential as a control technique.
Keywords: dusts; fly ash; agglomeration; air pollution control; thermal power plants; flue gas; industrial plants; pollution control equipment; performance.

73005 Assessment and Control of Wastewater Contaminants Originating from the Production of Synthetic Fuels from Coal. Singer, P.C. (University of North Carolina at Chapel Hill, School of Public Health, Chapel Hill, NC, 27514). **Project number:** F623A-91. **Contract:** R804917. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$484,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The purpose of this project is to assess the environmental impact of wastewater contaminants originating from the production of synthetic fuels from coal and to evaluate alternative wastewater treatment technologies for the control of these contaminants. The phases of the project are: (1) a literature review and survey of pilot and full-scale coal conversion facilities to identify specific contaminants in the wastewaters; (2) a study of the biodegradability of selected organic constituents from such wastewaters including aquatic bioassays on selected residuals; (3) biological and physical-chemical treatability studies of selected organic constituents and identification of the residuals; (4) animal toxicology studies to evaluate potential health effects of components not studied in sufficient detail elsewhere; and (5) treatability studies of composite synthetic and real coal processing waters.

Keywords: waste water; environmental impacts; synthetic fuels; biodegradation; toxicity; coal gasification; coal liquefaction; waste processing.

73006 Coal Cleaning Technology Evaluation and Development. Shaver, R.; McCandless, L. (Versar, Inc., 6621 Electronics Drive, Springfield, VA, 22151). **Project number:** F623A-313. **Contract:** 68-02-2199. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$690,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The overall objective of this program is to evaluate and develop the potential of coal cleaning technology to support the demand for low sulfur fuels. The program will provide detailed information on processes, equipment, costs, and pollution control factors for physical and chemical coal cleaning technology to remove sulfur. Significant outputs to date include: (1) the completion of a literature survey on the performance of physical coal cleaning equipment for sulfur reduction in fine coal, including identification of data gaps; (2) completion of a mobile test lab to help gather data; (3) completion of testing at two sites; and (4) completion of a technical and economic evaluation of chemical coal cleaning processes.
Keywords: coal; desulfurization; cleaning; equipment; technology assessment; cost; coal preparation.

73007 Environmental Assessment of Stationary Source NOx Control Technologies. Mason, H.B.; Waterland, L. (Acurex Corp., Energy and Environmental Division, 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** F624A-006. **Contract:** 68-02-2160. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$650,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this three-year systems study are to: (1) identify the multimedia environmental impacts of stationary combustion sources and NOx combustion modification (CM) controls; and (2) identify the most cost-effective CM to achieve and maintain acceptable air quality with respect to NO2. The approach was to divide the overall effort into five major tasks: (1) baseline emission characterization, (2) survey of pollutant impacts and standards, (3) experimental testing, (4) process engineering and environmental assessment, and (5) systems analysis. The effort is directed to consideration of the wide range of conventional combustion equipment/fuel combinations. The approach recognizes the need to provide efficient and timely assessments of near-term control technologies while also maintaining a comprehensive treatment of likely control needs to the year 2000.
Keywords: combustion control; nitrogen oxides; air pollution abatement; flue gas; boilers; fossil-fuel power plants; denitrification; environmental impacts; pollution control equipment.

73008 Field Testing: Application of Improved Combustion Technology to Power Generation Combustion Systems. Crawford, A.R.; Bartok, W.; Manny, E.H. (Exxon Research and Engineering Co., Government Research Labs., 1600 Linden Avenue, Linden, NJ, 07036). **Project number:** F624A-009. **Contract:** 68-02-1415. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$659,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The purpose of this study is to field test power generation combustion equipment including utility boilers, gas turbines, and stationary i.c. engines. Emphasis will be placed on utility boilers firing coal, but the study will include tests of gas- and oil-fired boilers capable of firing two or more fuels simultaneously. Tests to determine the effectiveness of additives for slag control to extend combustion modification shall also be included. Emissions to be measured are oxides of nitrogen, oxides of sulfur, hydrocarbons, carbon monoxide, carbon dioxide, oxygen, opacity, sulfates, nitrates, particulate (mass and size distribution), pom, and trace elements. The effect of combustion modification on air pollutant emissions and combustion efficiency will be determined. Also, the effect of modified operation on equipment performance (e.g., slagging, fouling, tubewall corrosion, steam temperature control) will be investigated. Staged combustion combined with low excess air firing has been found to be the most attractive combustion modification combination because it is an effective method of reducing NOx and is relatively easy and inexpensive to implement. However, some experts suspect the reducing atmosphere in the burner zone to increase tubewall corrosion rates on one boiler.
Keywords: nitrogen oxides; sulfur dioxide; hydrocarbons; carbon monoxide; carbon dioxide; oxygen; opacity; sulfates; nitrates; particles; aerosols; trace amounts; air pollution control; combustion; chemical reaction kinetics; optimization; coal; automobiles; exhaust gases; flue gas; gas turbines; combustion chambers; design.

73009 EPA Alkali Scrubbing Test Facility: Advanced Testing and Support Studies for Transfer of Technology to Full-Scale Operating Plants. Dyer, G.H. (Bechtel National Inc., Process Technology, 50 Beale Street, P.O. Box 3965, San Francisco, CA). **Project number:** F624A-045. **Contract:** 68-02-1814. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$441,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to optimize promising process and equipment variations studied earlier for lime/limestone processes for improving alkali utilization, removal efficiency, energy requirements, sludge disposal properties, reliability, water management, and process economics; and to transfer Shawnee-developed technology to full-scale plants. Results will be transferred to utilities, vendors, government agencies and others through published reports, symposia, and a design/economic study computer program. Demonstration has shown that conventional lime/limestone systems can be operated reliably. Two separate reliability problems have been identified--scaling and soft mud-type solids deposits--and methods to control each have been demonstrated. Process and equipment variations have also been demonstrated for improving alkali utilization, increased SO2 removal effciency, reducing costs and energy usage for scrubbing, and for forcing oxidation of sulfite to sulfate to reduce the quantity of sludge produced and to improve its dewatering properties.
Keywords: scrubbing; technology transfer; lime-limestone wet scrubbing processes; technology assessment; energy demand; economics; waste disposal; sulfur dioxide; removal; demonstration plants; air pollution control.

73010 Emissions Assessment of Conventional Combustion Systems. Matthews, B.J. (TRW, Inc., Energy Systems Group, 1 Space Park, Redondo Beach, CA, 90278). **Project number:** F624A-055. **Contract:** 68-02-2197. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$1,050,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

This project will assess the air and water pollutants from 54 combustion categories, including residential, commercial, institutional, industrial, and utility coal-, gas-, and oil-fired. Sampling and analysis includes the following: inorganic analysis, particulate matter by at least four size fractions, particulate sulfate, POM, PCB, SOx, and NOx. The emission rates of the pollutants will be determined by the most appropriate means, such as field sampling, material balance calculation, or manipulation of existing data.
Keywords: air pollution; water pollution; combustion; coal; natural gas; petroleum; boiler fuel; comparative evaluations; combustion products; data acquisition.

73011 Transfer and Utilization of Particulate Control Technology. Venditti, F.P. (University of Denver, Denver Research Inst., University Park, Denver, CO, 80210). **Project number:** F624A-417. **Contract:** R805725. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of the proposed project is to plan, organize, publicize, and conduct a series of annual symposia on the transfer and utilization of technology for the control of particulate emissions. A corollary objective is to conduct a series of tutorial sessions and/or workshops in the design of electrostatic precipitators, fabric filters, and scrubbers, with special attention to theory, modeling and instrumentation. A symposia will be conducted late in July of each year at appropriate locations subject to approval by the project officer of the Industrial Environmental Research Laboratory at Research Triangle Park of EPA. The three major technologies used for controlling particulate emissions scrubbers, electrostatic precipitators, and fabric filters would be discussed. Other technologies would be included as they become more fully developed. As part of the total effort, proper documentation would be provided in the form of written periodic reports, a final report and, most important of all, publication and distribution of the proceedings.
Keywords: aerosols; pollution control; technology transfer; technology utilization; air pollution control; removal; air filters; scrubbers; mathematical models; pollution control equipment; meetings.

73012 Geology of Contaminants in Coal. Cecil, B. (Geological Survey, 12201 Sunrise Valley Drive, Reston, VA, 22092). **Project number:** F627-02. **Contract:** D9-E685-FR. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to characterize the coal resources east of the Mississippi River as to their elemental and mineralogic composition, and to determine the geologic factors which effect or control

the physical cleanability of coal. In cooperation with state geological surveys, about 3200 to 3300 coal samples will be collected and analyzed chemically and about 1300 analyzed mineralogically over the next four years.
Keywords: coal; geology; contamination; coal deposits; chemical composition; sampling; mineralogy.

73013 Environmental Control Problem Definition Studies in Coal Conversion Processes: A High Reactive Coal In-Situ Gasification. Mead, S.W. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** F825-01. **Contract:** D9-E681-DG. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to measure and assess changes in groundwater quality and subsidence effects in the vicinity of in-situ gasification experiments, and to develop a predictive capability with regard to those effects that is applicable to commercial-scale, in-situ coal gasification. The approach is to do groundwater sampling before, during, and after in-situ gasification experiments; conduct laboratory studies of ash leaching and of containment sorption by coal and other media; and develop computer modeling of the evolving plume of contaminated groundwater.
Keywords: in-situ gasification; environmental impacts; ground water; water quality; ground subsidence; sampling; leaching; coal; sorptive properties; mathematical models; plumes.

73014 Flue Gas Desulfurization During Combustion of Coal/Oil/Water Emulsions. Dooher, J. (Adelphi University, South Avenue, Garden City, NY, 11530). **Project number:** F829-01. **Contract:** D9-E681-GN. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop the use of coal/oil/water (COW) emulsions to the point where sulphur oxides (SOx) emissions can be controlled for a wide range of applications such as in an industrial size boiler. The control of SOx emissions from COW is accomplished by adding SOx absorbents to the fuel. An SO2 expected value is calculated from the sulphur carbon and hydrogen content of the fuel. By comparing SO2 measured as a multiple gas analyzer with that calculated, the efficiency of SO2 reduction is computed.
Keywords: flue gas; desulfurization; coal; petroleum; combustion; water; emulsions; emission; air pollution control; sulfur dioxide.

73015 Trace Elements Characterization and Removal/Recovery from Coal and Coal Waste. Wagner, P. (Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM, 87544). **Project number:** F830-02. **Contract:** D9-E681-EJ. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to assess the nature and magnitude of trace elements in the drainage from coal preparation wastes and stored coal, identify trace elements of greatest environmental concern, and evaluate required pollution control technology. Structure, weathering, and leaching behaviors of the trace elements will be studied. Control technology will be assessed and developed based on findings of the study.
Keywords: elements; trace amounts; coal; waste water; solid wastes; coal preparation plants; waste management; leaching; weathering; pollution control; chemical analysis.

73500 In-Stack Measurements of Sulfate. Chehaski, J. (Engineering Science Co., Source Sampling Group, 7903 Westpark Drive, McLean, VA, 22101). **Project number:** G603A-AA-101. **Contract:** 68-02-2815. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$30,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

In-stack measurements will be supplied for input to state regional field study. Emissions characterization data of TVA Cumberland Steam Station for sulfate, SO2, and mass particulate emissions will be compiled over a period of six days.
Keywords: sulfates; monitoring; air pollution control; tennessee valley authority; fossil-fuel power plants; sulfur dioxide; particles; aerosols; flue gas; chemical composition; ecological concentration; air pollution; coal.

73501 Regional Scale Haziness: Origin, Spatial-Temporal Distributions, Properties and Effects on Atmospheric Radiation. Husar, R.B. (Washington Univ., 4559 Scott Ave., St. Louis, MO, 63130). **Project number:** G603A-AA-105. **Contract:** R806606-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to examine the relationship between particulate sulfur concentrations, acidity, fine particulate mass concentration, light scattering, air mass history, time of day and season; and to study the origin, spatial and temporal trends of regional scale haziness. Acidity of fine particle sulfur compounds will be monitored in St. Louis, MO, and University Park, PA, using a flame photometric particulate sulfur monitor combined with differential thermal analysis. Meteorological data of the U.S. Weather Service will be used to study regional haziness.
Keywords: visibility; environmental effects; earth atmosphere; air pollution; sulfur dioxide; missouri; pennsylvania; meteorology; data analysis; air quality.

73502 Meteorological Measurements and Interpretations in Support of EPA Field Studies. Dannevik, W.P. (Environmental Quality Research, Inc., 225 S. Meramec, Suite 112 IT, St. Louis, MO, 63105). **Project number:** G603A-AA-118. **Contract:** 68-02-2500. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$63,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of the research is to provide specialized meteorological support for field investigations conducted by the Aerosol Research Branch to measure the deposition velocity of aerosols and aerosol precursor gases, such as sulfur dioxide, nitrogen oxides, ozone, and organics. The contractor will employ the vertical gradient method to infer the vertical momentum exchange coefficient over natural surfaces such as grass, crops, snow, and water.
Keywords: meteorology; aerosols; aerosol monitoring; deposition; velocity; sulfur dioxide; nitrogen oxides; ozone; organic compounds; grass; crops; snow; texas.

73503 Aerosol Sulfur Transport Studies. Winchester, J.W. (Florida State Univ., 205 Wildwood Dr., Tallahassee, FL, 32306). **Project number:** G603A-AA-144. **Contract:** R806693-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to characterize the occurrence of sulfur in aerosol particles at sampling stations in locations between the midcontinent and eastern seaboard of continental USA. Emphasis is being placed on the concentrations of sulfur in relation to other elements present in the aerosol and on the time variability of these concentrations. This is done by continuing the PIXE (proton induced x-ray emission) analysis of time sequence streaker filter samples collected at 9 Class I sites of the SURE network. The associations of aerosol sulfur concentrations and their time variability with relative and absolute humidity, gaseous SO2, NOx, and O3 concentrations, and air flow trajectories will be given special emphasis.
Keywords: sulfur; atmospheric chemistry; aerosols; air pollution; sulfur dioxide; nitrogen oxides; ozone; ecological concentration.

73504 Formation of Atmospheric Aerosols II. Whitby, K.T. (University of Minnesota at Minneapolis, Department of Mechanical Engineering, 105 Morrill Hall, Minneapolis, MN, 55455). **Project number:** G603A-AA-160. **Contract:** R806801-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$49,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Aerosol size distributions have been measured in the St. Louis area as part of EPA's Project MISTT using aircraft and ground-based self-contained mobile laboratories. The University of Minnesota's portion of the project included aerosol measurements aboard an aircraft and the operation of a mobile van on the ground under the plumes. The past year was devoted primarily to data analysis, the development of new analysis techniques, and reporting results of aerosol data obtained over the past several years in Project MISTT and the roadway aerosol study. During the coming year the Particle Technology Laboratory of the University of Minnesota will be measuring aerosol size distributions for EPA's Project STATE (Sulfur Transport and Transformation in the Environment) in Tennessee and for EPA's Project SCRUB in Alabama and Minnesota. The STATE Program is directed to describing reactions and atmospheric processes affecting plume behavior over time scales of 12 to 96 hours and distances out to 1000 km. By contrast the SCRUB Program will provide as assessment of the transport and transformation occurring within a power plant plume with an SO2 scrubber out to distances of about 1000 km and travel times mostly less than 12 hours. Resources will be provided to complete data analysis and report on Project MISTT and to participate in the planning of Project SCRUB and the subsequent data analysis. Other tasks include the measurement of gaseous and aerosol pollutants under and

in plumes being characterized in Project STATE and development of an aerosol mobility chromatograph to determine molecular composition of sulfur-containing aerosols.
Keywords: air pollution; aerosols; atmospheric chemistry; sulfur; environmental transport; plumes; aerial monitoring; tennessee; alabama; minnesota; roads.

73505 Evaluation of the Accuracy and Validity of Physico-Chemical Air Quality Models. Seinfeld, J.H. (California Inst. of Tech., 1201 E. California Blvd., Pasadena, CA, 91109). **Project number:** G603A-AB-014. **Contract:** R805537. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Physico-chemical air quality models describe atmospheric pollutant behavior based on fundamental aspects of atmospheric chemistry and physics. The object of this research program is to develop techniques for assessing the accuracy and validity of physico-chemical air quality models. The program will consist of two parts: (1) to determine the range of variability of key parameters in physico-chemical air quality models and then to establish the range of variability of the concentration predictions of such models; and (2) to develop a consistent and general framework for evaluating the performance of models with respect to the degree to which their predictions match ambient pollutant concentration data. The result of the research will be a general framework for assessing quantitatively the accuracy and validity of physico-chemical air quality models.
Keywords: air quality; mathematical models; air pollution; atmospheric chemistry; accuracy; evaluation.

73506 Models in Environmental Decision Making Concerning Air Quality. Lynn, L.E. (Harvard Univ., Cambridge, MA, 02138). **Project number:** G603A-AB-016. **Contract:** R805558. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The study will evaluate the role air quality models play in the regulatory decision making process. The aim will be to assess the needs of the actual and potential model users, the current state of air quality modelling at EPA, and how the modelling process might be changed to better meet present and future needs. The case study method will be used to identify factors that may have posed obstacles to the interaction between modellers and regulators and to highlight certain profitable changes that might make it more likely that air quality modelling would make a significant contribution to the achievement of national air quality objectives. This project seeks to answer the question of how AQSM's are used in the regulatory decision making process, and how that use can be more effective.
Keywords: air quality; decision making; mathematical models; environmental policy.

73507 Investigation of the Impact of Topographic and Land/Sea Circulations on the Transport and Diffusion of Atmospheric Pollutants. Pielke, R.A. (Univ. of Virginia, Garrett Hall, Charlottesville, VA, 22903). **Project number:** G603A-AB-039. **Contract:** R806207-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The general intent of the proposed investigation is to examine the effect of mesoscale topographic and land/sea induced atmospheric circulations on air pollutant concentrations. The majority of the research effort will be directed toward the simulation of thermally driven circulations in broad valleys and the prediction of pollutant transport and diffusion in such circulations. Observations of mountain valley winds, when viewed in light of air pollution considerations, indicate that the complex vertical structure and recirculation potential of these winds could introduce substantial errors into current operational air pollution prediction methods which employ Gaussian dispersion models. The proposed investigation of valley circulations intends to use the most recent version of a mesoscale model originally described by Pielke (1974). The initial component of the investigation will involve the simulation of valley circulations in idealized two- and three-dimensional valleys to compare the predicted circulations with the descriptive and observational information available in the literature. Along with numerical simulations, parallel analyses will be undertaken to examine the applicability of the various model components to the valley problem.
Keywords: atmospheric chemistry; air pollution; mathematical models.

73508 Determination of the Exchange Processes Between Forests and the Atmosphere with Emphasis on Microscale Pressure Fluctuation Measurements. Knoerr, K.R. (Duke University, School of Forestry and Environmental Studies, Durham, NC, 27706). **Project number:** G603A-AB-40. **Contract:** R806393-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$18,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The research proposed for this study will apply a technique for measuring microscale pressure fluctuations within and above a forest canopy, to aid in the determination of the exchange processes between forests and the atmosphere. Micrometeorological measurements, including instantaneous fluctuations of pressure, velocity, and temperature, vertical profiles of windspeed, temperature, and CO2, plus total solar and net radiation will be made at an experimental forest research site used as the Triangle Site for the International Biological Project operated by Duke University. These measurements will enable us to better understand discrepancies in fluxes over forests calculated from the aerodynamic method and the Bowen ratio method. Initial measurements of the turbulent energy balance and Reynolds stress equation for the forest canopy will also be made. The time period covered by this proposal is three years. This allows sufficient time for calibration of the pressure, velocity, and temperature fluctuation measuring equipment, plus time for measurements during two full growing seasons.
Keywords: forests; pressure measurement; wind; velocity; temperature measurement; carbon dioxide; earth atmosphere; meteorology; solar radiation; atmospheric pressure; variations; environmental transport.

73509 Conduct Workshop on Research Recommendations for Modeling in Complex Terrain. Holvind, E.L. (North American Weather Consultants, 600 Norman Firestone Rd., Goleta, CA, 93017). **Project number:** G603A-AB-050. **Contract:** 68-02-3223. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to provide guidance for a major effort that will develop mathematical models of atmospheric dispersion with demonstrated reliability in complex terrain. The approach is to conduct workshop of invited experts in instrumentation, field measurement design, data handling, data analysis and model development, and model application and evaluation. In addition, a written report on consensus recommendations will be obtained.
Keywords: atmospheric chemistry; diffusion; equipment; topography; data processing; data acquisition; design; air pollution; education.

73510 Conducting of Carbon Monoxide Intrusion Study: Funding with HERL. Ziskind, R.A. (Science Applications, Inc., 1200 Prospect St., La Jolla, CA, 92037). **Project number:** G603A-AB-056. **Contract:** 68-02-3220. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

Carbon monoxide (CO) will be monitored inside and outside of vehicles in an area where ambient monitoring is currently being conducted. The relationship between concentrations in the roadway and inside the car will be studied. Continuous CO monitors will be installed in three vehicles to monitor concentrations both inside and outside the vehicles during commuter trips made during the typical commuter traffic periods. Speed time trace equipment will be installed in the vehicles to investigate the relationship of CO concentrations and traffic speed.
Keywords: carbon monoxide; vehicles; indoor air pollution; air pollution; ecological concentration; exhaust gases; monitoring; roads; environmental impacts.

73511 Model Selection and Validation. Spengler, K.C. (American Meteorological Society, 45 Beacon St., Boston, MA, 02108). **Project number:** G603A-AB-057. **Contract:** R806593-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objective of the project is to provide technical assistance in selecting and validating air quality models for regulatory applications. The EPA Guideline on Air Quality Models will be reviewed and changes recommended. Air quality models suggested for use by EPA will be reviewed and recommendations made on minimum acceptable criteria for model selection and validation, and the data base requirements for model use will be evaluated and the minimum requirements recommended.
Keywords: air quality; mathematical models; meteorology; information needs.

73512 Theoretical Studies of Aerosol Dynamics. Brock, J.R. (Univ. of Texas, 200 W. 21st St., Austin, TX, 78712). **Project number:** G603A-AC-005. **Contract:** R803660-03. **Supported by:** Environmental

Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

The objective is: (1) to develop theoretical models that describe the evolution of aerosol size distributions in urban atmospheres in the plumes; (2) to measure the dry deposition rates of aerosols for use in the models (AROSOL, REMOVAL, TERM); and (3) to perform measurements of radioactive aerosol content of power plant plume from coal burning station. The numerical computer model AROSOL will be used to predict 3-dimensional concentration patterns in urban areas. The processes to be taken into account include: advection, horizontal and vertical diffusion, coagulation, condensation, dry deposition, point and area sources, and nucleation. A fast-response electro-impactor will be used to measure aerosol dry deposition rates for particles with diameters 0.2-4 micrometers by the eddy-correlation method. A power plant plume will be sampled with an aircrast to determine the concentration and type of alpha radiation being emitted by aerosols.
Keywords: mathematical models; aerosols; particles; particle size; urban areas; plumes; fossil-fuel power plants; radioactive aerosols; sampling; dynamics; air quality; spatial distribution.

73513 Formation of Atmospheric Aerosols. Whitby, K.T. (University of Minnesota at Minneapolis, Department of Mechanical Engineering, 105 Morrill Hall, Minneapolis, MN, 55455). **Project number:** G603A-AC-007. **Contract:** R803851-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$215,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Aerosol size distributions have been measured in the St. Louis area as part of EPA's Project MISTT using aircraft and ground-based self-contained mobile laboratories. The University of Minnesota's portion of the project included aerosol measurements aboard an aircraft and the operation of a mobile van on the ground under the plumes. The past year was devoted primarily to data analysis, the development of new analysis techniques, and reporting results of aerosol data obtained over the past several years in Project MISTT and the roadway aerosol study. During the coming year the Particle Technology Laboratory of the University of Minnesota will be measuring aerosol size distributions for EPA's Project STATE (Sulfur Transport and Transformation in the Environment) in Tennessee and for EPA's Project SCRUB in Alabama and Minnesota. The STATE Program is directed to describing reactions and atmospheric processes affecting plume behavior over time scales of 12 to 96 hours and distances out to 1000 km. By contrast the SCRUB Program will provide as assessment of the transport and transformation occurring within a power plant plume with an SO2 scrubber out to distances of about 1000 km and travel times mostly less than 12 hours. Resources will be provided to complete data analysis and report on Project MISTT and to participate in the planning of Project SCRUB and the subsequent data analysis. Other tasks include the measurement of gaseous and aerosol pollutants under and in plumes being characterized in Project STATE and development of an aerosol mobility chromatograph to determine molecular composition of sulfur-containing aerosols.
Keywords: aerosols; atmospheric chemistry; sulfur; environmental transport; tennessee; alabama; minnesota; aerial monitoring.

73514 Role of Aromatic Hydrocarbons in Photochemical Smog Formation. Hendry, D.G. (SRI International, 300 Ravenswood Ave., Menlo Park, CA, 94025). **Project number:** G603A-AC-021. **Contract:** R806093-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this research program is to eludicate the primary and secondary products formed in the oxidation of aromatic hydrocarbons. The investigator will (1) obtain a product balance for the toluene plus OH reaction, (2) study the reaction of benzaldehyde and cresol with OH, (3) determine quantum yields for the photolysis of benzaldehyde, (4) study the reactions of phenoxy radicals, and (5) model aromatic/NOx smog chamber data.
Keywords: aromatics; photochemical reactions; smog; oxidation; toluene; hydroxides; benzaldehyde; photolysis; cresols; nitrogen dioxide.

73515 Kinetic Study of Simulated SO2, NOx, Rh-polluted Atmospheres. Calvert, J.G. (Ohio State University, Dept. of Chemistry, 164 W. 17th Avenue, Columbus, OH, 43210). **Project number:** G603A-AC-024. **Contract:** R804348-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$90,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Kinetic and mechanistic studies will be made to recognize and to quantitatively characterize the several reaction pathways which result in the chemical transformation and removal of SO2, NO, and NO2 in the polluted atmosphere. In one phase of the work the seemingly important reactions of the alkyl peroxy and hydroperoxy radicals with SO2, NO, and NO2 are being investigated. Kinetic flash spectroscopy, steady state photochemical systems, and studies in flow systems are employed to follow the kinetics of the RO2 reactions. The identification and kinetic characterization of the initial reactive products of these reactions will be attempted using infrared, visible, ultraviolet spectroscopy, mass spectroscopy, and more conventional chemical methods. In another phase of this work we plan to study the reaction pathways which involve the reactions of the electronically excited SO2 with atmospheric components and the reactions of the HO-radical with SO2, NO, NO2, and other atmospheric pollutants of special interest. The mechanism and kinetic information obtained in the study will be applied directly to the development of a more realistic computer simulation scheme for the prediction of rates of SO2 and NOx removal reactions and the nature of the initial sulfate and other unidentified and recognized products of the sunlight-irradiated, NOx, SO2, Rh-polluted atmospheres.
Keywords: sulfur dioxide; nitrogen oxides; nitric acid; removal; atmospheric chemistry; photochemical oxidants; photochemistry; ozone.

73516 Computer Modeling of Simulated Photochemical Smog. Hendry, D.G. (SRI International, 300 Ravenswood Park, Menlo Park, CA, 94025). **Project number:** G603A-AC-027. **Contract:** 68-02-2427. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$65,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to develop photochemical smog mechanisms describing the chemical transformations that occur in the polluted atmosphere. The emphasis of this effort will be directed towards validating the smog mechanisms for diurnally-varying sunlight and temperature. Mechanisms are tested and modified by comparing computer concentration-time smog chamber studies of irradiated hydrocarbons and NOx mixtures. Both detailed and generalized (lumped) mechanisms have been developed for four olefin/NOx systems and two paraffin/NOx systems.
Keywords: photochemical oxidants; mathematical models; atmospheric chemistry; air pollution; solar flux; temperature dependence; time dependence.

73517 Smog Chamber Study of Aromatics. Spicer, C.W. (Battelle Memorial Inst., 505 King Ave., Columbus, OH, 43201). **Project number:** G603A-AC-044. **Contract:** R805812-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this study is to identify the products of aromatic/NOx photochemical reaction processes. GC/IR and GC/MS techniques will be used to elucidate the products formed when aromatic/NOx systems are irradiated in both a 200 liter chamber operated in a dynamic mode and in a 17.3 cubic M chamber operated under static conditions.
Keywords: smog; aromatics; nitrogen dioxide; photochemical reactions; ultraviolet radiation; gas chromatography; mass spectroscopy; interferometry; atmospheric chemistry.

73518 Simultaneous Comparison of the Electrical Aerosol Analyzer and the Diffusion Battery for Atmospheric Aerosol. Bricard, J. (University of Paris, Lab. de Physique des Aerosols, Nucl de Fontenay aux Roses Ctr., 11 Quai St. Bernard, Paris, France, 75005 PA). **Project number:** G603A-AC-050. **Contract:** R804370-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this research is to compare particle size distributions measured by an electrical aerosol analyzer and a diffusion battery-nuclei counter which are simultaneously sampling atmospheric aerosol. Comparisons on laboratory-generated aerosols show that the two methods agree favorably for aerosols larger than 0.02 micron diameter. Below that size, the methods show significant disagreement. It was also determined that the counting efficiency of the condensation nuclei counter is a function of particle size, falling off sharply below about 0.06 micron diameter.
Keywords: aerosols; air pollution; air samplers; comparative evaluations; condensation nuclei; particle size; sampling.

73519 Development of Microextraction Procedure to Analyze Total Carbon and Organic Compounds from Dichotomous Filters. Karasek, F.W. (Arizona State Univ., Tempe, AZ, 85281). **Project number:** G603A-AC-059. **Contract:** R807028-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop and evaluate apparatus and methodology to provide total carbon measurements and qualitative and quantitative analyses of trace organic compounds associated with aerosols collected on dichotomous filter elements. A unitized teflon block apparatus which combines solvent extraction and condensation steps without sample transfer is proposed. The objective is to minimize multi-step sample handling, sample absorption and drastic sample condensation steps. The device will be constructed, modified and developed using model compounds for efficiency studies and radioactive tracers for quantitation of extraction samples, and finally evaluated using actual dichotomous filters with aerosols collected at environmental sites for practical assessment. The procedure will use aliquots of solvent dispensed into an extraction chamber where extraction will be conducted in a heated, ultrasonic bath. Subsequent transfer to a condensation chamber will be followed by GC and GC/MS analyses.

Keywords: air pollution monitors; filters; aerosols; hydrocarbons; gas chromatography; mass spectroscopy; extraction; quantitative chemical analysis; qualitative chemical analysis.

73520 Outdoor Smog Chamber Experiments to Test Photochemical Models. Jeffries, H.E. (Univ. of North Carolina, Chapel Hill, NC). **Project number:** G603A-AD-004. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this project is to perform outdoor smog chamber experiments for the purpose of acquiring optimum data for the testing and refinement of photochemical models. Smog chamber reactant and product concentrations are measured as a function of time. The chamber is operated under conditions of natural sunlight, temperature, and relative humidity. Data for thirty-eight pairs of smog chamber runs have been processed and made available to photochemical modelers for analysis.

Keywords: smog; photochemical reactions; mathematical models; data; atmospheric chemistry; data acquisition.

73521 NE Regional Oxidant Study: Field Support. Dickson, C.R. (Ames Lab., Ames, IA, 50010). **Project number:** G603A-AD-033. **Contract:** D9-X0348. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this effort are to obtain additional upper-air observations, to obtain continuous airborne measurements of ozone and meteorological parameters, and to follow an air-parcel using tetroons. The National Weather Service will make additional radiosonde observations at the existing upper-air stations; a specially instrumented research aircraft will be used to make the airborne observation, and the tetroons will be tracked using a mobile radar system.

Keywords: photochemical oxidants; ozone; atmospheric chemistry; regional analysis; air pollution.

73522 NE Regional Oxidant Study: Aircraft Measurements. Newman, L. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** G603A-AD-036. **Contract:** D9-X0737. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of this task is to obtain continuous measurements of O3, SO2, NOx, B-SCAT, and integrated hydrocarbon canister samples on a regional scale during a five week field program. The measurements will be made from an instrumented aircraft provided by the Brookhaven National Laboratory.

Keywords: photochemical oxidants; regional analysis; ozone; sulfur dioxide; nitrogen oxides; hydrocarbons; aerial monitoring; aerosols; ecological concentration.

73523 Rural Oxidant Studies and the Role of NOx in Rural Oxidation Formation. Westberg, H. (Washington State Univ., Pullman, WA, 99163). **Project number:** G603A-AD-038. **Contract:** R807053. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The principal objective of this study is the development of a natural hydrocarbon emission inventory to be used in the validation of a regional scale model as part of the Northeast Regional Ozone Study (NEROS). Aerosol and particulate phase samples will be collected to assay C14 isotope abundance. This assay will provide information of the fate and importance of natural hydrocarbon emissions in both urban and rural areas of the northeastern United States. The bag enclosure technique of Zimmerman and standard gas chromatographic procedures will be utilized for the development of the natural hydrocarbon emission inventory. A high volume sampler fitted with a particle fractionation head will be used to collect the aerosol and particulate radiochemical counting procedure.

Keywords: nitrogen dioxide; rural areas; hydrocarbons; emission; inventories; ozone; regional analysis; aerosols; particles; carbon 14; isotope ratio; gas chromatography; air samplers; air quality; air pollution.

73524 Northeast Regional Oxidant Study: Vertical Profiles of Oxidants. Vaughan, W. (Environmental Measurements, Inc., 1445 Old Annapolis Rd., Arnold, MD, 21012). **Project number:** G603A-AD-043. **Contract:** 68-02-2709. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the diurnal behavior of the vertical distribution of ozone on the lowest 10,000 feet of the atmosphere with particular emphasis on the documentation of the morning fumigation and the evening transition periods. A fixed wing aircraft will be instrumented to obtain temperature moisture and ozone measurements. The profiles will be obtained from vertical spirals flown at regular intervals throughout the diurnal period with measured sampling frequency during the rapidly evolving morning and evening periods. The primary site will be upwind of an urban area with alternate site selected to ascertain spatial variability in the ozone concentrations.

Keywords: photochemical oxidants; regional analysis; ozone; daily variations; air pollution; environmental transport; air quality.

73525 Development of a Mathematical Model for Atmospheric Aerosol Dynamics. Seinfeld, J. (California Inst. of Tech., 1201 E. California Blvd., Pasadena, CA, 91109). **Project number:** G603A-AE-021. **Contract:** R806844-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to predict the effect of changes in primary gaseous and particulate emission levels on particulate air quality which necessitates the development of mathematical models that include aerosol processes and gas-to-particle conversion. The object of this work is to study fundamental aspects of atmospheric aerosol size distributions to develop a model capable of predicting observed ambient aerosol properties. The development work will draw upon existing theoretical models, where appropriate. To describe the relevant aerosol dynamic and chemical processes including gas-particle interactions, condensation growth, and gas to particle conversion. Ambient measurements of aerosol size distribution and composition will be used in the development of the modeling approach as well as for comparative studies for evaluating the model.

Keywords: mathematical models; aerosols; air pollution; particle size; particles.

73526 Scavenging of Gases and Aerosol Particles by Clouds and Precipitation in the Atmosphere. Pruppacher, H.R. (Univ. of California, 405 Hilgard Ave., Los Angeles, CA, 90024). **Project number:** G603A-AE-028. **Contract:** R806257-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

Theoretical models will be developed to describe the scavenging of pollutant aerosols and gases by cloud and precipitation elements. The mathematical models will be experimentally evaluated using the UCLA rainshaft and cloud tunnel. The rainshaft will be modified for use with pollutant gases.

Keywords: aerosols; gaseous wastes; earth atmosphere; clouds; atmospheric precipitations; acid rain; particles; mathematical models; scavenging.

73527 Sulfur Dioxide and Sulfates Material Damage Study Part 4, Distribution in Cities. Cook, J.D. (Geomet, Inc., 15 Firstfield Rd., Gaithersburg, MD, 20760). **Project number:** G603A-AE-030. **Contract:** 68-02-2943. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective of this study is to develop and verify a quantitative model for the distribution of materials suceptible to damage by sulfur dioxide and sulfates, in and around metropolitan areas. The study consists of two major tasks: (1) the establishment of the actual spatial distribution of exposed materials for two typical cities (St. Louis, Missouri and Baltimore, Maryland); and (2) the development and validation of a straightforward model to estimate the distribution of exposed materials for a typical American city. Included in the

scope of this study are external structural materials, particularly painted steel, bare galvanized steel, painted galvanized steel, painted wood, concrete, limestone and marble. Excluded are motor vehicles and personal and business equipment, supplies, clothing, that is, any item which is readily movable. Also excluded are all forms of vegetation.
Keywords: sulfur dioxide; sulfates; damage; missouri; maryland; materials; steels; wood; concretes; limestone; marble; chemical reactions; spatial distribution; mathematical models; air pollution.

73528 Measurement of Tropospheric and Stratospheric Trace Gases by Gas Chromatography. Cronn, D.R. (Washington State University, Dept. of Chemical Engineering, Pullman, WA, 99163). **Project number:** G603A-AF-005. **Contract:** R804033. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$75,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to make measurements of the vertical concentration distributions of selected trace gas species in the troposphere and lower stratosphere. Emphasis will be placed on determinations of halocarbons and non-methane hydrocarbons. Determination of the concentrations of the halocarbon species will be accomplished by the methods of electron capture--gas chromatography and gas chromatography-mass spectrometry--while gas chromatography with flame ionization detection will be employed for the determination of the hydrocarbons. Samples will be collected by aircraft flights in the United States.
Keywords: troposphere; stratosphere; gases; gas chromatography; organic halogen compounds; hydrocarbons; ecological concentration; monitoring.

73529 Analysis of Photochemical Air Quality for the Houston, Texas Area. Martinez, J.R. (SRI International, 300 Ravenwood Ave., Menlo Park, CA, 94025). **Project number:** G603A-AH-019. **Contract:** 68-02-2984. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Data collected under the Houston Oxidant Modeling Study (HOMS) will be compiled in a structured data base for use by modelers and analysts. Selected aspects of the HOMS data base will be analyzed and compared with data collected under the Houston Area Oxidant Study (HAOS). A variety of statistical analysis techniques will be applied to the data available to analyze spatial and temporal variations of pollutant species. Identification of characteristic patterns through statistical comparisons with emission distribution and meteorological variables will also be considered.
Keywords: texas; air quality; data compilation; statistics; spatial distribution; air pollution.

73530 Polymeric Interfaces for Continuous Monitoring of Hydrocarbon Emissions. Felder, R.M. (Univ. of North Carolina, Raleigh, NC, 27607). **Project number:** G712B-BA-023. **Contract:** R805-194-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100); **R and D categories:** Pollutant characterization and analysis.

Permeabilities, diffusivities and solubilities of major hydrocarbon pollutants and of oxygen in a variety of polymeric materials will be measured as functions of temperature, pressure, and pollutant concentration. The results of these measurements will be used to design interfaces for source monitoring of hydrocarbons, but their utility should extend well beyond this particular application. Potential applications include the design of hydrocarbon permeation tubes for calibrating ambient hydrocarbon analyzers, and the evaluation of plastic bag materials for storing grab samples to be analyzed for hydrocarbon concentrations. Membranes will be sought which are either selectively permeable or impermeable to oxygen, with the object of reducing or eliminating the oxygen effect in flame ionization detection. A portable interface-analyzer system for continuous unattended monitoring of hydrocarbon emissions will be designed, assembled, and field tested in a variety of source environments.
Keywords: hydrocarbons; emission; monitoring; air pollution monitors; polymers; interfaces; oxygen; physical properties; design.

73531 Ion Chromatography of Aromatic Amines. Frohliger, J.O. (University of Pittsburgh, Dept. of Industrial Environmental Health, 4200 5th Avenue, Pittsburgh, PA, 15260). **Project number:** G712B-BB-007. **Contract:** R805298-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$20,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective of this research project is to develop a liquid chromatographic method for the separation and analysis of amines found in environmental samples. The liquid chromatographic method to be utilized is a modification of ion chromatography as described by Small. The amines to be examincd are aromatic amines, many which are known or suspected carcinogens. The environmental samples to be utilized will be obtained on hi-volume filters. These filters will be collected in the vicinity of sources of amines such as coke works and dye manufacturing facilities. Emissions from these types of sources have been implicated in lung and bladder cancers. A tentative ion chromatographic procedure has been developed and plans are being made to test or evaluate the method near coke works and dye facilities.
Keywords: ion exchange chromatography; aromatics; air pollution; amines; technology utilization; neoplasms; carcinogens; coke; health hazards; coal industry.

73532 Interpretation of RAPS Atmospheric Elemental Concentration Data. Gordon, G.E. (Univ. of Maryland, College Park, MD, 20742). **Project number:** G712B-BB-081. **Contract:** R806263-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

In previous studies, workers at the University of Maryland have measured concentrations of about thirty elements attached to particles released from major air pollution sources. They also developed methods for resolving the observed concentration patterns of urban aerosols into contributions from those sources. Those methods are chemical element balances and factor analysis. In previous EPA-supported studies by other workers, abut 34,000 size-segregated air filter samples were collected over a two-year period in and near St. Louis, MO, as part of the Regional Air Pollution Study (RAPS). Those samples were analyzed for about 25 elements by x-ray fluorescence (XRF). In this project, the Maryland group is applying chemical element balances and factor analyses to resolve the St. Louis data into contributions from various major sources. This study also incorporates other types of RAPS data, including meteorological data, source-emissions inventories and measurements of pollutant gases, to provide a comprehensive interpretation of the St. Louis data set. Since XRF analyses miss some elements that are important for the interpretations, selected samples are being analyzed for additional elements.
Keywords: air pollution; ecological concentration; particles; aerosols; regional analysis; missouri; x-ray fluorescence analysis; inventories; meteorology; pollution sources; quantitative chemical analysis; chemical effluents; air quality.

73533 Continuous Monitoring of Particulate Sulfur Compounds by Flame Photometry. Huntzicker, J.J. (Oregon Graduate Center, 19600 NW Walker Rd., Beaverton, OR, 97005). **Project number:** G712B-BB-82. **Contract:** R804750-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to: (1) develop a field monitor to measure atmospheric concentrations of particulate sulfur compounds with a flame photometric detector; and (2) complete the development of a microprocessor to completely automate analysis and data reduction. The approach is: (1) to develop gas denuders to remove gaseous sulfur species and H2SO denude to differentiate between sulfuric acid and other aerosol sulfates; and (2) to develop hardware and software for data reduction.
Keywords: monitoring; particles; sulfur compounds; photometry; data processing; automation; sulfuric acid; sulfates; aerosols; air pollution.

73534 Development of an In Situ Monitoring Technique for Molecular Comparison of Particulate Emissions. Gravatt, C.C. (National Bureau of Standards, Washington, DC, 20228). **Project number:** G712B-BC-013. **Contract:** D6-F012. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$22,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

NBS, with its micro-Raman capability in facilities and expertise will perform the following tasks: (1) Generate preliminary reference spectra of various major types of stationary source particulates of interest to EPA, including sulfates, nitrates, and carbonates. Several representative particulate samples to be provided by EPA will be analyzed. These samples will have been previously characterized for elemental composition by EPA or their contractors to provide a basis for comparison with micro-Raman results. (2) Cooperate with and advise EPA in the development of stack sampling methods compatible with micro-Raman analysis. (3) Develop and install rapid automated sample holding systems for the NBS micro-Raman instrument in order to reduce data acquisition time, and to permit unattended operation in the analysis of multi-particle samples.

Keywords: particles; aerosols; molecular structure; in-situ processing; air pollution monitors; stationary pollutant sources; point pollutant sources; aerosol monitoring; air pollution control; optimization.

73535 Task Orders on Characterization of Emissions from Newly Designated Industries. Chehaski, J. (Engineering-Science, Inc., 7903 Westpark Dr., McLean, VA, 22101). **Project number:** G712B-BC-047. **Contract:** 68-02-2815. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Emission factors will be experimentally verified for pollutants (sulfur dioxide, sulfates, NOx, opacity, particulate mass) designated by new source performance standards (NSPS). Stack emission measurements are conducted by prescribed methods (Nos. 5, 6, 7, and 9 in Federal Register) when applicable or by newly developed methods. Contractor reports will be given on emission characterization data on selected field studies. Contractor hours have been allocated for measurements to be carried out in FY-79 in support of field studies directed by in-house staff.
Keywords: field tests; industry; stationary pollutant sources; monitoring; stacks; sulfur dioxide; sulfates; nitrogen dioxide; particles; emission; qualitative chemical analysis.

73536 Fuel Economy and Emissions Performance of Diesel Automobiles. Gibbs, R.E. (New York State Dept. of Environmental Conservation, 50 Wolf Rd., Albany, NY, 12205). **Project number:** G712B-BC-053. **Contract:** R805934-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective of this project is the collection of comprehensive emission and fuel consumption data from in-use diesel powered automobiles. The consumer vehicles will be tested over periodic intervals for regulated emissions, fuel consumption, particulate mass, detailed chemical analysis of particulate, and mutagenic activity of particulate extracts by the Ames method.
Keywords: automobiles; diesel engines; exhaust gases; fuel economy; fuel consumption; particles; mass; data acquisition; performance testing.

73537 Technical Symposium: Implications of a Low NOx Vehicle Emission Standards. Hicks, F. (Ebon Research Systems, 1542 9th St. NW, Washington, DC, 20001). **Project number:** G712B-BC-076. **Contract:** 68-02-3219. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

As the first step in the development of a report mandated by Congress, the purpose of the symposium was to identify, examine, and make available all of the information bearing upon the need for, and technological and economical feasibility of, a 0.4 g/mile NOx emission standard applicable to future light duty motor vehicles. The objective was accomplished by inviting active investigators in the field to address the complex issues that impact on any future determination by the U.S. Congress concerning the control of nitrogen oxides emitted from automobiles and other sources.
Keywords: nitrogen oxides; automobiles; exhaust gases; air pollution control; meetings; pollution regulations; feasibility studies.

73538 Long Term Measurements of Selected Trace Constituents in Air. Singh, H.B. (SRI INternational, 300 Ravenwood Ave., Menlo Park, CA, 94025). **Project number:** G760C-DA-015. **Contract:** R806729-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this program is to determine the tropospheric burden and fate of trace pollutants (halogenated hydrocarbons SF6, nitrogen species, and light hydrocarbons) at a remote clean site. The resulting data base will be used to derive seasonal variations as well as atmospheric growth patterns of these pollutants. Ambient air and seawater samples will be collected on a biweekly basis at a remote site on the California coast. Samples will be collected in stainless steel and glass containers and then immediately analyzed by gas chromatographic/coulometric measurement techniques. A data base has been compiled of the atmospheric loadings of these trace pollutants at urban, rural, and remote sites within the northern hemisphere and to a lesser extent within the southern hemisphere.
Keywords: trace amounts; elements; troposphere; organic halogen compounds; air; nitrogen compounds; hydrocarbons; seasonal variations; air pollution; sampling; seawater; california; gas chromatography; urban areas; rural areas.

73539 Studies on Droplet Electrification in Relation to Liquid Chromatographic Detection. Liu, B. (Univ. of Minnesota, 105 Morrill Hall, Minneapolis, MN, 55455). **Project number:** G762B-DB-010. **Contract:** R806175. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to determine the feasibility of developing a new high-pressure liquid chromatographic (HPLC) detector based on droplet electrification. A two-year program is proposed with the main emphasis during the first year on demonstrating feasibility of the concept. If feasibility is shown, the second year of research will be conducted, during which an actual detector based on this principle will be designed, constructed and tested.
Keywords: air pollution; pesticides; hydrocarbons; liquid column chromatography; air pollution monitors; design; particles; aerosols; monitoring.

73540 Cooperative Micrometeorological Experiments of Pollutant Fluxes Over Natural Surfaces. Hicks, B. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** G775G-CC-012. **Contract:** D8-X0193. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to measure the atmospheric turbulent transport of airborne contaminants to natural surfaces. The dry deposition of fractionated aerosols (in the range 0.2 to 0.4 micrometer), total fine aerosol, sulfate, nitrate, sulfur dioxide, nitric acid, and ozone will be measured for various crops, forests, lakes, snows, etc. The deposition velocities will be used in the dry removal function of regional models. Techniques of eddy-correlation and vertical profile will be used; ANL will provide the meteorological measurements, and ESRL will provide the fast-response pollutant sensors and profile measurements.
Keywords: air pollution; atmospheric chemistry; sulfur dioxide; sulfates; nitrates; nitric acid; ozone.

73541 Characterization of Emissions from Prototype Motor Vehicles Designed for Low NOx Emissions. Martin, S.F. (Southwest Research Inst., 8500 Culebra Road, San Antonio, TX, 78228). **Project number:** G815B-CA-011. **Contract:** 68-02-2497. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$25,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The purpose of this project is to select, qualify, and then utilize suitable measurement instrumentation and techniques for the characterization of regulated and a variety of currently nonregulated exhaust emissions from gasoline automobiles using various catalytic methods to achieve low oxides of nitrogen. A literature review will be conducted to determine candidate analytical methods. Recommendations for the analysis of each exhaust species of interest will be made. All procedures and analytical instruments will be directly interfaced with a motor vehicle exhaust sampling system and evaluated for suitability. Four light duty vehicles, two with dual bed and two with three-way catalysts, will be tested using three fuels of differing sulfur content. Tests will be performed at 0, 5,000, 10,000, and 15,000 miles. Results to date include selection and evaluation of all the analytical procedures to be used in the final vehicle testing phases of the contract. Satisfactory procedures have been defined for all compounds of interest with the exception of the organic amines. The qualification experiments indicate difficulty in quantitative transport of the amines from the vehicle to the analytical instrumentation.
Keywords: automobiles; vehicles; exhaust gases; nitrogen oxides; air pollution control; chemical composition.

73542 Sulfuric Acid Monitor. Fowler, P. (Cabot Corp., Concord Road, Billerica, MA, 01821). **Project number:** G815-CA-022. **Contract:** 68-02-2402. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$12,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to fabricate, test, and deliver automated sulfuric acid samplers, sampler-calibrators and analyzers to EPA. The samplers are designed to collect sulfuric acid with a minimum of acid neutralization from coarse basic particles and gaseous ammonia. The acid aerosol is run through a diffusion scrubber for removal of NH3 and then a dichotomous sampler so only the fine aerosol fraction is collected on three 1/2-micron unbacked fluoropore filters. Built-in calibrators on some samplers allow for internal quality control of sampler and filter transport procedures. The analyzer is designed to separate H2SO4 from other sulfur compounds on the filter by low-temperature volatilization and to detect the sulfur with

a sensitive FPD. All instruments have been delivered. Samplers have shown reasonable reliability when given adequate shelter from weather and have been successfully used in 6 field studies to collect ambient H2SO4 aerosols. The amount of field support and maintenance required limits their usefulness to very special short-duration studies. The sampler-analyzer-calibrator delivered to HERL appears to meet all design specifications. Other analyzers meet these specifications only if the aerosol is analyzed immediately following collection imposing severe limitations on their usefulness. Any future design modifications will be performed in-house or with another outside contractor.
Keywords: sulfuric acid; air pollution monitors; fabrication; performance testing; air samplers; aerosol monitoring; separation processes; sulfur compounds.

73543 Atmospheric Transport and Transformation of Emissions from Coal-Fired Power Plants: Atmospheric Interaction in Scrubber Plumes. Meagher, J.F. (Tennessee Valley Authority, Muscle Shoals, AL, 35660). **Project number:** G832B-EA-031. **Contract:** D9-E721-DL. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to study gas to aerosol conversion processes in scrubbed power plant plumes. Sulfate and nitrate formation will be emphasized in the study. Plume sampling as a function of time will be done using an airplane and a helicopter. Gas and particulate measurements will be made in the plume. In-stock measurements will be made for the primary emissions of SO2, sulfate, nitrate and aerosol size distribution.
Keywords: gaseous wastes; fossil-fuel power plants; emission; atmospheric chemistry; environmental transport; plumes; scrubbers; aerosols; sulfates; nitrates; sampling; sulfur dioxide; particle size; distribution.

73544 Development and Verification of a Point Source Diffusion Model for Sources in Complex Terrain. Egan, B.A. (Environmental Research and Technology, Inc., Air Quality Studies Division, 696 Virginia Road, Concord, MA, 01742). **Project number:** G832B-EA-060. **Contract:** 68-02-2759. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$75,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this contract is to develop a reliable air quality transport/diffusion model for estimating ambient air ground level concentrations from point sources in areas of complex terrain. The model will be applicable but not necessarily restricted to large point sources with significant plume rise, i.e., a power plant. The work will consist of development and/or modification and implementation of new or state-of-the-art methodologies for treatment of dispersion from point sources in complex terrain, and evaluation and verification of the approach. A worst-case, short-term, single point source model based on potential theory for estimation of ground level impact upon a variety of individual terrain features, and a sequential, hourly, long-term model for estimation of ground level impact upon a set of distributed terrain features are to be developed. The models will be evaluated on the field measurement data sent from the Clinch River Valley power plant study and from the Clinch River Valley wind tunnel simulation experiments performed at the EPA Fluid Modeling Laboratory.
Keywords: diffusion; environmental transport; plumes; air pollution; mathematical models; fossil-fuel power plants; topography.

73545 Air Sampling at the Coal Gasification Plant in Region Kosovo, Yugoslavia. Bombough, K.J. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** G32B-EA-131. **Contract:** 68-02-2608. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are: to collect and analyze inorganic and organic particulates and vapor phase organic emissions released to the atmosphere from a full scale commercial low Btu coal gasifier; to assess the impact of this facility on the surrounding atmosphere; and to produce a data base for use in assessing the potential impact of locating such a facility in various regions of the United States. Using a total of five (5) ground based sites located around the plant complex, particulate and vapor-phase samples were collected over a period of 16 days on a 24-h basis. Several inorganic and organic species will be determined and analyzed in conjunction with extensive process and fugitive emission data.
Keywords: aerosol monitoring; coal gasification plants; yugoslavia; air; quantitative chemical analysis; qualitative chemical analysis; environmental impacts; particles.

73546 Quality Control in Organic Aerosol Analysis. Guerin, M.R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** G823B-EA-151. **Contract:** D9-X0601. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to perform quality control analyses for the determination of organic components in selected particulate and vapor-phase samples from various EPA field studies related to advance fossil fuel technologies. The approach is to analyze for organic constituents collected on quartz fiber filters and Oak Ridge National Lab-designed organic vapor absorption systems using thermal desorption and solvent extraction techniques. Analytical approaches include the use of carbon-14 labeled standards, high performance liquid chromatography, flame ionization detection, and for selected samples, gas chromatography-mass spectrometry.
Keywords: air quality; aerosol monitoring; quality control; field tests; fossil fuels; emission; carbon 14 compounds; tracer techniques; liquid column chromatography; gas chromatography; mass spectroscopy.

73547 Study of Acidic and Basic Constituents of Air, Concentration and Distribution and Effect on Acidity of Precipitation and Dry Deposition. Lazrus, A. (National Center for Atmospheric Research, P.O. Box 1470, Boulder, CO, 80302). **Project number:** G832B-EA-166. **Contract:** D9-X0574. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to explore the atmospheric chemistry of acidic components of air and precipitation on a regional basis and determine the contributions of these components to acid precipitation and dry deposition. Surface and airborne measurements below clouds and in clouds will be made to sample air and liquid water concentrations of acidic and basic components, with samples to be analyzed by numerous participants in the acid precipitation experiment (APEX). Results will be analyzed to determine regional and seasonal differences of atmospheric acidity and contributing constituents.
Keywords: ph value; air; acid rain; atmospheric chemistry; regional analysis; sampling; seasonal variations; sulfur dioxide; nitrogen dioxide.

73548 Processing of SURE Plume Study Data. Vaughan, W.M. (Environmental Measurements, Inc., 8506 Delmar Blvd., University City, MO, 63124). **Project number:** G832B-EA-207. **Contract:** 68-02-2709. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to provide a data volume and data tape of airborne measurements made during a coordinated study of power plant plumes in Mississippi and Michigan in the spring of 1977. Data tapes will be processed and edited to provide output data in engineering units for analyses by other SURE contractors.
Keywords: plumes; power plants; mississippi; michigan; data processing; monitoring; air pollution.

73549 Identification and Measurement of Inorganic Compound Emissions. Henry. (Battelle Memorial Inst., 505 King Ave., Columbus, OH, 43201). **Project number:** G833D-EB-005. **Contract:** 68-02-2296. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The contractor will review methods and develop procedures for the collection, identification, and measurement of the amounts of inorganic compounds emitted from sources using fossil fuels. Laboratory evaluation and field testing at sources using or processing fossil fuel (fossil fuel power plant, oil refinery, and coal conversion) of the methods will be conducted to obtain emission characterization data. This report will be performed in three (3) distinct phases.
Keywords: fossil fuels; air quality; air samplers; air pollution monitors; fossil-fuel power plants; petroleum refineries; emission; sampling; monitoring; qualitative chemical analysis; quantitative chemical analysis; aerosols; particles; gaseous wastes.

73550 Research on Air Sampling Filter Media. Liu, B.Y. (University of Minnesota, Dept. of Mechanical Engineering, 105 Morrill Hall, Minneapolis, MN, 55455). **Project number:** G833D-EB-004. **Contract:** R804600-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$25,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The primary objective of this program is to study air sampling filter media and to evaluate the available commercial filter media in terms of their sampling efficiency, resistance to flow, dust holding capacities, moisture retention characteristics, and other physical properties of interest. All major commercial filter media will be studied. The end result of the project will be the preparation of a filter handbook in which the major filter characteristics are described. In addition, a concurrent study will be undertaken to relate the sampling efficiency and flow resistance of filters to those predicted by theory. Also, the series filter method will be studied as a possible alternative to the dichotomous sampler for separating atmospheric particles into a fine and a coarse fraction with a cut point near 2.0 microns.
Keywords: aerosol monitoring; air pollution; air filters; air samplers; technology assessment; manuals; aerosols.

73551 Identification and Measurement of High Molecular Weight Organic Compounds in Emissions from Power Plants and Oil Refineries. Barrett, W.J. (Southern Research Institute, 2000 9th Avenue South, Birmingham, AL, 35205). **Project number:** G833D-EB-006. **Contract:** 68-02-2272. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives of this project are to develop methods and procedures to identify and measure the organic compounds emitted to the atmosphere from energy-related sources and to determine by means of bioassays what fractions or classes of the organic emissions are of potential toxicological significance. The experimental work involves the development of sampling methods for the quantitative collection of organic emissions from coal-burning power plants and oil refineries; the use of separation techniques for classifying types of organic compounds and isolating individual compounds; identification of individual compounds by gas chromatographic, mass spectrometric, and other methods; and the screening of isolated fractions for toxicity by tissue-culture methods. Laboratory and field studies at coal-fired power plants have been conducted with sampling trains that incorporated porous-polymer solid sorbents. The collected solvent samples were extracted and analyzed with methods such as gas chromatography/mass spectrometry. A method based on a tissue-culture assay was selected and developed for biological toxicity testing.
Keywords: organic compounds; toxicity; fossil-fuel power plants; petroleum refineries; air pollution; chemical effluents; gaseous wastes; chemical analysis; sampling.

73552 Design and Fabrication of an Automated Field Monitor for the Measurement of Atmospheric Nitric Acid. Ross, W.D. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayton, OH, 45407). **Project number:** G833D-EB-015. **Contract:** 68-02-2755. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$90,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objectives of the proposed program are to design, fabricate, evaluate, and deliver to the EPA a semicontinuous monitor for the measurement of atmospheric nitric acid at levels as low as 0.0005 ppM. This monitor will be an automatic device developed by integrating the following five operations into a single mechanical system: an ambient air sampling system; a nitric acid recovery device; a reaction system which achieves aromatic nitration; an automated injection system; and a gas chromatograph equipped with an electron capture detector. This integrated system will provide for automated monitoring of ambient air. The monitor will be packaged for field use. An automated sampler has been delivered. The current plans call for a separate (not integrated) analysis unit. The overall system integration has proven too costly in engineering and development to be implemented at this time.
Keywords: nitric acid; air pollution monitors; design; fabrication; automation; performance testing; monitoring.

73553 Sulfur Budget in Power Plant Plumes: Processing, Management, and Analysis. Gillani. (Washington Univ., 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G603A-AA-015. **Contract:** R805918-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

This project continues the tasks performed during the first year of the grant, i.e., processing, management, and analysis of data collected as part of the August 1978 Tennessee Plume Study (Phase I of Project STATE). Similar responsibilities wll be undertaken for the Cold Weather Plume Study (Phase II of Project STATE). Specific tasks include: (1) software organization and development; (2) data base system design and implementation; (3) data analyses and model development; (4) preparation for, and participation in, the STATE Cold Weather Plume Study field program; and (5) production of an aircraft data volume.
Keywords: fossil-fuel power plants; plumes; sulfur dioxide; tennessee; data analysis; data base management; weather; information systems; air quality.

73554 Formation of Atmospheric Aerosols. Whitby, K.T. (Univ. of Minnesota, 105 Morrill Hall, Minneapolis, MN, 55455). **Project number:** G603A-AA-019. **Contract:** R803851-0354. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

Aerosol size distributions have been measured in the St. Louis area as part of EPA's Project MISTT using aircraft and ground-based self-contained mobile laboratories. The University of Minnesota's portion of the project included aerosol measurements aboard an aircraft and the operation of a mobile van on the ground under the plumes. The past year was devoted primarily to data analysis, the development of new analysis techniques, and reporting results of aerosols data obtained over the past several years in Project MISTT and the Roadway Aerosol Study. During the coming year the Particle Technology Laboratory of the University of Minnesota will be measuring aerosol size distribution for EPA's Project STATE (Sulfur Transport and Transformation in the Environment) in Tennessee and for EPA's Project SCRUB in Alabama and Minnesota. The STATE Program is directed to describing reactions and atmospheric processes affecting plume behavior over time scales of 12 to 96 hours and distances out to 1000 km. By contrast the SCRUB Program will provide an assessment of the transport and transformation occurring within a power plant plume with an SO2 scrubber out to distances of about 1000 km and travel times mostly less than 12 hours. Resources will be provided to complete data analysis and report on Project MISTT and to participate in the planning of Project SCRUB and the subsequent data analysis. Other tasks include the measurement of gaseous and aerosol pollutants under and in plumes being characterized in Project STATE and development of an aerosol mobility chromatograph to determine molecular composition of sulfur-containing aerosols.
Keywords: aerosols; atmospheric chemistry; missouri; aerial monitoring; aerosol monitoring; plumes; data analysis; sulfur dioxide; environmental transport; scrubbers; fossil-fuel power plants; chromatography; tennessee; alabama; minnesota; particle size.

73555 Atmospheric Transport and Transformation from Coal-Fired Plants. Jones, H.C. (Tennessee Valley Authority, Muscle Shoals, AL, 35660). **Project number:** G603A-AA-025. **Contract:** D9-E721-DL. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The major objective of this study is to study the meteorological and chemical factors which influence the transport, transformation, and removal of pollutants in the Cumberland Tennessee Power Plant plume. TVA will perform a two-week plume study program. Using the TVA helicopter, they will supply instrumentation for the following measurements: SO2, O3, NO, NOx, condensation nuclei (CNC), light scattering via integrated nephelometer, temperature, dew point, altitude, and position of aircraft. The pollutant instrumentation will be calibrated before and immediately after each sampling test. In addition TVA will furnish a filter collection sampling system for aerosol samples and subsequent analysis. They will also conduct in stack measurements to determine primary sulfate contributions to the plume composition. In addition, a continuous SO2 analyzer will be used to monitor plant output. The following meteorological support will be furnished during the plume measurements program: (1) pilot balloon soundings, two per hour during a plume measurement experiment; (2) solar intensity, hourly averages; (3) temperature profiles; (4) tower wind data; and (5) meteorological forecast.
Keywords: fossil-fuel power plants; coal; environmental transport; tennessee; plumes; aerial monitoring; sulfur dioxide; ozone; nitrogen oxides; nitrogen dioxide; condensation nuclei; light scattering; temperature measurement; dew point; sampling; aerosols; stacks; meteorology; removal.

73556 Over-Water Measurements of Atmospheric Processes. Hobbs, P. (Univ. of Washington, Seattle, WA, 98105). **Project number:** G603A-AA-123. **Contract:** R805263-0151. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to measure transformations of SO2 to sulfate and NO/NO2 to nitric acid under relatively high humidity, low sunlight intensity levels. The isolated emissions from Great Britain will be sampled sequentially as air moves across the North Sea toward the Scandinavian Peninsula to measure conversion and deposition rates.

Keywords: sulfur dioxide; nitrogen oxides; environmental transport; atmospheric chemistry; oxidation; north sea.

73557 Laboratory Investigations of Diffusion and Fumigation into the Mixed Layer. Deardorff, J.W. (Oregon State Univ., 126 Agricultural Hall, Corvallis, OR, 97331). **Project number:** G603A-AA-170. **Contract:** R805912-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to obtain quantitative descriptions of the mean concentration profiles and diffusion rates of material released from elevated point sources under very unstable conditions and to derive smilar information for plumes fumigating into the convective mixed layer from a stable layer aloft. A large laboratory water tank in which convection below a stable inversion layer can be simulated will be used.
Keywords: diffusion; fumigants; bench-scale experiments; layers; mixing; point pollutant sources; air pollution; plumes; environmental transport; convection.

73558 Aircraft Measurements of Plume Dispersion and Chemistry. Vaughan, W.M. (Environmental Measurements, Inc., 8506 Delmar Blvd., University City, MO, 63124). **Project number:** G603A-AA-178. **Contract:** 68-02-2709. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

In order to acquire the data base necessary for the development of control strategies for the reduction of ambient air concentrations of sulfates and nitrates, EPA will conduct a large-scale program of discrete, intensive experimental field studies during the fiscal years 78-81. The proposed studies are identified by the acronym STATE (Sulfur Transport and Transformation in the Environment). Air quality simulation models are the expected end product. The contractor will supply two moving laboratory platforms for plume transport and transformation from the Cumberland Power Plant in Tennessee. One platform will be an instrumented aircraft and the other will be an instrumented automobile (Air Quality Moving Laboratory, AQML) for measurements in the downwind plume. The aircraft has sampled and measured SO2, SO4 (continuous and integrated), B SCAT, NO, NO2, NH4, SF6 (continuous), and hydrocarbons over a 4-week period involving approximately 100 flight hours. Sampling and measurements were made for SO2 at the surface, SO2 aloft by remote sensor (COSPEC), SF6 (continuous), and hydrocarbons.
Keywords: aerial monitoring; plumes; dispersions; atmospheric chemistry; sulfates; nitrates; air pollution control; field tests; environmental transport; fossil-fuel power plants; tennessee; sampling; mathematical models; sulfur fluorides; ammonium compounds; sulfur dioxide; hydrocarbons; remote sensing.

73559 Optimization of RAM Dispersion Model. Cataland, J.A. (Aerocomp, Inc., 3303 Harbor Blvd., Costa Mesa, CA, 92626). **Project number:** G603A-AB-011. **Contract:** 68-02-2948. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to optimize the FORTRAN computer codes for the dispersion model programs in the RAM system in order to decrease the computer running time. RAM is an efficient Gaussian-plume multiple source algorithm. It is primarily used for non-reactive pollutants from point and area sources in urban areas. A users' guide for optimized models which include four versions of RAM (RAM, RAMR, RAMF, RAMFR) and three supporting programs is planned.
Keywords: mathematical models; fortran; diffusion; pollution sources; optimization; air pollution.

73560 Modeling of Atmospheric Flows And Pollutant Dispersal Over and Around Hills and Buildings. Arya, S.P. (State Univ. of North Carolina, Raleigh, NC, 26707). **Project number:** R805595-03. **Contract:** G603A-AB-012. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to conduct basic fluid modeling and theoretical studies of the flow and diffusion of pollutants over complex topography. Work will include comparisons of newly acquired data with existing theories and modeling techniques in order to verify and refine present models as well as to develop new ones. Visualization techniques and ground level concentration measurements using the wind tunnel and water channel/towing tank will provide the data necessary for the studies.
Keywords: air pollution; environmental transport; atmospheric chemistry; flow models; topography; diffusion.

73561 Boundary Layer Model Improvement and Validation. Blackadar, A.K. (Pennsylvania State Univ., 116 Deike Bldg., University Park, PA, 16802). **Project number:** G603A-AB-019. **Contract:** R806048-0152. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: (1) model surface exchange processes; (2) model planetary boundary layer, wind, temperature, and moisture profiles; and (3) measure wind and temperature profiles, along with other PBL characteristics. Simplified numerical models will be compared with field data and other existing data sets.
Keywords: earth atmosphere; boundary layers; mathematical models; wind; humidity; temperature distribution.

73562 Identification and Characterization of Organic Pollutants in Ambient Air. Mulik, J.D. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AA-010. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives are to identify and characterize organic constituents in the atmosphere at various locations in order to assess and anticipate potential air pollution problems. Special attention is focused on hazardous/toxic materials and their cofactors. Overall identification is through the use of combined gas chromatography and mass spectrometry. Samples are collected in the field at selected locations and returned to the laboratory for analysis.
Keywords: air pollution; air; organic compounds; gas chromatography; mass spectroscopy; sampling; sulfur compounds; nitrogen compounds; particles; fossil fuels; combustion products.

73563 Meteorological Support and Research Services. Niemeyer, L.E. (Dept. of Commerce, Research Triangle Park, NC, 27711). **Project number:** G603A-AA-30. **Contract:** D9-V0348-1. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

Research will be conducted on various aspects of air pollution meteorology including the development and evaluation of air quality simulation models of all temporal and spatial scales, and the development and improvement of air pollution climatological techniques. These models and techniques are applied to various environmental problems and requirements. The research is conducted in the laboratory and the field. Mathematical models are developed and then evaluated in field programs. Physical modeling studies of air pollution meteorology problems are conducted in a wind tunnel and water channel/towing tank.
Keywords: air pollution; meteorology; air quality; mathematical models.

73564 Additional Effort on LIDAR and SODAR Support for State. (SRI International, 300 Ravenswood Ave., Menlo Park, CA, 94025). **Project number:** G603A-AA-033. **Contract:** 68-02-2790. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The overall objective of the program proposed by SRI International is to provide LIDAR and SODAR support to the state program to characterize boundary layer aerosol distributions downwind of the TVA Cumberland Power Plant during intensive experimental periods conducted during August 1978. This includes both the temporal behavior of mixed layer heights, horizontal and vertical spread, and mass density of the power plant plume. The approach is to participate in field study with mobile LIDAR system and acoustic sounding system; reduce all LIDAR data in terms of intensity modulated displays depicting boundary layer and plume structure; compute sigma Y, Z for plume measurements; and compute mass concentrations and opacity for the plume measurements using data on particle size distribution collected by other state participants.
Keywords: aerosols; distribution; boundary layers; fossil-fuel power plants; time dependence; plumes; density; environmental transport; optical radar; tennessee; environmental impacts.

73565 Regional Scale Haziness: Origin, Spatial-Temporal Distributions, Properties, and Effects on Atmospheric Radiation. Husar, R.B. (Washington Univ., 4559 Scott Ave., St. Louis, MO, 63130). **Project number:** G603A-AA-149. **Contract:** R806606-0151. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are: (1) to examine the relationship between particulate sulfur concentrations, acidity, fine particulate mass concentration, light scattering, air mass history, time of day, and season; and (2) to study the origin, spatial and temporal trends of regional scale haziness. Acidity of fine particle sulfur compounds will be monitored in St. Louis, MO, and University Park, PA, using a flame photometric particulate sulfur monitor combined with differential thermal analysis. Meteorological data of the U.S. Weather Service will be used to study regional haziness.

Keywords: air pollution; sulfur compounds; particles; light scattering; seasonal variations; spatial distribution; opacity; monitoring; missouri; pennsylvania; photometry; differential thermal analysis; meteorology; regional analysis; mathematical models; air quality; environmental transport.

73566 Transformation of Visibility-Related Pollutants in Western Pristine Areas. Blumenthal. (Meteorology Research, Inc., 464 W. Woodbury Rd., Box 637, Altadena, CA, 91001). **Project number:** G603A-AA-179. **Contract:** 68-02-3225. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop quantitative techniques to predict visibility degradation from new energy sources. Several field studies will be conducted and the data used to evaluate existing visibility and haze models. Instrumented aircraft, communications facilities, ground mobile measurements, airborne lidar, plume chemical tracers, tetroons or other plume markers, and other meteorological support will be used. Parameters to be determined include rate of transformation of sulfur dioxide to sulfate; sulfur dioxide, sulfate, and aerosol removal rates; plume optical properties and effects; and terrain effects on dispersion and transport.

Keywords: visibility; opacity; energy source development; field tests; aerial monitoring; aerosol monitoring; plumes; meteorology; sulfur dioxide; sulfates; atmospheric chemistry; aerosols; optical properties; topography; environmental transport.

73567 Fluid Modeling. Snyder, W. (Environmental Protection Agency, Research Triangle Park, NC). **Project number:** G603A-AB-020. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the research are to simulate and study plume dispersion in complex terrain, plume rise in a calm, linearly stratified environment, diffusion around buildings, surface exchanges, and highway modeling. The approach is to use the wind tunnel and tow channel of the EPA fluid modeling facility at Research Triangle Park, NC, to simulate terrain and atmospheric conditions.

Keywords: plumes; diffusion; topography; layers; buildings; simulation; mathematical models; wind tunnels; environmental transport; air pollution.

73568 Air Quality Simulation Modeling. Eskridge, R.E. (Environmental Protection Agency, Research Triangle Park, NC, 27711). **Project number:** G603-AB-021. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the research are to develop, evaluate, and validate air quality simulation models that include atmospheric-photochemical transformations, long range transport, radiative transfer mechanisms, boundary layer dynamics, turbulence, advanced statistical concepts, and meteorological processes. The approach involves refinement and adaptation of existing models, theoretical development, evaluation against data bases obtained from field studies, and statistical analysis for verification.

Keywords: air quality; mathematical models; atmospheric chemistry; environmental transport; radiative cooling; heat transfer; boundary layers; turbulence; meteorology; photochemical reactions; data; comparative evaluations; statistics; air pollution; monitoring.

73569 Dynamics and Kinetics of Aerosol Pollutants. Durham, J.L. (Environmental Protection Agency, Research Triangle Park, NC, 27711). **Project number:** G603A-AC-011. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are: (1) to manage and conduct gas-aerosol interaction studies; (2) to coordinate programs leading to the development of a variety of aerosol sub-models that integrate chemical and physical aspects of aerosol formation, growth, and removal; and (3) to report on the morphology of urban aerosols. The approach is to conduct field studies and laboratory investigations to obtain the necessary data base.

Keywords: aerosols; chemistry; atmospheric chemistry; mathematical models; chemical reactions; coordinated research programs; morphology; urban areas; bench-scale experiments; removal; production; chemical reaction kinetics; thermodynamics; air pollution.

73570 Dynamics and Kinetics of Gaseous Air Pollutants. Bufalini, J.J. (Environmental Protection Agency, Research Triangle Park, NC, 27711). **Project number:** G603A-AC-032. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to manage and conduct studies of the dynamics and kinetics of air pollutants to determine their mechanisms and rates of chemical reactions. The approach is through laboratory and field studies; development of photochemical modeling techniques; and use of smog chambers to study reactivity of simulated and real atmospheres.

Keywords: air pollution; chemical reaction kinetics; bench-scale experiments; photochemical reactions; mathematical models; smog.

73571 Photochemical Modeling of Smog Chamber Data. (Systems Applications, Inc., 950 Northgate St., San Rafael, CA, 94903). **Project number:** G603A-AC-054. **Contract:** 68-02-3281. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to develop photochemical smog mechanisms describing the chemical transformations that occur in the polluted atmosphere. The emphasis of this effort will be directed towards validating the smog mechanisms for diurnally-varying sunlight and temperature. Mechanisms are tested and modified by comparing computer concentration-time dependencies of various reactants and products obtained in outdoor smog chamber studies of irradiated hydrocarbon and NOx mixtures.

Keywords: photochemical oxidants; smog; simulation; hydrocarbons; nitrogen oxides; ultraviolet radiation; atmospheric chemistry; air pollution; daily variations.

73572 Photochemical Oxidant Studies. Bufalini, J.J. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AD-006. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to manage and conduct studies to qualify the chemical and physical mechanisms and rates involved in the formation of specific photochemical oxidants; and to relate oxidant and oxidant precursor levels to meteorology, topography, emissions, and other factors on local to regional scales. The approach is to obtain data laboratory and outdoor chamber studies; conduct field studies; and analyze data to provide a kinetic module for the various photochemical air quality simulation models under development.

Keywords: photochemical oxidants; atmospheric chemistry; meteorology; topography; emission; regional analysis; simulation; air quality; mathematical models.

73573 Air Pollution Climatology and Meteorology. Holzworth, G.C. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AE-012. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to determine and forecast air pollution potential for specific geographic areas and to establish relationships among air quality data, meteorological parameters, visibility, physical processes affecting air quality, and site characteristics. The approach is to use meteorological parameters forecasted by the National Weather Service to develop air quality forecasting techniques, analyze data from field studies using statistical techniques, and conduct limited field experiments and analyze optical data.

Keywords: air pollution; air quality; meteorology; visibility; forecasting; mathematical models; statistics.

73574 Pollutant Materials Damage of St. Louis. Haynie, F. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AE-031. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to correlate short term corrosion monitor data with climatic and pollution variables. The approach is to

conduct theoretical and statistical analysis of data for the St. Louis area obtained from the Regional Air Pollution Study.
Keywords: missouri; urban areas; corrosion; climates; correlations; air pollution; environmental impacts; monitoring.

73575 Corrosion of Galvanized Steel Near Power Plants. Coleman. (TVA, Muscle Shoals, AL, 35660). **Project number:** G603A-AE-032. **Contract:** D9-F0754. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to establish the variation in corrosion behavior of galvanized steel as a function of distance, direction, and elevation, with respect to power plant location. The thickness of galvanizing on power line transmission towers will be measured and compared with the specification thickness at installation and a corrosion rate as a function of location will be calculated. Average relative humidity, temperature, windspeed, and wind direction will be considered in determining a damage function which will be compared with existing damage functions to estimate long term average SO2 levels.
Keywords: fossil-fuel power plants; sulfur dioxide; corrosive effects; electrochemical corrosion; surface coating; steels; power transmission lines; damage.

73576 Atmospheric Halocarbons. Hanst, P.L. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AF-004. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) assess the impact of fluorocarbons and other halogenated organics on stratospheric ozone levels; (2) manage and conduct research to characterize the air in various locations; and (3) provide insight into future atmospheric problems. The approach is to combine laboratory experimental measurements, through the use of specialized instrumentation, e.g., long path infrared absorption, with theoretical modeling work. Samples of halocarbons will be collected by aircraft to provide vertical profiles from the earth's surface into the stratosphere.
Keywords: organic fluorine compounds; stratosphere; ozone; forecasting; aerial monitoring; infrared spectra; monitoring; mathematical models; environmental impacts; atmospheric chemistry.

73577 Numerical Investigation on the Role of Various Halocarbon Reactants on Ozone. Crutzen, P.J. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** G603A-AF-008. **Contract:** R804921. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The overall objective is to obtain an understanding of the impact of halogenated compounds, especially methylchloroform, on the environment. A two-dimensional photochemical model extending from the ground to 55 km will be used to calculate the impact of various anthropogenic emissions on the troposphere and stratosphere.
Keywords: ozone; chlorinated aliphatic hydrocarbons; atmospheric chemistry; environmental impacts; troposphere; stratosphere; mathematical models.

73578 Management of Sampling and Analysis of Air Pollutant Studies. Wagman, J. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-EA-002. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to coordinate, manage and conduct research on the development of sampling and analysis techniques for the identification and meaurement of pollutants from sources; and provide emission measurement methodology for the research, monitoring, and regulation and enforcement activities of the agency. Methods and instrumentation for precise and rapid identification and measurement of pollutants from mobile and stationary sources are developed. Pollutant emission data are obtained. Field studies and laboratory investigations are conducted.
Keywords: sampling; measuring methods; monitoring; stationary pollutant sources; mobile pollutant sources; emission; data compilation; field tests; bench-scale experiments; air pollution; chemical analysis; air quality.

73579 Sampling and Analysis Techniques for Pollutants from Stationary Sources. Knapp, K. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-007. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to manage, administer, and conduct research to develop sampling and analytical techniques for the identification and measurement of pollutants from stationary sources. The stationary sources simulator at Research Triangle Park is used; remote plume opacity measurements are employed; and improved sampling technology, methodologies, and instrumentation are made. Work is carried out in part by ESRL and by contractors and grantees.
Keywords: sampling; chemical analysis; stationary pollutant sources; simulation; plumes; opacity; aerosols; air pollution; air quality.

73580 Development of LIDAR Methodology for Measuring Fugitive Particulate. Euthe, E. (SRI International, 300 Ravenswood Ave., Menlo Park, CA, 94025). **Project number:** G712B-Ba-013. **Contract:** 68-02-2752. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The object of the project is to develop a procedure for evaluating fugitive air pollution particulate emissions from a plant by measuring the flow of particulate pollution in the atmosphere downwind of the plant. The existing LIDAR equipment will be used to measure the spatial distributions and concentrations of fugitive emission clouds downwind of the fugitive emission sources. This data will then be integrated and coupled with wind velocity data to determine the degree of correlation with artifically generated emissions with known emission rates.
Keywords: air pollution; monitoring; optical radar; wind; velocity; correlations.

73581 Fluidic Flow Meter for Measuring Flow in Three Dimensions in Stationary Source Dust Effluents. Sieracki, L.M. (Tri Tec, Inc., 8325 McGaw Ct., Box 56, Columbia, MD, 21045). **Project number:** G712B-BA-026. **Contract:** 68-02-2785. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

This program is to design and develop a fluidic sensor capable of measuring the gas velocity and flow direction in stationary source ducts. After performing a literature survey, the approach is to choose candidate fluidic system(s), design the system, build a breadboard device and test in laboratory conditions, and fabricate the operational device. Wind tunnel and field test will be made.
Keywords: fluid flow; flowmeters; design; testing; fabrication; coal; natural gas; petroleum; gaseous wastes.

73582 Sampling Analysis Techniques for Pollutants from Mobile Sources. Bradow, R.L. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-043. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to manage, administer, and conduct research to develop sampling and analytical techniques for the identification and measurement of pollutants from mobile source. The mobile source testing facility at Research Triangle Park is used; improved vehicle driving simulation is employed; and new instruments, sampling and analysis technologies, and methodologies for measuring mobile emissions are developed.
Keywords: mobile pollutant sources; sampling; air pollution; quantitative chemical analysis; qualitative chemical analysis; automobiles; efficiency; emission; exhaust gases.

73583 Design and Development of a Field Prototype Monitor for Sulfuric Acid Vapor in Stationary Sources. Pearson, E. (Laser Analytics, Inc., 25 Wiggins Avenue, Bedford, MA, 01730). **Project number:** G712B-BA-072A. **Contract:** 68-02-2290. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

This task provides for the design and fabrication of a research field prototype instrument capable of measuring sulfuric acid vapor in flue gases. The H2SO4 monitor will be used in characterization studies of sulfate emissions from various industrial sources. The proposed H2SO4 monitor will be in-situ measurement system employing a diode laser spectroscopic technique.
Keywords: sulfuric acid; measuring instruments; vapors; flue gas; laser spectroscopy; sulfates; coal; combustion; oils; gas analysis; fabrication; design.

73584 Development of Remote Particle Size Method for Smoke Stack Emissions. Euthe, E. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** G712B-BA-090. **Contract:** 68-02-3267. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective of this project is to develop methodology for remote measurement of the mean particle sizes of smoke-stack emissions. A laboratory study will examine the applicability of multiwavelength lidar to particle size measurement. Lidar transmission and backscatter measurements at selected wavelengths will be made on artificially generated aerosols of different size.
Keywords: particle size; remote control; measuring instruments; optical radar; aerosols; coal; combustion; stack disposal; design.

73585 Design and Fabrication of a Monitor for HCL Emissions in Stationary Sources. (Environmental Data Corp., 608 Fig Avenue, Monrovia, CA, 91016). **Project number:** G712B-BA-091. **Contract:** 68-02-3286. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

This task provides for the design and fabrication of an HCL monitor which will be used for characterization studies at refuse burning steam generating facilities. The proposed HCL monitor is of the in-situ type and employs the gas-filter correlation measurement technique.
Keywords: design; fabrication; refuse-fueled power plants; sulfur compounds; energy conservation; hydrochloric acid; monitoring; gas analysis; gas meters.

73586 *Identification of Compounds in Particulate Pollutants by X-Ray.* Birks, L.S. (Naval Research Lab., 4555 Overlook Ave. SW, Washington, DC, 20375). **Project number:** G712B-BA-062. **Contract:** D8-V0229. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to investigate the capabilities of x-ray diffraction analysis techniques for the identification and analysis of airborne particles. Attempts will be made to apply cauchois and/or Seemann-Bohlin optics for diffraction analysis of filter-deposited samples.
Keywords: particles; air pollution; x-ray diffraction; aerosols; filters; sampling; structural chemical analysis.

73587 Identification and Measurement of Inorganic Compound Emissions. Henry, W.M. (Battelle Columbus Labs., Columbus, OH, 43201). **Project number:** G712B-BA-100. **Contract:** 68-02-2296. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to develop, evaluate, and test methods for identification of specific inorganic compounds in particulate emissions from stationary sources. Several methods will be coupled. Subtractive Fourier transform infrared, elemental analysis, and x-ray diffraction are the major approaches.
Keywords: stationary pollutant sources; quantitative chemical analysis; particles; emission; x-ray diffraction; fourier transformation; measuring methods; nonmetals; sulfur compounds; air quality; aerosols; air pollution.

73588 Instrumentation for Aerosol Sampling and Analysis. Jaklevic, J.M. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** G712B-BB-072. **Contract:** D9-X0712. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to provide funding for developing an improved x-ray fluorescence analyzer, a portable sulfur analyzer, and an improved aerosol size fractionator. The TAPS dichotomous sampler data will be edited. The approach is to (1) fabricate and deliver an improved x-ray fluorescence spectrometer for analyzing aerosol deposits on teflon filters; (2) fabricate and deliver a sulfur analyzer and a sampler that can be used to determine particulate sulfur aerosol particles smaller than 2.5 micron diameter; (3) prepare a final data tape that includes all of the elemental and mass analyses that were performed on the dichotomous samplers used in the RAPS; and (4) develop a fully engineered and tested, low cost aerosol size fractionator that can be used to sample particles in the 0 to 2.5 micron and 2.5 to 15 micron size range independent of wind speed ranging from 0 to 20 km/hr.
Keywords: aerosol monitoring; sampling; samplers; aerosols; design; chemical analysis; sulfur compounds; inorganic compounds; coal; gas analysis.

73589 Identification and Characterization of Emissions from Stationary Sources. Nader, J.S. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-005. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to manage, administer, and conduct research programs on methods and instrumentation for the identification and characterization of pollutants from stationary sources. Research is to be conducted on particle mass, size, composition, and capacity for particulates and on gases and odors for gaseous emissions specified in criteria documents, state implementation plans, and current and future federal emission standards.
Keywords: stationary pollutant sources; air pollution; particle size; mass; chemical composition; odor; air pollution monitors; monitoring.

73590 Task Order to Support Stationary Source Particulate Emissions Characterization. Dewees, W.G. (PEDCO Environmental, Inc., 11499 Chester Rd., Suite 13, Cincinnati, OH, 45256). **Project number:** G712B-BC-027. **Contract:** 68-02-2811. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide contract service to support in-house field studies in particulate emission characterization. The approach will be to sample with the characterization sampling train at various stationary sources. The collected samples will be further analyzed in the laboratory for chemical and physical characterization.
Keywords: particles; chemical properties; physical properties; pollution sources; sampling.

73591 Electro-Optical Techniques for the Identification and Characterization of Air Pollutants. Herget, W.F. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-032. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives are to manage, administer, and conduct research programs on the application of electro-optical instruments and systems for the identification and characterization of air pollutants from stationary and mobile sources. The morphology and elemental composition of particles emitted from sources is determined by transmission and scanning electron microscopy in conjunction with electron diffraction and microprobe measurements. High resolution infrared emission and long-path adsorption spectroscopy, laser-Doppler velocimeter and other remote sensing instruments are used.
Keywords: air pollution; stationary pollutant sources; mobile pollutant sources; research programs; measuring instruments; chemical composition; particles; scanning electron microscopy; electron diffraction; electron microprobe analysis; infrared spectra; absorption spectroscopy; velocimeters; remote sensing; monitoring; emission spectroscopy.

73592 Characterization of Emissions from Advanced Automotive Power Plant. Hare, C.T. (Southwest Research Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, TX, 78228). **Project number:** G712B-BC-044. **Contract:** 68-02-2703. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate emissions of regulated and currently unregulated pollutant substances in the exhaust of five vehicles having advanced concept power plants. Analyses involve a wide variety of gaseous and particulate components with some new methods developed. Engines being tested include gas turbines, sterling cycle, turbocharged diesel, Rankine cycle, and stratified charge. The basic approach includes initially qualifying analytical methods and procedures for use with distillate fueled cars. These methods would cover virtually all pollutant substances found to date in any automotive source plus several hypothesized compounds. Subsequently, a number of vehicles would be studied to include all advanced engineering prototype engines available at the beginning of the run window.
Keywords: classification; automobiles; exhaust gases; automotive fuels; gas turbine engines; rankine cycle engines; stratified charge engines; diesel engines; chemical analysis; monitoring; air pollution.

73593 Study of Emissions from Trucks Over Transient Driving Cycles. Dietzman, H.E. (Southwest Research Inst., 8500 Culebra Rd., P.O. Drawer 28510, San Antonio, TX, 78284). **Project number:** G712B-BC-040. **Contract:** 68-02-2993. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to characterize a variety of currently unregulated emissions, both gaseous and particulate in state, over transient driving schedules simulated by a chasssis dynamometer. Gaseous emissions to be measured include individual hydrocarbons, HCN, N2O, and sulfur compounds. Particulate analysis includes extractable organics, molecular weight distributions, BAP, and Ames assay. A series of six diesel and gasoline trucks have been selected to represent current in-use heavy duty trucks. These will be studied using a heavy duty truck chassis dynamometer and ultra-CVS sampling device recently installed in the SWRI facility. The dynamometer test schedules include simulations of Los Angeles and New York local traffic and freeway driving routes. The basic goal is to obtain as complete as possible characterization of unregulated emissions from heavy duty trucks.
Keywords: trucks; exhaust gases; aerosols; air pollution; hydrocarbons; hydrocyanic acid; nitrous oxide; sulfur compounds; diesel fuels; gasoline; molecular weight; dynamometers; monitoring; mutagen screening.

73594 Northrop Support Service to Stationary Source Emission. Stekeleather, J.; Dellenger, B. (Northrop Services, Inc., P.O. Box 12313, Research Triangle Park, NC, 27709). **Project number:** G712B-BC-026. **Contract:** 68-02-2566. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

Northrop Services, Inc., operates and maintains facilities at EPA's Environmental Research Center, Research Triangle Park, NC, and provides the following technical services to the Environmental Sciences Research Laboratory, Stationary Source Emissions Branch: (1) operation and maintenance of the Simulated Stationary Source Facility; (2) field and laboratory studies in gaseous stationary source emissions; and (3) field and laboratory studies in particulate stationary source emissions.
Keywords: stationary pollutant sources; bench-scale experiments; air pollution; aerosols; gases; particles; monitoring; simulation.

73595 Identification and Characterization of Emission from Mobile Sources. Bradow, R.L. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-036. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to manage, administer, and conduct research programs on methods and instrumentation for the identification and characterization of pollutants from mobile sources. The mobile source testing facility at Research Triangle Park (RTP) is used to identify and characterize emissions from passenger cars and trucks, focusing on diesel engines. Effects of new fuels, new control systems, and emission control strategies are assessed.
Keywords: mobile pollutant sources; automobiles; trucks; diesel engines; exhaust gases; automotive fuels; monitoring; air pollution; air pollution control; planning.

73596 Study and Collect Particle Emissions from Turbocharged Rabbit Diesel. John, R.R. (DOT, 55 Broadway, Kendall Square, Cambridge, MA, 02142). **Project number:** G712B-BE-020. **Contract:** 68-02-3275. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to create a documented sample of particulate matter from the DOT-prototype turbocharged automobile for purposes of health-effects experimentation. The general objective is to produce sufficient material to permit a complete battery of mutation and carcinogenesis bioassays to be performed. The results of these bioassays would, then, permit comparison of a variety of production and prototype diesel-engine power vehicles with respect to their ability to produce cancer-causing chemical emissions. The general approach involves a quick survey of particle emissions from the turbocharged vehicle over a range of driving cycles, selection of appropriate conditions for large volume collection, then collection of particulate material sufficient to provide at least 50 grams of particle organic extract for use in biological experiments.
Keywords: diesel engines; exhaust gases; particles; sampling; chemical composition; sample preparation.

73597 Study of Secondary Formation Products in a Power Plant Scrubber Plume. (Radian Corp., 8500 Shoal Creek Blvd., P.O. Box 9948, Austin, TX, 78760). **Project number:** G712B-BE-021. **Contract:** 68-02-3273. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The study of gas-to-particle conversion processes in a mixed (scrubber/unscrubbed) plume situation is the objective of this project. An instrumented airplane will be used to make measurements of gaseous and aerosol species in a power plant plume as a function of time (downwind distance). In particular sulfate and nitrate formation rates will be determined.
Keywords: aerial monitoring; plumes; fossil-fuel power plants; scrubbers; aerosols; sulfates; nitrates; atmospheric chemistry.

73598 Atmospheric Processes Affecting Airborne Organic Toxic Substances. Hanst, P.L.; Bufalini, J. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G760C-DA-005. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to: (1) describe and determine the formation and persistence of toxic organic chemcial substances in the atmosphere; (2) assess the effects of selected bromohalocarbons on the stratospheric ozone layer; (3) manage, administer, and conduct research programs; and (4) provide technical assistance to OTS. Field measurements at selected urban and industrial atmospheres will provide concentration levels to be evaluated against sources, meteorology, and transformation processes. Long path FTIR will be used to assess degradation rates.
Keywords: toxic materials; organic compounds; organic bromine compounds; urban areas; industrial wastes; ozone; stratosphere; atmospheric chemistry; meteorology; environmental impacts; monitoring.

73599 Diesel Emissions Research. Bradow, R.L.; Black, F.M.; Tejada, S. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G815B-CA-020. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to manage, coordinate, and conduct research on the characterization of unregulated automobile pollutants, diesel exhaust and exposure assessment. Chassis and engine dynamometers will be used for characterization work. Large samples of diesel particulate mass will be generated for health effects studies.
Keywords: automobiles; exhaust gases; diesel fuels; aerosols; biological effects; classification.

73600 Management and Coordination of Energy Transport Studies. Dimtriades, B.; Niemeyer, L.E.; Wagman, J. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G832B-EA-010. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to manage, administer, coordinate, and conduct research on the chemical, physical, and meteorological processes affecting the transport and fate of energy related pollutants in the atmosphere. Field studies are carried out to assess the transport and transformation of pollutants, focussing on particulates, sulfates, nitrates, and their effects on visibility. Secondary organisms are also studied, particularly from second generation fossil fuel technologies.
Keywords: atmospheric chemistry; air pollution; particles; aerosols; nitrates; sulfates; visibility; biological effects; environmental effects.

73601 Assessment and Emission Characterization of Major Fossil Fuel Power Plants in the Ohio River Valley. Mason, W. (PEDCO-Environmental, Inc., Cincinnati, OH, 45256). **Project number:** G832B-EA-130. **Contract:** DU-79-B084. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The study will characterize the atmospheric emission from five major coal-fired power plants in the Ohio River Valley. This characterization will provide data which is representative of the boiler-fuel-emission control combinations of the current power plant population as well as those scheduled to go on-line before January 1983. Three conventional power plants and two units equipped with

SO2 scrubbers will be studied. Five days of measurements are planned at each source.
Keywords: fossil-fuel power plants; emission; ohio valley region; air pollution; sulfur dioxide; scrubbers; monitoring; stacks; plumes; chemical composition.

73602 Analysis and Characterization of Organic Carbon Compounds in Atmospheric Particulate Matter. Freiser, H.; Moyers, J. (Univ. of Arizona, Tucson, AZ, 85721). **Project number:** G832B-EA-146. **Contract:** DU-79-B104. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop reliable and universally applicable methodology for the analysis of the multitude of organic compounds associated with particulates collected on both teflon dichotomous filters and glass fiber-hi-vol filters. The approach is to investigate the use of selective solvent extraction coupled with high performance liquid chromatography and total carbon instrumentation in separating the organic fraction into classes and subsequently into individual species.
Keywords: organic compounds; particles; air pollution; chemical analysis; solvent extraction; liquid column chromatography; carbon.

73603 Ion Chromatographic Analysis of Aromatic Amines. Frohliger, H. (Univ. of Pittsburgh, 4200 5th Ave., Pittsburgh, PA, 15260). **Project number:** G832B-EA-164. **Contract:** 68-02-3271. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop ion chromatographic techniques for the analysis of aromatic amines. Column technology along with uv detection of aromatic amines is developed.
Keywords: chromatography; amines; aromatics; ultraviolet spectrometers; coal; combustion products; air pollution; air quality.

73604 Development of a Portable Miniature Collection System for the Exposure Assessment of Carcinogens, Precarcinogens and Cofactors. Brooks, J. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayton, OH, 45407). **Project number:** G632B-EA-185. **Contract:** 68-02-3285. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to develop a miniaturized personal sampler for the genotoxic vapors and to develop a screening technique for the important genotoxic families. Several commercially available solid absorbents for the collection of organic carcinogenic vapors will be evaluated for collection efficiency breakthrough times, etc. Portable collection devices using solid absorbents and analytical methodology for subsequent analysis of collected carcinogens will be developed. Test methodology will be developed under field conditions.
Keywords: personnel; samplers; vapors; toxic materials; organic compounds; carcinogens; monitoring; sulfur compounds; nitrogen compounds; carbon oxides; aerosols; design; safety.

73605 Management and Coordination of Instrument Development for Energy-Related Pollutants. Stevens, R.; Mulik, J. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G833D-EB-001. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to manage, administer, coordinate, and conduct research to develop instrumentation for the measurement of energy-related pollutants in ambient air. Pollutants of interest include particulate sulfates and nitrates, size fractionated particulate matter, specific inorganic particulates, organic vapors, trace metals, and sulfuric and nitric acids. Field studies for the testing and comparison of measurement systems will be made. New software programs for GCMS data evaluation will be developed. Raman scattering method for real time analysis of ambient particulates will be presented.
Keywords: monitoring; equipment; pollution control equipment; design; nitric acid; sulfuric acid; particles; data acquisition systems; organic compounds; inorganic compounds; sulfur compounds; nitrogen compounds; aerosols; elements; trace amounts; metals; us epa.

73606 Management and Coordination of Stationary Source Energy Pollutant Studies. Nader, J. (EPA, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G83D-EB-002. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to manage, administer, coordinate, and conduct research on the development of instrumentation to measure pollutant emissions from stationary source energy technologies. Prototype instrumentation will be developed to measure H2SO4 vapor emissions from combustion sources. Laser Raman monitoring of sulfur oxides in stack emissions will be made, and an aerosol mass distribution monitor will be developed and evaluated.
Keywords: stationary pollutant sources; air pollution; sulfuric acid; vapors; air pollution monitors; sulfur oxides; stack disposal; monitoring; lasers; raman effect; mass; distribution.

73607 Develop Multi-Residue Analysis for 20 of the Most Significant Carcinogens and Screening Techniques for Classification. McMillan, C. (Monsanto Research Corp., 1515 Nicholas Rd., Box 8, Dayton, OH, 45407). **Project number:** G833D-EB-018. **Contract:** R805427-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to identify 20 of the most significant suspected atmospheric carcinogens that are produced in high volume and develop analytical methodology for their analysis. The approach is performed in high volume chemicals that are carcinogens or suspected carcinogens. From this survey, 20 chemicals are to be selected for development of methods for their subsequent collection and analysis.
Keywords: carcinogens; air pollution; chemical analysis; classification; environmental impacts; monitoring; planning.

73608 Study of Particulate Emissions from Motor Vehicles: Report to Congress. Hare, C.T. (Southwest Research Inst., 8500 Culebra Rd., San Antonio, TX, 78284). **Project number:** G712B-BC-050. **Contract:** 68-02-2951. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are: (1) to conduct a study of the emissions rates of particulate matter from motor vehicles; (2) to estimate ambient air impact; and (3) to estimate ultimate influence on the public health and welfare. Subsequently, an informational report will be sent to Congress on the results of that study according to the requirements of Section 214 of the 1977 CAAA. No experimental work is involved. The approach is to summarize available emissions factors from the literature and, from these, estimate emissions inventories for the United States as a whole and for several metropolitan areas. Using dispersion models and surrogates, impacts on ambient air quality for the study cities and for a few specific local exposure situations are calculated. A literature survey of health and welfare effects to be expected from exposure to the pollutant compounds determined to be present in mobile sources particles will be prepared and compared to projected ambient air levels.
Keywords: automobiles; trucks; exhaust gases; public health; monitoring; air pollution; usa; mathematical models; aerosols; aerosol monitoring.

73609 Kinetics and Mechanisms of Nitrate Formation in Photochemical Smog. Spicer, C.W. (Battelle Memorial Inst., Columbus, OH, 43201). **Project number:** G832B-EA-145. **Contract:** R805812-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this work are: (1) to determine the fate of NOx in the atmosphere, and (2) to conduct modeling and atmospheric studies to site 5 research monitoring stations for nitrates, organics, and sulfates in the Ohio River Basin. The fate of NOx will be determined in smog changers that simulate actual atmospheric conditions. Experiments will be performed on NO/NOx mixtures for the specific purpose of identifying the chemical and physical removal processes of NOx. Region transport/transformation modeling will be conducted to identify areas that will be measurably impacted by the operation of new power plants on the Ohio River. Aerial profiling of pollutant concentrations will be done to demonstrate that sites are not under local influence.
Keywords: nitrates; photochemical oxidants; kinetics; atmospheric chemistry; smog; mathematical models; sulfates; organic compounds; ohio valley region; aerosol monitoring; environmental transport; fossil-fuel power plants; aerial monitoring; environmental impacts; air pollution control.

74500 Conduct Interlaboratory Performance Studies. Jarvis, A.N. (EPA, Office of Research and Development, Quality Assurance Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J801A-003. **Supported by:** Environmental Protection

Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$129,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to ensure precision and accuracy of environmental measurements in order that EPA policy decisions are based on valid and comparable data of known reliability. This will be accomplished by conducting interlaboratory performance studies and preparing reports to advise monitoring progams and laboratory directors of analytical problems. Interlaboratory performance studies are being conducted with federal, state, university and private laboratories. An ongoing laboratory intercomparison studies program, involving environmental media (milk, water, air, food, soil and gases) and a variety of radionuclides was conducted. Approximately 2000 samples of known activity levels were distributed to the 180 participating laboratories for analyses. Assessment of the precision and accuracy of radioactive measurements has been made and computerized reports sent to participants at monthly and/or quarterly intervals. Two laboratory performance evaluation studies (blind sample) in support of the National Interim Primary Drinking Water Regulations were conducted.
Keywords: hot labs; performance testing; comparative evaluations; reliability; monitoring; environment; pollution; radiochemical analysis; drinking water; standards.

74501 Groundwater Research Monitoring of Energy-Related Developments Sampling Frequency for Water Quality Trend Analysis. Harmeson, R.H. (Illinois State Water Survey, Box 232, Urbana, IL, 61801). **Project number:** J801A-006. **Contract:** R804337-02. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$196,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop a statistical base for evaluating the necessary frequency of sampling and analysis for data collection designed to assure accuracy in determining short-term trends in water quality in streams and lakes. Conversely, we will determine the average percent deviations for sampling intervals greater than daily. Daily sampling, both grab and composite, will be conducted at 6 stream sampling sites and 3 lake sites. These samples will be analyzed for 17 parameters. Data will be related to watershed size, stream flow characteristics, physiographic features, and climatology. For lakes, the data will be related to size, depth area, characteristics of the drainage area, and climatology. Final output will be in the form of a report on percent deviations determined from the median 1-, 2-, 3-, 4-, 5-, 7-, 14-, 30-day and annual sampling frequencies.
Keywords: ground water; research programs; monitoring; sampling; water quality; energy source development; environmental impacts; surface waters.

74502 Monitoring Guidelines for H2S and Non-Condensible Hazardous Gases. (EPA, Environmental Monitoring and Support Lab., Las Vegas, NV, 89114). **Project number:** J827B-003. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide input into a multi-media geothermal resource monitoring strategy. A two-year program to collect meteorological and air quality data will be conducted at Roosevelt Hot Springs KGRA. An aerometric measurement network has been established and supplemented with seasonal air sampling and measurements for H2S, SO2, NH3, and CH4.
Keywords: hydrogen sulfides; monitoring; air pollution; gaseous wastes; hazardous materials; roosevelt hot springs; sulfur dioxide; ammonia; methane.

74503 Monitoring Guidelines for H2S and Non-Condensible Hazardous Gases. Woodard, R.N. (Northrup Corp., Northrup Services, 4220 S. Maryland Parkway, La Plaza Building, Las Vegas, NV). **Project number:** J827B-02. **Contract:** 68-03-2591. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$100,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

This research effort is undertaken to provide input to a multimedia monitoring strategy for assessing the impact on the environment of geothermal energy development. A two-year field program to collect meteorological and air quality data at the Roosevelt Hot Springs geothermal resource area has been established. An aerometric measurement network for gathering wind speed and direction has been set up at five sites in the area. Four seasonal intensive study periods of two weeks duration each will be conducted to collect data on concentration levels of H2S, SO2, O3, NH3, and CH4. Total suspended particulates will be measured and the samples analyzed by x-ray emission spectroscopy. Pibal data will be collected during the intensive study periods. Baseline data will be established for the design of air monitoring networks for geothermal energy development. Wind speed and direction has been collected from five sites in the area since November 1977. This data is being reduced to wind roses and tabular form as collected. Two air intensive studies have been made. Reports of these studies are being prepared.
Keywords: hydrogen sulfides; geothermal energy; environmental impacts; sulfur dioxide; ozone; ammonia; methane; aerosols; meteorology; wind; velocity; baseline ecology; air quality; monitoring; ecological concentration; roosevelt hot springs; utah; geothermal fields.

74504 Monitoring the Impacts or Geothermal Development on Groundwater Systems. Hess, J. (Univ. of Nevada, 4505 S. Maryland Pkwy., Las Vegas, NV, 89154). **Project number:** J827B-060. **Contract:** R806457. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

The objective is to validate published guidelines for monitoring the impact of geothermal resource development in groundwater systems. These guidelines will be applied to the Roosevelt Hot Springs, Utah, KGRA over a four year period.
Keywords: ground water; geothermal energy; environmental impacts; monitoring; recommendations; roosevelt hot springs; utah; water quality.

74505 Development of a Strategy for Monitoring Contamination of Plants, Animals, and Soils by Studying Areas in Roosevelt Hot Springs, Utah. Potter, G.D. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J827B-064. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$75,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a biological monitoring strategy by making a biological baseline assessment for Roosevelt Hot Springs Geothermal Resource Area, and by collecting and analyzing plants, animals, and soils for pollutants known to exist in geothermal effluents. Species and populations will be identified. A report on recommended biological monitoring strategy to be used by federal, state, and local governments to monitor the effects of geothermal resource development will result.
Keywords: utah; terrestrial ecosystems; monitoring; contamination; baseline ecology; imperial valley; geothermal energy.

74506 Development of a Strategy for Monitoring Contamination of Plants, Animals, and Soils by Studying Areas in Roosevelt Hot Springs. Alexander, G. (Univ. of California, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** J827B-065. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to analyze plant and soil samples collected in and near the Roosevelt Hot Springs geothermal research area for 26 trace elements. Analyis of plants and soil samples will be completed by optical emission spectrometry and atomic absorption spectrometry. One-quarter of the estimated sample load of 9000 samples have been analyzed and data reported to the principal investigators.
Keywords: contamination; environmental effects; quantitative chemical analysis; plants; animals; soils; geothermal energy; environmental impacts; baseline ecology; roosevelt hot springs; ecology.

74507 Air and Water Monitoring Guidelines for Advanced Coal Conversion and Combustion Plants. Garlauskas, A. (Dalton-Dalton-Little-Newport, 3605 Warrensville Center Road, Cleveland, OH, 44122). **Project number:** J833C-061. **Contract:** 68-03-2755. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

This program is designed to develop preliminary guidelines for environmental pollutant monitoring strategies or systems applicable to commercial scale operations of the following types of processes: (1) fluidized bed combustion, (2) low Btu gasification (surface and in situ), (3) high Btu gasification, (4) coal liquefaction, and (5) in situ oil shale conversion. These guidelines will be formulated by compiling existing information on the processes, extrapolating this to commercial scale and then choosing or designing the appropriate monitoring techniques. The final output will be a report on monitoring guidelines for in situ oil shale, low and high Btu gasification, coal liquefaction, and fluidized bed combustion.
Keywords: air quality; water quality; monitoring; coal industry; environmental impacts; coal liquefaction; coal gasification; oil shale industry; fluidized-bed combustion.

74508 Validation of Groundwater Quality Methodology in an Area of Intensive Energy Development. Mullican, J.W. (Texas State

Dept. of Water Resources, P.O. Box 13087, Austin, TX, 78711). **Project number:** J833C-064. **Contract:** 68-03-2705. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of this project, as a continuation of an existing program, is to complete verification of an optimum methodology for monitoring groundwater quality developed for EPA by General Electric-Tempo. The methodology is a series of 15 procedural steps designed to lead to the most effective groundwater quality monitoring program for a selected area. The initial steps, concerned basically with area characterization and pollutant identification, are completed. This project will complete the remaining steps which can be divided into three major parts as follows: (1) evaluate mobility of pollutants previously identified and prioritize pollutants and pollution sources; (2) select appropriate monitoring system considering all on-going programs; and (3) initiate monitoring program, review results, and adjust program as necessary. The 15-step methodology for design and implementation of groundwater quality monitoring systems was developed by. EPA to provide guidance to agencies required by recent federal legislation to enter into such activities. This project will establish the practicability of the monitoring system design methodology and will assess feasibility of large scale implementation of the program.
Keywords: ground water; water quality; energy source development; measuring methods; monitoring; optimization.

74509 Energy-Related Radiological Pollutant Monitoring and Techniques Development. Hahn, P.B. (EPA, Office of Research and Development, Methods Development and Analytical Support Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J833C-066. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$75,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objectives are to: (1) develop techniques to monitor potentially hazardous radiological effluents and emissions from nuclear fuel cycle facilities and characterize the physical and chemical properties of discrete particles emitted by selected energy-related facilities; (2) recommend and collaboratively test analytical methods for the measurement of plutonium in soil and air, including the development of appropriate reference materials for calibration and methods evaluation; and (3) perform individual particle characterizations using state-of-the-art micro-analytical techniques such as electron microscopy, electron microprobe, x-ray spectrometry, ion microprobe mass analysis, x-ray and electron diffraction and photographic and track etch autoradiography to determine size, shape, elemental and radiochemical composition, and chemical form of elements in individual particles. Reports evaluating a fusion and an acid dissolution method for measuring plutonium in soil have been published. A report describing the characterization of emissions from plutonium-uranium oxide fuel fabrication has demonstrated the utility of several micro-analytical techniques which fill gaps in the information obtained in conventional environmental and source monitoring for particulates. Sample collection for the characterization of emissions from coal-fired power plants is in progress.
Keywords: radioactive effluents; monitoring; plutonium; soils; air; measuring methods; radioactive aerosols; particles; fossil-fuel power plants; health hazards; uranium; fuel fabrication plants.

74510 Energy Related Overhead Monitoring. Shelton, G. (EPA, Office of Research and Development, Remote Sensing Operations Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J833C-071. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$225,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to establish preliminary guidelines for, and demonstrate overhead remote monitoring of, western energy related activities, including computer processing procedures for locating, mapping, and quantifying energy resource extraction activities. A NASA/EPA cooperative western energy monitoring program has been established to define, demonstrate, and develop operational remote sensor techniques to monitor, in a cost effective manner, energy related extraction site rehabilitation, including determination of environmental baselines for establishing rehabilitation criteria and environmental effects. Accomplishments thus far include: (1) operational multispectral scanning data acquisition and digital data processing system for assessing environmental impact of energy related activities; (2) publication of a joint EPA/NASA report, Western Energy Related Overhead Monitoring Project; and (3) publication of research report, Guide to Preselection of Training Samples and Ground Truth Collection.
Keywords: remote sensing; aerial monitoring; maps; energy source development; environmental impacts; data acquisition; coal; oil shales; energy sources; baseline ecology; site selection; usa; western region.

74511 Four Corners Ambient Air Monitoring Network. Smith, D.E. (UTE Research Lab., Box 119, Fort Duchesne, UT, 84026). **Project number:** J833C-074. **Contract:** 68-03-2345. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$175,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are: (1) to maintain an air quality monitoring network in the Four Corners area to evaluate the present and future air quality impact of energy-related developments in the western United States; and (2) to integrate the air quality monitoring data collected by this network with data collected elsewhere. A 18-station hi-vol network is operated over the Four Corners region. A 24-hour sample is collected three times per week. Each sample is analyzed for trace elements (Pb, Cr, Cu, Ni, Fe, and Cd), sulfate, nitrate, and total suspended particulate. All data are entered into the EPA Saroad system.
Keywords: earth atmosphere; monitoring; air quality; western region; data analysis; lead; chromium; nickel; iron; cadmium; sulfates; nitrates; aerosols; particles; baseline ecology; ecological concentration.

74512 Regional Visibility: The Colorado Plateau. Pitchford, M. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J833C-079. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop background visbility data necessary for (1) setting visibility standards, and (2) validation of visibility models. A 14- to 30-station network of visibility monitoring stations is being established on the Colorado Plateau to develop a uniform regional data base on visbility in the western energy resource development area. Stations will be instrumented with telephotometers, and some with nephelometers, particulate samplers, and meteorological instruments. Six months of baseline data have been collected from 14 stations.
Keywords: colorado; air quality; baseline ecology; regional analysis; visibility; monitoring; aerosol monitoring.

74513 Aerial Remote Sensor Data Collection, Processing, and Analysis for Environmental Monitoring. Donaldson, J.R. (Lockheed Electronics Co., Las Vegas, NV, 89114). **Project number:** J833C-080. **Contract:** 68-03-2636. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to provide continuing on-site, nonpersonal services support to the remote sensing program operational and research/development at the EPA Environmental Monitoring and Support Laboratory-Las Vegas. The approach includes: remote sensor data acquisition, reduction and processing image analysis, preparation of output products, work in electronic data processing concerns technique development, and the operation and maintenance of the digital image analysis system. Support is provided in the development of active type airborne monitoring systems. The contractor is presently completing its fifth year of support.
Keywords: remote sensing; information centers; data processing; air pollution.

74514 Trace Element Analysis of Particulate Samples. Cahill, T. (Univ. of California, Davis, CA, 95616). **Project number:** J833C-082. **Contract:** 68-03-2669. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide trace element analysis of particulate samples collected from ambient air sampling stations in the Western Energy Resource Development area and for other special EPA air quality studies. Gravimetric and particle-induced x-ray analysis will be used.
Keywords: air pollution; air samplers; particles; elements; trace amounts; aerosols; gravimetric analysis; x-ray emission analysis; monitoring; air quality.

74515 Fine Particulate Monitoring in the Western Energy Resource Development Area. Cahill, T. (Univ. of California, Davis, CA, 95616). **Project number:** J833C-083. **Contract:** R806459-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to establish a baseline of air ambient fine particulate data in the Western Energy Resource Development area.

A 40-station fine particulate sampling network will be deployed over the states of Arizona, New Mexico, Colorado; Utah, Wyoming, North Dakota, Montana, and South Dakota. The mass and elemental composition of aerosols in two size ranges (less than 2.5 micron, less than 15 micron) will be determined on the twice-weekly samples at each station. Correlations will be developed with meteorological data and other air quality measurements (e.g., visibility).
Keywords: aerosols; particles; monitoring; western region; aerosol monitoring; particle size; arizona; new mexico; colorado; utah; wyoming; north dakota; montana; south dakota; air quality; optimization.

74516 Evaluation of Statistical and Economic Factors in the Design of Water Quality Monitoring Networks. Ward, R.C. (Colorado State University, School of Engineering, Department of Agricultural and Chemical Engineering, Fort Collins, CO, 80523). **Project number:** J833C-062. **Contract:** R805759-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$13,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is one of developing improved criteria for the design of routine stream quality monitoring networks. The networks of concern are those operated primarily at the state level for the purpose of determining annual means and long-term trends of the pertinent water quality parameters. The design criterion chosen for this study is one of achieving reasonably small confidence intervals while maximizing the degree of uniformity in information content supplied by the various stations in the network relative to estimating annual means. The width of the confidence interval is a statistically sound measure of the precision of an estimate of an annual mean, and is a statistical tool which personnel in state water management agencies should find easy to understand and practical to apply. No data will be collected as a part of this project. However, water quality data collected by others will be analyzed in the course of the project. A report on improved procedures for incorporating statistics and economics into the design of regulatory water quality monitoring networks will be published. A paper, Statistical Tradeoffs in Monitoring Network Design, was presented at the AWRA Symposium--Establishment of Water Quality Monitoring Programs, San Francisco, in June, 1978.
Keywords: water quality; monitoring; design; seasonal variations; data analysis.

74517 Monitoring the Impact of Western Coal Strip Mining and Oil Shale Extraction on Groundwater Quality. Everett, L. (General Electric Co., 735 State Street, Santa Barbara, CA, 93101). **Project number:** J833C-065. **Contract:** 68-03-2449. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$350,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop and field validate a strategy for monitoring groundwater changes that are occurring or could potentially occur as a consequence of strip mining of coal, modified in-situ development of oil shale, and mining and surface retorting of oil shale. The approaches are to select study areas that have problems that are fairly representative of these energy developments in the West, identify potential pollutants, prioritize pollutant sources, design a most appropriate monitoring system for the study areas, and then test that system by field tests over a sufficient time period. Reports will be prepared as guidance documents for use in designing and operating monitoring systems.
Keywords: coal mining; surface mining; oil shale industry; ground water; water quality; environmental impacts; monitoring; oil shales; in-situ processing; water pollution.

74518 Energy Related Water Monitoring Data Integration. Thomas, R.W. (EPA, Office of Research and Development, Water and Land Quality Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J833C-073. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$99,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to establish a water monitoring network throughout the western United States to monitor and assess the impact of energy resource development. Through the use of computer data banks, primarily STORET, water monitoring stations that began operation in 1970 or before and are currently in operation, with a large number of reported parameters, were selected for incorporation into a primary monitoring net. Parameters of interest were identified and a quality assurance program is being established in participating laboratories. Historical data have been reviewed and baseline water quality conditions are being established. Reports discussing present and past water quality and evaluating and projecting the impact of energy resource developments will be published for use by Federal and state planning and management agencies.
Keywords: water quality; monitoring; usa; western region; energy source development; environmental impacts; baseline ecology.

74519 Regional Visibility: The Colorado Plateau. Walther, E.G. (John Muir Inst. for Environmental Studies, Inc., 743 Wilson Street, Napa, CA, 94558). **Project number:** J833C-076. **Contract:** R805788-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$20,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The project proposes to measure (and collect from others) background visibility data necessary for the setting of visibility standards and the validation of visibility models. A 14- to 30-station network of visibility monitoring stations is being established on the Colorado Plateau to develop a uniform regional data base on visibility in the Western Energy Resource Development area. Stations will be instrumented with telephotometers, and some with nephelometers, particulate samplers and meteorological instruments. Six months of baseline data from 14 stations have been collected.
Keywords: colorado plateau; visibility; air quality; aerosols; standards; measuring methods.

74520 Surface Water Monitoring Techniques Verification for Oil Shale Development. Kinney, W.L. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J833C-077. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$50,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

The objective is to test, validate, and describe a biological monitoring design appropriate for assessing alterations in water quality in surface waters to be potentially impacted by oil shale development. A study area in the White River was selected and various sampling techniques and designs were employed to obtain aquatic biota. Data obtained will be examined to determine optimum selection and frequency of sampling sites; necessary parameters; sampling frequency and intensity; field and laboratory methodologies; and data processing, reduction, analyses and presentation methods. A report addressing biological monitoring requirements for assessing the impact of oil shale development on aquatic ecosystems will be published for use by Region VIII and other monitoring agencies. The quantified traveling kick method of sampling has been demonstrated to be a preferred alternative to Surber net sampling in semi-arid western states' rivers and streams. Required sampling frequencies to adequately assess water quality have been determined.
Keywords: surface waters; monitoring; oil shales; energy source development; environmental impacts; water quality; usa; western region.

74521 Remote Instrumental Techniques for Monitoring Energy-Related Pollutants and Effects. Eckert, J.A. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., Remote Monitoring Methods Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J833C-078. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$125,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives are to assemble, test, and report on an operational Raman downwind-looking Lidar incorporating real time normalization of the Mie-scattered return using the Raman N2 return; and to demonstrate Raman normalized technique in pristine areas in the vicinity of energy resource development and establish historical data base. One solution to quantifying the airborne Lidar returns is to simultaneously measure the Raman return from N2 molecules and the scattered return from particulates. The N2 distribution is known, and thus Lidar returns made at different places and times can be compared. The Lidar system has been constructed for use as test frame in Raman N2 experiments. Software has been written to simulate Lidar returns for aid in system decision.
Keywords: monitoring; measuring methods; remote sensing; western region; pacific northwest region; air pollution; aerosols; particles; aerosol monitoring; environmental effects.

74522 Provide Quality Control Guidelines and Procedures Manuals. Jarvis, A.N. (EPA, Office of Research and Development, Quality Assurance Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J859A-001. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$35,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to produce guidelines and procedures manuals to be used by the EPA as quality control guides for radiochemical analysis of public drinking water. This will be accomplished by testing existing procedures, recommending new ones when appropriate, and compiling and publishing this information. In cooperation with other agencies we have published or assisted in publishing such documents as: A Handbook for Analytical Quality Control in Ra-

dioanalytical Laboratories; Quality Control for Environmental Measurements Using Gamma-Ray Spectrometry; Least-Squares Resolution of Gamma-Ray Spectra; Quality Assurance Guidelines for Biological Testing; and Mercury, Lead, Arsenic, and Cadmium in Biological Tissue--The Need for Adequate Standard Reference Materials. A report on Acid Dissolution Method for the Analysis of Plutonium in Soil is in print, and a guideline document on standard preparation is being prepared.
Keywords: drinking water; standards; quality control; radiochemical analysis; manuals; hot labs; recommendations.

74523 Testing and Validation of Measurement Methods. Jarvis, A.N. (EPA, Office of Research and Development, Quality Assurance Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J859A-002. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$106,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide valid measurement methods required to support EPA's regulatory standards and special environmental studies. This will be accomplished by the testing and validation of measurement methods and recommending the appropriate ones. Validated methods along with supporting test results will be submitted for consideration as approved EPA methods. Evaluation studies of two published methods for the measurement of radium-228 in water have been completed.
Keywords: measuring methods; standards; quality assurance; pollution; recommendations; water; radium 228; radiochemical analysis; performance testing; reliability.

74524 Development of Natural-Matrix Radioactivity Standards. Mann, W.B. (Center for Radiation Research, 14th and Constitution Ave., NW, Washington, DC, 20234). **Project number:** J859A-005. **Contract:** D6-0011. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The NBS will develop eight natural-matrix radioactivity standards over the next three years. These materials will be used for definitive test of environmental radioactivity monitoring procedures. The NBS will pulverize (if necessary), grind, sieve, homogenize, and package the natural-matrix radioactivity standards. The NBS will supply the Quality Assurance Branch, Monitoring Systems Research and Development Division, Environmental Monitoring and Support Lab., Las Vegas, with 200 samples (100 G/sample) of each of four of these standards.
Keywords: calibration standards; radioactivity; monitoring; quality control; us nbs.

74525 Develop Reference Samples and Materials. Jarvis, A.N. (EPA, Office of Research and Development, Quality Assurance Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J859A-057. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$106,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide a total quality assurance program for all radiation measurements and advanced monitoring techniques including biological research and exposure monitoring. This will be accomplished, in part, by maintaining an inventory of existing standards and reference materials for instrument calibration and chemical yield determinations and by developing new materials as required. These will be distributed to participating laboratories on a continuing basis. Standards and reference materials are being supplied to laboratories involved in environmental radiation measurements upon request. Approximately 1000 calibrated radionuclide solutions were distributed to user laboratories upon request. Traceability studies with the National Bureau of Standards were conducted and are continuing. Standard aqueous solutions of radium-228 were developed and are being distributed on a continuing basis, with accompanying decay scheme data, to laboratories upon request. Standards and reference materials are being supplied to other laboratories as requested. Approximately 1200 calibrated radionuclide solutions were distributed to user laboratories. Reference fly ash samples have been developed and are being characterized for radium-226 and radium-228.
Keywords: standards; radiation monitoring; bioassay; dosimetry; hot labs; quality assurance; radiochemical analysis; radium 228; drinking water; soils.

74526 Laboratory Evaluation, Performance Studies, and Assistance to Regions and States in Support of Public Drinking Water Act. Jarvis, A.N. (EPA, Office of Research and Development, Quality Assurance Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J859A-056. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$24,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

To comply with the provision of the National Interim Primary Drinking Water Regulations, research will consist of on-site laboratory evaluations and conduct of laboratory performance studies. The certification of laboratories analyzing public drinking water will result. At the request of the EPA regions, on-site laboratory evaluations were conducted and reports of findings were prepared for approximately 40 laboratories. Seminars were also conducted in several regions at the request of the regions. Interlaboratory performance studies required to support the acceptance criteria for certification of laboratories were implemented and are continuing.
Keywords: human populations; drinking water; chemical analysis; standards; education; implementation; pollution regulations; pollution laws; quality control.

74527 Hazardous Waste Monitoring Program. Holboke, L.E. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J877A-088. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of this program are to evaluate the sampling and analytical requirements described in the proposed regulations for hazardous waste and to initiate a quality assurance program to support the Agency's monitoring of these regulations. Proposed sampling procedures for identification of hazardous waste will be evaluated. Samples collected in accordance with the proposed regulations will be analyzed to determine reproducibility and acceptability of the procedures. Proposed extraction procedure/analytical methods will be evaluated. The proposed methods will be used to analyze typical wastes in accordance with the proposed regulations to determine their acceptability. Selected waste streams that are identified as hazardous waste in the proposed regulations will be analyzed for their toxic components. A quality assurance program to support the monitoring requirements of the proposed regulations will be initiated.
Keywords: hazardous materials; toxic materials; monitoring; waste management; environmental impacts; quality assurance; water pollution.

74528 Sulfur dioxide Pollution: Review and Assessment of Future Measurement Needs from Airborne Lidar. Copeland, C.E. (Old Dominion Univ., P.O. Box 6173, Norfolk, VA). **Project number:** J883A-037. **Contract:** R805017-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to obtain suitable software for simulating returns from planned or existing downward looking Lidar systems. Initial effort was focused on feasibility studies for constructing a pollutant specific Lidar for measuring SO2 but there was a need for more general simulation software applicable to other proposed or existing systems. The software will be used in a feasibility study considering normalization of Lidar backscatter with Raman N2 returns. The software has been written and debugged.
Keywords: sulfur dioxide; aerial monitoring; raman spectra; computer codes; remote sensing; optimization.

74529 Development of Environmental Keys. Webb, V. (EPA, Environmental Photographic Interpretation Center, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J883A-038. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$59,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to develop aerial photography interpretation keys as analysis aids for novice and experienced photo-interpreters, and to examine photography for environmental characteristics, impacts and trends. Using aerial photography collected for environmental assessment studies in support of EPA program and Regional Office, guideline reports and photo displays for training and reference material will be prepared that describe various environmental sites, areas, pollution sources, and environmental impacts. Photo interpretation guidelines on harbor pollution sources and detection of leachate from waste disposal sites have been completed.
Keywords: remote sensing; environment; data analysis; standards; aerial monitoring; land use; behavior; environmental transport; pollution; biological models; surface waters; environmental effects.

74530 Develop Airborne NADIR Laser for Molecular Pollutants in Troposphere. Thompson, R.T. (EPA, Environmental Monitoring and Support Lab., Remote Monitoring Methods Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J883A-039. **Support-**

ed by: Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to design, construct and interpret data from airborne NADIR-viewing, laser differential adsorption systems. A CO2 laser system will be developed to measure ozone. A frequency doubled dye laser system (approx. 300 mm) will be developed to monitor sulfur dioxide. The use of differential absorption systems to monitor selected tracer gases will be investigated. The systems each consist of two lasers, the wavelengths of which have been selected to optimize the difference in reflected signal due to the wavelength dependence of the pollutant or tracer gas. A computer code has been developed to simulate data tapes using a model atmosphere. Simulations are used to develop interpretive software and analyze system parameters. A prototype ozone system was ground tested successfully on a topographic target and a report has been written. A paper has been written evaluating candidate tracer gases which can be monitored using the differential absorption system. An airborne system for monitoring ozone has been constructed.
Keywords: aerial monitoring; lasers; air pollution; aerosols; molecular structure; ozone; air pollution monitors; design; optimization.

74531 Develop Airborne Lidar System for Monitoring Atmospheric Particulates. Eckert, J.A. (EPA, Office of Research and Development, Remote Monitoring Methods Branch, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J883A-044. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$50,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop downward-looking airborne Lidar systems for ranging aerosol distributions in the atmosphere. Applications include: (1) assessment of mixing layer height; (2) determining point source plume dimensions; and (3) a determining structure in urban plume. Approaches utilized include testing of a two-frequency Lidar with particle size discrimination capability, and utilizing off-the-shelf hardware with emphasis on microcomputer systems for maximum system flexibility. Data acquisition and control subsystems will provide a basic software-flexible unit for use in other applications requiring a flight qualified system for processing very fast pulse information. Field testing includes comparisons to data bases obtained with in-situ techniques. Three systems have been constructed to date: (1) a prototype ruby laser system; (2) an operational dye Lidar system with real time display capability; and (3) two frequency system. The dye system was used in support of the 1978 Sulfur Transport and Transformation in the Environment (STATE) field study.
Keywords: earth atmosphere; aerosols; aerosol monitoring; aerial monitoring; air samplers; air; particles; remote sensing; optical radar; design; air pollution.

74532 Methods Development for Water Monitoring Systems. Pijanowski, B. (Dept. of Commerce, Office of Ocean Engineering Management, Rockville, MD, 20852). **Project number:** J88YA-001. **Contract:** D8-X0357. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of this effort is to develop water monitoring instrumentation, techniques and methodologies. Of particular interest are investigations of a dissolved oxygen solid-state chip sensor and an oil sensor capable of detecting and quantifying oil in or on water under prolonged unattended field conditions. Researchers are being identified and funded through an IAG with NOAA to: (1) develop, test, and evaluate dissolved oxygen chip sensors for use in field water monitoring equipment; (2) develop, test, and evaluate an oil sensor for use in field water monitoring systems; and (3) evaluate other electro-chemical/enzyme sensors for field applications. Reports presenting results of the effort and transfer of developed hardware to EPA will be used by monitoring organizations. Prototype dissolved oxygen chips have performed very well. Mass production attempts have encountered numerous problems. These are being solved on a case-by-case basis.
Keywords: water; monitoring; water pollution monitors; design; field tests.

74533 Develop and Verify Lake Trophic Classification Techniques Based Upon Phytoplankton Forms or Assemblages. Williams, L. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-020. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives of this study are to: (1) determine the relationships of lake biological response to nutrient and other water quality parameters, and (2) develop biological techniques (phytoplankton) for assessing and/or predicting water quality. Existing data holdings will be analyzed to determine the distribution of phytoplankton forms with regard to geographic, physical, chemical, or hydrologic conditions. Identification of those genera/species or communities indicative of specific ranges of conditions will be made. A report identifying phytoplankton of high indicator value for assessing water quality in eastern lakes, a second report refining techniques and extending the previous information to other areas, a report on conditions favoring algal problems, a report extending and verifying the results of the earlier indicator reports, and a final report extending and refining the data on conditions favoring algal problems will be produced for use by water quality researchers and managers. Several indices have been developed which show good predictive ability to assess trophic state, relative phosphorus levels, and chlorophyll-a levels and the onset of other lake problems. Publication of the last of the discussed reports is presented projected for December 1980.
Keywords: lakes; water quality; monitoring; classification; phytoplankton; technology assessment; biological indicators.

74534 Water Monitoring for Oil Shale Development Nonpoint Source Pollutants. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-021. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

The objectives are to develop, test, and assess design and procedures for monitoring nonpoint source pollutants resulting from oil shale development. Parameters of interest, analytical techniques, spatial and temporal sampling frequencies, and other monitoring elements will be assessed and optimum design established. Data handling and analysis will also be considered and described. Methods, instrumentation, and parameters tested in the lower reaches of the White River will be augmented by new techniques and sampling extended to the upper White River and its tributaries (including Piceance Creek). Integrative monitoring of surface water quality, ground water character and discharge, biological elements, and other factors will be conducted and data analyses techniques developed. A biological sampling technique has been developed for use in the highly variable, often sparsely populated western streams. Temporal and spatial regimes have been selected for the lower White River. Instrumentation problems and new instrumentation and parameters of interest have been identified.
Keywords: water pollution; oil shale industry; nitrogen compounds; hydrocarbons; elements; trace amounts; water pollution monitors; sampling; surface waters; water quality; ground water; rivers; nevada; environmental effects; monitoring.

74535 Develop and Test a Turbidity Sensor. Newton, R. (Texas A and M Univ., College Station, TX, 77843). **Project number:** J88UA-023. **Contract:** R806351-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

A reliable, accurate, and stable sensor to measure turbidity is required for monitoring water quality by unattended systems. A laser technique appears promising as a solution. Investigations as to surface effects, characterization of turbidity contributors, and evaluation of its operation in a submerged mode will be made. A report describing the system and presenting the results of the project tests will be published for use by monitoring agencies.
Keywords: water; turbidity; monitoring; laser radiation; measuring instruments; water quality.

74536 Test and Evaluate Deployable Monitoring Packages. Whitehurst, C.A. (Louisiana State Univ., University Station, Baton Rouge, LA, 70803). **Project number:** J884A-025. **Contract:** R806313-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The project objective is to determine the effectiveness of commercial water monitoring systems in severe environment. Reliability, accuracy, failure rate and causes, service requirements, and other pertinent data will be obtained through deployment of instruments in coastal estuarine environs. Some modifications will be attempted to eliminate common failures. A report documenting project activities and results will be published and provide an assessment of the current state-of-the-art of monitoring equipment and determine areas for further development efforts.
Keywords: efficiency; reliability; water pollution monitors; estuaries; failures; field tests; water pollution.

74537 Test Commercially Available Sensors, Samplers, and Systems for Field Applications. Lambou, V.W. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-026. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to identify presently available equipment and techniques for field monitoring applications. Commercially available laboratory equipment will be modified if necessary and their use in field monitoring applications assessed. New equipment designed for field applications will also be evaluated under operational conditions. Reports documenting field experiences will provide an assessment of the subject instruments' suitability for utilization in field monitoring applications. Work with the phenol analyzer using local waters and spiked replicates is continuing satisfactorily.
Keywords: water pollution; water pollution monitors; water quality; hydrocarbons; equipment; field tests; monitoring.

74538 Develop Advanced Techniques for Trophic Classifications of Lakes and Assessing Estuarine and Wetlands Areas. Lambou, V.W. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-027. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop a method to assess lacustrine trophic state and land use impact on lakes through a combination of satellite and aircraft multiscanner data and in situ data. The development and verification of such a system is being cooperatively pursued by EMSL-LV and NASA's JPL at Pasadena. Ground truth (in situ) data are being obtained through cooperative efforts with EPA regional, state, and other federal agency personnel. Construction of algorithms, overflight data acquisition, and computer processing are being conducted by JPL-Pasadena. Data analyses and interpretation are accomplished jointly. A report on the results obtained will be published. A second report describing the methodology, developed software, and other operational details will also be published to provide an operational monitoring tool for assessment of lake water quality by federal, state, and other interested organizations. Collection of contact sensed data by cooperating agencies' personnel is being conducted. Landsat scenes for the appropriate data have been ordered, and data processing has begun.
Keywords: lakes; aquatic ecosystems; classification; eutrophication; water quality; monitoring; biological models.

74539 State-of-the-Art Automated In Situ Water Monitoring Workshop. Wrubee, D.T. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-028. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective was to establish the present state-of-the-art of technology for unattended in situ water monitoring. Federal research needs and ongoing programs were also defined through an interagency workshop. A report on presentations and panel findings will be published. An executive summary of the workshop findings has been produced. The larger, more comprehensive report is in preparation for use by federal agency planners.
Keywords: water quality; monitoring; optimization; automation; technology assessment; water pollution.

74540 Evaluate and Modify Viking Lander X-Ray Fluorescence Analyzer. Kelleher, W. (National Aeronautics and Space Administration, Langley Research Center, Hampton, VA, 23665). **Project number:** J884A-029. **Contract:** D7-0053. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective of this project is to convert the x-ray fluorescent analyzer developed for the Viking Spacecraft for use in water monitoring applications. First a detailed evaluation of problems regarding detection limits, preconcentration, cooling, etc., will be made to determine the potential for adapting the instrument. If adaptation appears economically feasible, identified modifications will be made to the unit and it will be field tested. A report on the feasibility and anticipated problems of converting the x-ray fluorescence unit for use in water monitoring will be delivered. If approved, a report on modifications made and results of tests will be prepared. An existing IAG with NASA-Langley has been modified to permit this work. Conversations with other researchers have identified many potential problem areas which must be addressed. Work at NASA-Langley is presently being initiated.
Keywords: x-ray fluorescence analyzers; space vehicles; water pollution monitors; feasibility studies; field tests; water.

74541 Development of Deployable Multiparameter Water Monitoring Sensor/Sampler System. Thomas, D. (National Aeronautics and Space Administration, Langley Research Center, Hampton, VA, 23665). **Project number:** J884A-033. **Contract:** D6-0053. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop an air-deployable multiparameter water monitoring sensor/sampler system that is modular in design, can accept off-the-shelf sensors, and is capable of unattended operation. Design, fabrication, and testing is being conducted through an interagency agreement with NASA-Langley. A tested air-deployable multiparameter sensor/sampler system and a report describing the system will be used by EPA research and monitoring personnel. Sensors, sampler, anchoring system, and memory have all been bench-tested. Assembly into computer system is underway with completion estimated by October 1978. Testing and demonstration of the system is planned for fall 1978 through early summer of 1979. The estimated publication date of the project report is December 1979. Delivery of four helicopter sensor/sampler units for use on the Chesapeake Bay survey was made.
Keywords: samplers; water; water pollution monitors; design; testing.

74542 Nonpoint Source Surface Water Monitoring Technology for Oil Shale Development. Kinney, W.L. (EPA, Office of Research and Development, Field Operations Section, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-034. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$57,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant monitoring.

The objective is to test, validate and describe optimal water quality monitoring procedures and techniques for quantitatively assessing the contribution of nonpoint source pollutants in a stream segment potentially impacted by oil shale development activities. Field testing of a surface water quality monitoring design incorporating biological, chemical and physical components was conducted on the lower reaches of the White River in eastern Utah in the vicinity of Federal oil shale tracts UA-UB. Automated in-situ contact sensor packages, automated water samplers, conventional water grab sampling techniques, and a variety of biological sampling techniques were assessed for application in streams of semi-arid regions characterized by highly variable flows and high levels of suspended materials. Adequacy of the design was evaluated in terms of parameters and parameter phases were selected for measurement, frequency of measurement, sample site selection, field sampling and measurement techniques, laboratory analytical techniques and data handling procedures. Final output will be in the form of a report describing field program and evaluating monitoring design based upon approximately 1 year of field testing in an 18-mile reach of stream adjacent to UA-UB Federal oil shale tracts. Components of the monitoring design are assessed for application in streams of semi-arid regions impacted by nonpoint source pollutants, particularly those associated with energy developmental activities. A quantitative kick method for biological sampling in semi-arid western streams has been developed. The report is presently in the review stage with a projected publication date of March 1979.
Keywords: surface waters; monitoring; oil shales; energy source development.

74543 Application and Demonstration of Multispectral Scanner (MSS) Digital System for Environmental Monitoring. Dockter, M. (EPA, Environmental Monitoring and Support Lab., Remote Sensing Operations Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-043. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$127,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives are to determine feasibility and demonstrate application of aerial multispectral scanning (MSS) for remote sensing of sediment in water, description of land use relationships, and silviculture/agriculture nonpoint sources of pollution; and optimize aerial thermal infrared scanner survey techniques. The approach is through collection of surface and airborne MSS data to study atmospheric attenuation corrections and site-to-site algorithm transferability, and analyze results compared to EPA standard laboratory testing methods. The feasibility of an airborne MSS system utility for environmental monitoring purposes has been established, and a field applications demonstration of a satellite scanner for an EPA coastal zone study has been completed.
Keywords: environment; monitoring; infrared spectra; feasibility studies; remote sensing.

74544 Use of Remote Sensing to Determine the Horizontal Distribution of Chlorophyll and Surface Currents in Las Vegas Bay, Lake Mead. Deacon, J. (Univ. of Nevada, 4505 S. Maryland Pkwy., Las Vegas, NV, 89154). **Project number:** J884A-044. **Contract:** R805045-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide measurements of chlorophyll concentrations in support of an EPA program to develop a laser fluorosensor method for performing the measurements from an airborne platform. Measurements are made and samples collected from boats at premarked locations coincident with an overflight by the aircraft-borne remote monitor. Samples are analyzed and compared to results from the remote monitor. A number of flights have been conducted over Lake Mead and correlations have been observed between the respective data bases.
Keywords: remote sensing; chlorophyll; water currents; water quality; lasers; aerial monitoring.

74545 Develop Laser Fluorosensors for Monitoring Surface Water Chlorophyll A. Bristow, M. (EPA, Environmental Monitoring and Support Lab., Remote Monitoring Methods Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-045. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$75,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop an airborne laser fluorosensor capable of measuring and mapping surface water chlorophyll A concentrations and monitoring fluorescent tracing dyes. The airborne laser fluorosensor employs a flashlamp pumped dye laser tuned to the absorption peak of chlorophyll A. The laser-induced fluorescence is collected by a telescope and focussed onto a detector. Correction for variation in water transmission is made by monitoring the laser-induced water OH stretch Raman band. The signal is displayed on a CRT, digitized and recorded on magnetic tape. By making repeated passes in a fixed or rotary wing aircraft, it will be possible to produce a map of chlorophyll fluorescence-to-water Raman ratio for use as an indicator of surface water chlorophyll A concentration. Development results will be described in an EPA report. Developed hardware will be available to EPA, federal, and state agencies for applications. The system is currently being evaluated in a helicopter. At a height of 1000 ft above the water surface, good signal-to-noise ratios are obtained for surface chlorophyll concentrations of the order of 1 micron g/l.
Keywords: lasers; fluorescence; surface waters; chlorophyll; remote sensing; aerial monitoring; measuring instruments.

74546 Develop Laser Fluorosensors for Monitoring Surface Waters (Organic Carbon). Bristow, M. (EPA, Environmental Monitoring and Support Lab., Remote Monitoring Methods Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J884A-057. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$10,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The ultimate objective of this program is to develop an active airborne monitoring system capable of providing quantitative data on the concentration of total organics in surface waters. The principle employed is an extension of the laboratory technique of spectrofluorometry. A water sample is irradiated with ultraviolet (uv) light of a specific wavelength and intensity, and the resultant fluorescence emission is then monitored using a monochromator-multichannel detector combination. The fluorescence signal arises from dissolved organic materials. The water Raman emission band is conveniently employed as a built-in reference source with which to compare the amplitude of information concerning the concentration of the dissolved organics. A firm correlation has been established between dissolved organic carbon (DOC) and normalized fluorescence measurements made on a large number of field samples. Plans are being made to build airborne laserfluorosensor based on this principle.
Keywords: surface waters; water pollution monitors; lasers; carbon; quantitative chemical analysis; ecological concentration.

74547 State Phytoplankton Reports. Taylor, W.D. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J613A-015. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to report the results of analyses of phytoplankton collected during the 1973, 1974, and 1975 years of the National Eutrophication Survey. Computer files are accessed and data retrieved are incorporated into standardized report formats. Thirty-eight state phytoplankton reports for use by federal and state water quality researchers and managers will be published. Publication and distribution to over 600 requesters of 37 state phytoplankton summary reports has been made. The remaining 11 reports are in advanced stages of editorial review.
Keywords: phytoplankton; water quality; biological models; management; baseline ecology.

74548 Special Studies in the Atchafalaya Basin. Hern, S.C. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J613A-018. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to provide data and consultation to the Atchafalaya Basin's agency management group for use in development of a multipurpose plan for the management of the Atchafalaya Basin wetland resources. The basin's productivity is a function of its unique hydrologic regime. Maintenance of the high recreational and commercial value of the basin depends upon management of the water cycles in the face of channelization (flood control operations) proposed by the Corps of Engineers. Special studies on water quality, energy fixation and transport, and oxygen relationships associated with various hydrologic regimes and identifying pesticide concentrations in the Atchafalaya Basin were designed to provide necessary input to identify the optimal hydrologic regimes to maintain the high productivity of the basin. Reports will summarize the findings and recommendations for water cycle management. Informal data submissions provide periodic update to the agency management group. The Atchafalaya Basin is relatively free of organophosphorus pesticides and only a few organochlorine compounds are present in the bottom sediments. Aldrin, dieldrin, polychlorinated biphenyls and DDT and its derivatives were found in fish. Mean nutrient levels within the Atchafalaya River Basin are great enough to support high levels of biological activity regardless of geographical area, season or water level. Dissolved oxygen levels in the basin are often depressed which is detrimental to resident populations of aquatic life. Dissolved oxygen concentrations are the most important gauge of the Basin's water quality and its ability to support a well-balanced aquatic fauna. The report Pesticides and Polychlorinated Biphenols in the Atchafalaya Basin, Louisiana, is in the final editorial stages. The report on water quality in the basin is currently undergoing technical review.
Keywords: louisiana; water quality; management; land use; baseline ecology; water resources.

74549 Lake Tahoe Technical Support. Simonian, T.L. (Univ. of Nevada, 4505 S. Maryland Pkwy., Las Vegas, NV, 89154). **Project number:** J613A-019. **Contract:** 68-03-2619. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this contract is to provide physical and chemical water sampling and analyses in support of the Lake Tahoe study to determine the effectiveness of meadowland treatment of drainage waters in the Lake Tahoe basin. Sampling is performed weekly on stream segments containing meadowlands in the south Lake Tahoe area. In addition, water samples are obtained in association with runoff episodes of snowmelt or rainfall origin. Physical and chemical analyses are performed at sampling sites and in a mobile laboratory located at south Lake Tahoe. Data and samples are forwarded to EMSL-Las Vegas for subsequent analyses and computerization. Results obtained from the above effort and subsequent sample and data analyses will be published in reports relating meadowlands to nutrient and suspended sediment load reductions. These will be used by Region IX and the Lake Tahoe planning agencies to formulate landuse and other management plans. To date field sampling has been completed. Preliminary data releases to Tahoe basin research groups have been made.
Keywords: lakes; water pollution; sampling; water quality; runoff; quantitative chemical analysis; monitoring; quality assurance.

74550 Trophic Classifications of Lake Mead Utilizing Contact and Landsat Data. Boland, D.H. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J613A-022. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The general objective is to determine the utility of Landsat multispectral scanner data for the investigation of the spatial-temporal aspects of trophic indicators and trophic state in a large lake (Lake Mead). Specific objectives include: (1) development and evaluation of models to predict the magnitude of selected trophic indicators; (2) development and evaluation of models to predict the trophic state of a lake; and (3) generation and evaluation of thematic photomaps which depict trophic indicator magnitudes and trophic index

values within a lake. Water quality data were collected from Lake Mead on 8 different dates during 1976 concurrently or near-concurrently with Landsat and NASA aircrafts. Remotely sensed data were acquired by multispectral scanners and aerial mapping cameras. Multispectral data from 29 Landsat scenes are being compared with water quality data obtained from some 40 lake sampling sites and, if statistically significant relationships are found, thematic photomaps will be generated. The maps will display the temporal-spatial aspects of trophic indicators and a trophic index. A report will be written describing the project results for use by other EPA, federal, and state agency monitoring personnel. Significant correlations between remote data and water quality parameters have been identified. **Keywords:** lakes; water quality; aerial monitoring; remote sensing; data acquisition; measuring methods.

74551 Atchafalaya River Basin Management Unit Study. Hern, S.C. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J613A-026. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives are to: (1) compare the hydrologic regimes within and between three demonstration management areas in the Atchafalaya River Basin, Louisiana; (2) evaluate the effects of these regimes upon the basin; and (3) provide specific recommendations with respect to water cycle management to maintain present high productivity in the event that the major Corps of Engineers channelization proposal for the basin becomes a reality. Field studies regularly gathered general water quality data through the Atchafalaya Basin, with particular emphasis on the Pat's Bay, Buffalo Cove, and Henderson management units. Productivity, oxygen and carbon and other nutrient transport processes were evaluated relative to hydrologic cycles in each area through an entire water year. Reports will provide findings and recommendations for the hydrologic management of each of the management units. Periodic inundation provides a rich new substrate for the detritus-based food chain, as evidenced by increased respiration rates and conversion of energy-rich particulate carbon to dissolved forms. Disturbance of the historical flooding regime of one area of the basin appears to have resulted in a fundamental shift from detritus to autotrophic-based food chains. The integrity of the highly productive basin ecosystem is dependent upon hydrologic management practices which maintain a regime of periodic overflow. A report (A Comparison of Three Flooding Regimes Atchafalaya Basin, Louisiana) was published and distributed. This report concluded that management of the basin is dependent upon an annual flood cycle and recommended a managed throughflow regime to maintain environmental quality. The amount and nature of carbon import and export is highly dependent upon the type of flooding regime (throughflow, backflow, etc.) experienced. **Keywords:** louisiana; water quality; land use; coastal regions; management; dredging; water resources.

74552 Atchafalaya Basin Water Quality Study. Gagliano, S.M. (Coastal Environments Inc., 1260 Main Street, Baton Rouge, LA, 70802). **Project number:** J613A-027. **Contract:** 68-03-2561. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop specific recommendations relative to U.S. EPA's regulatory responsibilities in the Atchafalaya Basin concerning: (1) need for and possible adverse effects of channel dredging; (2) the present causes of environmental quality degradation and water management requirements to maintain environmental integrity; and (3) evaluation of compatibility between various uses and the natural environment for alternative management schemes. The work incorporated and expanded on the results of previous studies undertaken by the U.S. EPA, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service, as part of an interagency Atchafalaya land and water management study. Reports summarizing findings and recommendations will be used by Atchafalaya planning agencies. Preliminary report (Recommendations for Resource Management in the Atchafalaya Basin, Louisiana, Relative to EPA's Regulatory Responsibilities) has been prepared. Two draft research and development reports have been prepared: (1) Hydraulics of the Atchafalaya Basin Main Channel System: Considerations from a Multi-Use Standpoint; and (2) Operation of the Old River Control Structure: An Evaluation from a Management Standpoint. Reports are all in final editorial stages.
Keywords: water quality; pesticides; dredging; environmental impacts; water resources; management; land use; louisiana; coastal regions.

74553 Trophic Classification of Illinois Lakes. Boland, D.H. (EPA, Las Vegas, NV, 89114). **Project number:** J613B-024. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The general objective is to classify Illinois lakes according to trophic state using Landsat multispectral scanner data in conjunction with water quality data collected by the National Eutrophication Survey. Specific objectives include: (1) ranking of Illinois lakes as to Secchi depth transparency, (2) ranking of lakes according to chlorophyll A levels, (3) ranking of lakes according to a trophic index, and (4) compilation of lake surface area estimates. Statistical relationships between water quality data from Illinois lakes sampled by the National Eutrophication Survey and Landsat multispectral data for the same lakes will be examined. If significant relationships are found, models will be developed to estimate the magnitude of the trophic indicators and the trophic index in the NES lakes. The models will then be used to estimate the parameter values in the remaining Illinois lakes. A report will be published describing the project's results and, including the ranking, will be used by Region V and Illinois water quality managers. To date, comparison of Landsat and contact data trophic rankings, Secchi depth, and chlorophyll A were quite successful. Interpolation for lakes not originally contact sensed was good; however, extrapolation to Secchi depth and chlorophyll A values beyond those originally used to establish algorithms was less successful. Clusters of lakes provided by the algorithms appeared to correspond to groups of lakes having many natural properties in common. A project report, Trophic Classification of Illinois Water Bodies, has passed technical review.
Keywords: lakes; classification; water quality; illinois.

74554 In Vivo Incorporation of Toxic Elements into Animal Tissues. Hopkins, T. (Univ. of Maryland, Princess Anne, MD, 21853). **Project number:** J622B-002. **Contract:** R805175-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to prepare animal tissue material containing toxic elements via in vivo incorporation. The elemental compounds to be studied will be enclosed in gelatinous capsules and administered orally on a daily basis. The final output will be reference materials containing in vivo incorporated toxic elements. The grantee has completed administration of the toxicants. The goats were sacrificed and the tissue of interest recovered. Processing and analyses of the tissues are in progress.
Keywords: tissues; tissue cultures; in vivo; goats; metals; toxicity; sample preparation.

74559 Energy-Related Ambient Air Quality Monitoring in the Western Energy Development Area. Snelling, R.N. (EPA, Office of Research and Development, Air Quality Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J625C-075. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$368,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to provide integrated and validated air quality monitoring data (baseline and trend) for the western areas of the U.S. which are or will be impacted by energy-related development activities. The geographic coverage includes the Northern Great Plains, Four Corners Area, Colorado Plateau (oil shale), Black Mesa, Arizona, and areas of New Mexico. The methods are to maintain inventory of existing and projected pollution sources and monitoring networks, integrate air quality monitoring data, assess impact of energy-related activities, and conduct aircraft air quality monitoring missions to supplement ground-based network data. Annual reports of ground-based monitoring data and airborne monitoring data will be prepared. Two years of baseline data have been accumulated.
Keywords: air quality; monitoring; usa; baseline ecology; rocky mountain region; southwest region; aerial monitoring; data acquisition; colorado; arizona; new mexico; inventories; energy source development; environmental impacts.

74560 Plan and Conduct Field Studies to Identify and Quantify the Environmental Level of Specified Toxic Substances: Aryl Phosphates. Crockett, A.B. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J763A-002. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

This study is designed to determine the levels of aryl phosphate compounds in environmental media. Two-phased approach is underway. Field sampling has been completed at eight locations representing manufacturing, formulating, and use facilities. At each site soil, vegetation, air, water, and sediment samples were collected. Laboratory studies are designed to determine the potential fate and transport characteristics of aryl phosphates. Controlled chambers in the greenhuse are being dosed with 14C-labeled tricresyl phosphate. Report will be submitted to the Office of Toxic Substances, EPA, on

the results of field and laboratory studies. Aryl phosphates have been detected in soil, water, air, and sediments at all four facilities where sampling was conducted. An unpublished report was prepared and additional sampling will be conducted under contract.
Keywords: toxicity; organic phosphorus compounds; ecosystems; sampling; soils; plants; air; water; sediments; tracer techniques; carbon 14 compounds.

74561 Aryl Phosphate Sampling Project. (Northrop Services, 1293 E. Patrick Ln., Las Vegas, NV, 89119). **Project number:** J763A-003. **Contract:** 68-03-2591. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine the extent and magnitude of aryl phosphate contamination around four facilities manufacturing or using the compounds. Samples of soil, vegetation, fish, sediment, and air will be collected at various distances from the facilities and analyzed for aryl phosphates.
Keywords: aryl radicals; phosphates; industrial plants; soils; plants; fishes; sediments; air; sampling; chemical analysis; environmental transport; sulfur compounds.

74562 Multi-Media Sampling for Selected Carcinogens. Crockett, A.B. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J763A-004. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to determine environmental levels of various pollutants in areas of high human exposure. Multi-media samples will be collected and analyzed to determine levels of specific pollutants. The residue levels provide some data on the potential for human exposure.
Keywords: carcinogens; human populations; environmental exposure pathway; quantitative chemical analysis; risk assessment; ecological concentration; monitoring; ecosystems.

74563 Deterministic Wind Field Submodel for Use in Phoenix, AZ, and Application of Sea Breeze Wind Field Model to Tampa and St. Petersburg, FL. Liu, M. (Systems Applications, Inc., 950 Northgate Drive, San Rafael, CA, 94903). **Project number:** J620A-46. **Contract:** 68-03-2446. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$12,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The major objective is to use a dynamic model, developed by Systems Applications Incorporated (SAI), to simulate the land and sea breeze in the Tampa/St. Petersburg area. The model is based on the finite difference solution of the primitive equations. Other objectives are to: reexamine the model formulation and numerical techniques to include up-to-date information; modify the treatment of subgrid-scale processes to include recent results for the characterization of the surface boundary layer; prepare a data base for the Tampa/St. Petersburg application and exercise the model for no fewer than 3 test days; and adapt the wind model so that it is compatible with the input to the airshed model. Reports will be written delineating complex terrain wind field model and its evaluations at Phoenix (No. 1) and sea breeze--land breeze model and its evaluation at Tampa/St. Petersburg (No. 2). Models will be used to provide input information for airshed model to develop data base for use with in-house algorithm for designing optimal network for monitoring ambient air quality. Preliminary results of evaluations indicate that the models provide cost effective information appropriate for the above applications of the airshed model.
Keywords: wind; arizona; seas; mathematical models; florida; air pollution; environmental transport.

74564 Optimum Air Quality Monitoring Network Design Methodology. Behar, J.V. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J620A-47. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$149,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop a method for selecting the optimum number and disposition of sampling sites for monitoring air quality, encompassing several aspects: meteorology, topography, source distribution, pollutant types, and emissions inventory. The development of the methodology for optimizing the design of ambient air quality networks requires a field sampling program for collecting air quality data and meteorological data, and the application of these data to an urban airshed simulation model for predicting pollutant concentrations under various meteorological conditions. Optimum sampling locations will be determined by mathematical analysis of several sets of pollution concentration patterns from meteorological simulation for the more commonly occurring weather regimes. The geographical position of the point or points of maximum concentration will be determined and plotted on a map. Monitoring stations will be placed within the overlapping areas for various weather regimes. The number of stations will be allotted in terms of acceptable error associated with reproducing simulated concentration distributions for the various weather regimes. Ambient air monitoring network optimization guides for inert pollutants (carbon monoxide) and photochemical oxidants can be used by other federal, state, and local agencies in designing new or re-designing existing networks. Results include demonstration of utility of network design methodology by application to Las Vegas for carbon monoxide.
Keywords: air quality; monitoring; optimization; design; sampling; air pollution.

74565 Optimum Air Pollution Sampling Network Selection in Urban Areas: Test and Evaluation. Vukovich, F.M. (Research Triangle Inst., Dept. of Geosciences, P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** J620A-48. **Contract:** 68-03-2187. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$43,000.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate a statistical--dynamical method for optimization in the design of air quality monitoring networks which incorporates station designation using the statistical aspects of the wind field determined with a dynamic meteorological model. An objective variational analysis model based on the network stations and the pollutant source inventory is then used to specify the pollutant distribution. Evaluation will be carried out for inert pollutants and reactive pollutants for the St. Louis metropolitan area.
Keywords: air pollution; sampling; air quality; monitoring; urban areas; optimization; carbon monoxide; missouri; ecological concentration.

74566 Develop and Apply Biological Monitoring Methods. Rogers, R.D. (EPA, Office of Research and Development, Pollutant Pathways Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J620A-49. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$40,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Plants, animals, and various indices will be evaluated as to their value as biological monitors and potential for incorporation into operational monitoring networks. Soil, vegetation, and small mammals will be collected around a coal-fired power plant and in a highly urbanized area. After a potential monitor has been identified, factors affecting the receptor will be studied to determine its response and usefulness. Domestic livestock will also be evaluated. Also, studies will evaluate biological monitoring techniques as tools for determining the impact of pollutants on soil microorganisms viability. The applicability of a hydrogen oxidation test which is dependent on the activity of a group of soil bacteria in determining the impact of various pollutants will be studied. The final output will consist of published EPA/EMSL-LV reports detailing the results of the field and laboratory investigations showing biological monitors and their potential for accumulation and/or retaining environmental pollutants. They will also show available monitoring procedures which may be employed to assess pollutant dose or pollutant exposed stress. Complete sampling at Four Corners power plant for soil and vegetation has been carried out and analyses of soil have been conducted for mercury, lead, cadmium, zinc, selenium, and copper. Rats have been collected in Los Angeles for lead studies. A soil microorganism, Alcaligenes paradoxus, was identified as an organism responsible for hydrogen oxidation in soils. The effect of SO2, Cd, and Hg on soil organism metabolism as indicated by hydrogen oxidation was determined.
Keywords: terrestrial ecosystems; monitoring; plants; animals; biological indicators; fossil-fuel power plants; urban areas; domestic animals; soils; microorganisms; metabolism; environmental effects; hydrogen; oxidation; metals.

74567 Transport/Transformation/Pathway Research. Rogers, R.D. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775A-050. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to develop methodology for assessing the transformations of toxic organic and inorganic chemicals mediated by biological and nonbiological soil factors, and to determine and report the rates of uptake of organic and inorganic chemicals by plants. Research will be initiated to determine the pathways of selected environmental pollutants as they move from source(s) to

critical receptor. In addition, transformation and degradation products resulting from physico-chemical and biological interactions will be identified. There will be emphasis placed on the identification characteristics which are similar for all pollutants of a given chemical class so that correlations between transport/transformations/pathways and more easily obtained chemical/physical properties can be developed. Studies will be initiated with soil sorption techniques, terrestrial microcosms, and laboratory animals.
Keywords: toxicity; chemical effluents; environmental transport; environmental exposure pathway; biological models; ecosystems; environment; organic compounds; inorganic compounds; plants; soils.

74568 Development of a Model for Calculating Airborne Particulate Concentrations Based on Vegetative Pollutant Levels. Davidson, C. (Carnegie-Mellon Univ., Frew Avenue and Margaret Morrison, Pittsburgh, PA, 15213). **Project number:** J775A-051. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: develop a model for calculating airborne particulate concentrations based upon vegetative pollutant levels; provide assistance and advice in the selection of plant species and/or plant groups to be collected for experimentation and examination; and provide input into the selection of vegetative sampling sites to evaluate the model. The approach will be to predict and calculate the deposition of selected environmental contaminants such as lead on the leaves of vegetation, using fundamental theories of convective diffusion, impaction, sedimentation, along with size distributions and airborne convective pollutant concentrations. Leaf morphology, such as shape, size, boundary layers micrometeorological parameters will be required inputs. Also measurements of leaf boundary layers micrometeorological parameters will be evaluated and incorporated into the model.
Keywords: air pollution; aerosols; ecological concentration; mathematical models; plants; biological indicators; particles; calculation methods.

74569 Air Monitoring Siting by Objective. Seinfeld, J.H. (California Inst. of Technology, Dept. of Chemical Engineering, 1201 E. California Blvd., Pasadena, CA, 91109). **Project number:** J775A-053. **Contract:** 68-03-2441. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$4,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives are to: develop a method for estimating the full temporal and spatial distribution of air pollutants over a region using limited pollutant concentration measurements in conjunction with an Air Quality Simulation Model (AQSM); apply estimation theory to systems described by partial differential equations to produce a computer algorithm for yielding spatial and temporal pollutant distributions (algorithm processes monitoring data and uses processed data with AQSM to produce distribution); and test algorithm for a hypothetical region to illustrate the key features of the method. A report describing algorithm for inert pollutants and test results for the hypothetical region will be written. Once concentration distributions have been estimated for a region using such an algorithm, new monitoring sites can be located or existing sites can be relocated based on several siting criteria as discussed in the report. The feasibility of method has been demonstrated through intensive test for a hypothetical region.
Keywords: air quality; monitoring; optimization; spatial distribution; ecological concentration; statistical models.

74570 Oxidant Monitoring Network Design in Tampa/St. Petersburg. Behar, J.V. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775A-054. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$110,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objectives are to verify an optimum network design methodology in cooperation with EPA Region IV Office in a field test around Tampa/St. Petersburg, Florida; and to optimize the design of the network for airshed monitoring of the reactive pollutants (oxides of nitrogen, ozone, and hydrocarbons). The development of the methodology for optimizing the designs of ambient air quality networks requires a field sampling program for collecting air quality data and meteorological data, and the application of these data to an urban airshed simulation model for predicting pollutant concentrations under various meteorological conditions. Optimum sampling locations will be determined by mathematical analysis of several sets of pollution concentration patterns from meteorological simulation for the more commonly occurring weather regimes. The geographical position of the point or points of maximum concentration will be determined and plotted on a map. Monitoring stations will be placed within the overlapping areas for various weather regimes. The number of stations will be allotted in terms of acceptable error associated with reproducing simulated concentration distributions for the various weather regimes. Final output will be an ambient air monitoring network design for photochemical oxidants in the Tampa/St. Petersburg area of Florida for use by EPA Region IV, State of Florida, and local agencies in SIP formulation and for evaluation for existing networks. Preliminary values for natural hydrocarbon emissions are much higher than expected. Special simulations may have to be made with photochemical airshed model to determine necessity of considering them in SIP.
Keywords: florida; air quality; photochemical oxidants; nitrogen oxides; ozone; hydrocarbons; monitoring; optimization.

74571 Application of Slope Wind Model. Berman, N. (Arizona State University, School of Engineering and Applied Science, Tempe, AZ, 85281). **Project number:** J775A-056. **Contract:** CB-8-0472-J. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$2,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives are: to develop diurnal near-surface wind patterns in the Phoenix, AZ, metropolitan area under meteorological situations dominated by locally-induced upslope and downslope winds; and to re-examine the slope wind model developed by Arizona State University for improved treatment of initial and boundary conditions for the Phoenix area, and exercise the model for no fewer than three 24-hour periods. Final output will include a report delineating the model simulations; simulated data will be used with an in-house algorithm for optimal siting of ambient air monitoring stations for carbon monoxide in the Phoenix metropolitan area.
Keywords: daily variations; wind; meteorology; simulation; arizona; carbon monoxide; diffusion.

74572 Optimal Number of Air Monitoring Sites. Liu, M. (Systems Applications, Inc., 950 Northgate Drive, San Rafael, CA, 94903). **Project number:** J775A-058. **Contract:** 68-03-2446. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$58,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to develop an algorithm for the determination of the optimal number of monitoring stations in an ambient air quality monitoring network and apply it to Las Vegas. A mathematical/statistical procedure will be devised for allotting the number of stations in terms of minimal acceptable error associated with reproducing simulated pollutant concentration patterns; the patterns are developed using an air quality simulation model for specific weather regimes associated with high pollution potential. A report describing algorithm and test results for carbon monoxide for Las Vegas will be presented. Algorithm will be incorporated into an in-house methodology for determining the number and disposition of stations in an ambient air quality monitoring network. The algorithm has been coded and is in operation, and its utility for a hypothetical case has been determined.
Keywords: air quality; nevada; monitoring; optimization.

74573 Review of Literature on Measurements and Effects of Toxic Elements on Biological Systems . Jenkins, D. (National Inst. of Scientific Research, Environmental Division, Box 1617, Rancho Santa Fe, CA, 92067). **Project number:** J775A-059. **Contract:** 68-03-2456. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$30,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives include: the assessment of work reported world-wide on measurements and effects of toxic elements on biological systems; review and evaluation of world-wide literature on the response of terrestrial and aquatic organisms to specified toxic elements and pesticides; and review and evaluation of literature for historic trends in levels of toxic elements and projection of future trends. Final output includes a summary report of a survey of world literature on the use of biological materials as monitoring tools. Interim reports have been submitted for internal review on Toxic Metals in Biological Organisms, for 14 toxic metals.
Keywords: toxic materials; toxicity; reviews; measuring methods; terrestrial ecosystems; aquatic ecosystems; pesticides; environmental transport; global aspects.

74574 Develop and Apply the Concepts of a Multimedia Monitoring System. Potter, G.D. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775A-060. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$1,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Basic information on animals will be provided to define intestinal absorption rates and relationships of blood, lead and cadmium in different forms in order to relate these to exposure assessments to be used for integrated monitoring concepts. Laboratory animals will be dosed orally with lead and cadmium tracers and blood and tissue levels will be analyzed to determine uptake and blood levels.
Keywords: monitoring; animals; blood; metabolism; lead; cadmium; uptake; bioassay; tissues.

74575 Retrospective Exposure Monitoring for Selected Environmental Carcinogens. Potter, G.D. (EPA, Environmental Monitoring and Support Lab., Exposure and Dose Assessment Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775D-004. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$8,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objectives are to determine the availability and locate materials which can be analyzed for concentrations of selected chemicals. Suitable materials may include home or locally packaged foods, biological specimens, such as tree rings, soil cores, preserved plants avd/or animals. The selection of suitable samptes will be investigated. Methodologies for collection and analysis will be documented. A series of reports which can be used to estimate past exposure populations to specific carcinogenic or toxic materials released from industrial or agricultural sources in specific impact areas will be completed. A preliminary study on tree rings has been completed and analytical data from neutron activation spectra of the rings for potential marker materials transported with toxic substances is underway. A report will be completed showing correlation between arsenic emissions from a smelter and its concentration in annual rings from trees.
Keywords: carcinogens; dosimetry; chemical effluents; ecological concentration; monitoring; trees; soils; plants; animals; measuring methods; quantitative chemical analysis.

74576 Biosynthesis of N-Nitroso Compounds from Trace Level Precursors. Epstein, S.S. (University of Illinois, Medical Center, Box 4348, Chicago, IL, 60680). **Project number:** J775D-005. **Contract:** R805431-02. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$160,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to investigate the biosynthesis of N-nitroso compounds (both volatile and non-volatile) from trace levels of their amine and nitrosating precursors using thermal energy analyzer techniques with frozen animal procedures. Final output will include assessments of rates of in-vivo biosynthesis of N-nitroso compounds from environmental levels of precursors; catalytic and inhibitory effects of different agents on the nitrosamine biosynthesis; and analytical methods for detecting low levels of nitrosamines. To date, data has been compiled on in-vivo nitrosation, improvements on nitrosamine analytical method have been completed, and in-vivo nitrosation from NO2 at 25 ppM has been established.
Keywords: organic nitrogen compounds; biosynthesis; trace amounts; mice; environmental transport; metabolism.

74577 Design a System for Cost-Effective Assessment of Environmental Carcinogens (No. 16). Behar, J.V. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775D-005. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$7,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to design a monitoring network for an environmental carcinogen which is cost-effective. This will be accomplished by applying the total environmentally integrated exposure assessment monitoring concept to the network design. The final output will be a report on the method of designing a cost-effective monitoring system and an example of its application. A workshop was convened to select carcinogen receptor pair. An outline of the screening process and monitoring system design criteria has been prepared.
Keywords: carcinogens; regional analysis; economics; monitoring; evaluation.

74578 Exposure Monitoring for Selected Environmental Carcinogens. McFarlane, J.C. (EPA, Environmental Monitoring and Support Lab., Pollutant Pathways Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775D-007. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$137,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to develop needed research techniques, tools, and analytical procedures for detailed pathways studies of carcinogenic chemicals in plant-soil system; investigate various types of microcosms; study benzene uptake, utilization and degradation as a function of plant-soil interactions and metabolism; and report on techniques and methods for studying carcinogenic chemicals in microcosms. Benzene is accumulated and metabolized by plants only after a period of exposure. The induction process was demonstrated in four different plant types. It is related to leaf area but apparently does not depend on light for energy. Small exposure microcosms were tested and found adequate for these studies. The rate of benzene assimilation was found to be proportional to the benzene concentration in the air during the induction period. This suggests that this phenomena may form the basis of an exposure monitor.
Keywords: dosimetry; doses; measuring methods; carcinogens; biological pathways; human populations.

74579 Compile Existing Information Relating to Selected Carcinogen Pathways and Initiate Studies to Supply Missing Information. McFarlane, J.C. (EPA, Environmental Monitoring and Support Lab., Pollutant Pathways Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J775D-008. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$65,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to identify environmental pathways of carcinogenic pollutants; determine fate of chemicals and transformation products; from literature source and use information, select carcinogenic compounds for initial studies; and conduct laboratory greenhouse, growth chamber, and microcosm studies on movement and fate of carcinogenic chemicals. A series of research reports describing the environmental pathways of carcinogenic pollutants will be written. Initial studies with benzene show soils to be a probable major sink for environmental benzene. In soil it is degraded to CO2 through a series of organic acids.
Keywords: data compilation; carcinogens; biological pathways; environmental transport.

74580 Critical Review of Retrospective Monitoring Methods. Frank, C.W. (Univ. of Iowa, Jessup Hall, Iowa City, IA, 52240). **Project number:** J775D-010. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide documentation of methodologies for retrospective monitoring of toxic materials with a critical review of these methodologies. The approach is to procure an annotated bibliography directed toward retrospective monitoring of metal pollutants by searching relevant data bases to provide a critical review of such methodologies and reprints of pertinent publications.
Keywords: toxic materials; metals; air pollution; water pollution; land pollution; monitoring; quantitative chemical analysis; bibliographies; data compilation; information needs; data base management; environment; technology assessment; quality assurance.

74581 Airborne Air Quality Measurements Systems Development. Van EE, J. (EPA, Environmental Monitoring and Support Lab., P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J763A-005. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to design and test-fly an airborne air quality measurements system that can be easily moved from aircraft to aircraft. The system is to be compact and lightweight as possible with minimum electrical power requirements, and be tailored to withstand the vibration and rapid temperature and pressure changes in aircraft. The system should reduce costs and inflexibility currently associated with dedicated air quality measurements aircraft. The approach is to develop an instrument package for measurement of temperature, dew point, altitude, position, ozone, particulates, and oxides of nitrogen which can be quickly instalied in the nose and cabin areas of a small twin-engine private plane. The existing air pollution instrument will be modified in varying degrees and miniaturizing electronics employed to achieve a small lightweight system.
Keywords: air quality; aerial monitoring; systems analysis.

74582 Environmental Radioactivity Measurements. McClendon, L.T. (National Bureau of Standards, Washington, DC, 20228). **Project number:** J-883A-100 004. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective is to assist EPA in achieving and maintaining an optimum radiological monitoring program to ensure quality assurance in the measurement of environmental radioactive pollutants by providing measurement methodology and radioactive SRM's and/or calibration standards. NBS will calibrate a new series of NBS high-

level radioactive standards; develop radiochemical techniques required in the source preparation and calibration of new natural matrix SRM's; construct and develop operating procedures for an alpha particle spectrometer system to be used for measuring low activity levels of alpha emitting radionuclide; and develop measurement methods/techniques in order to produce environmental level radioactivity standards.
Keywords: radiation monitoring; calibration; optimization; standards; radioactivity; alpha particles.

74583 Personal Exposure Monitors. Zielinski, W.L. (National Bureau of Standards, Washington, DC, 20228). **Project number:** J-884A-100 003. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop principles, concepts, and actual devices for determining personal exposure to critical air pollutants. Both passive and active monitors will be developed to provide time-integrated exposures and short term events. The approach is to: (1) investigate a fluorimetric analytical procedure for a passive 03 sampler; (2) evaluate promising NO2 devices; (3) evaluate the Palmes diffusion tube passive device for NO2; (4) investigate membrane-backed diffusion devices as passive sensors for NO2; (5) perform literature report for toxic organic personal monitoring; (6) select and evaluate possible sampling heads and collection techniques for respirable particulates; and (7) select and evaluate candidate sampling approaches.
Keywords: air pollution; chronic exposure; acute exposure; air pollution monitors; dose rates; ozone; nitrogen dioxide; particles; aerosols; organic compounds; personnel monitoring; monitoring; man; design; hydrocarbons; public health; dosemeters.

75000 Water Quality Research Program Development. Sanders, W.M. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K609A-051. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The Associate Director for Water Quality Research establishes and maintains liaison with appropriate offices within EPA and other organizations in order to determine the research needs in the area of water quality and serves as an interface in getting research results to users optimally. The Associate Director screens incoming proposals for relevance and provides expert scientific advice, consultation and assistance on matters relating to water quality to ERL staff, EPA officials, other federal and state agencies, foreign governments, industries, and private organizations.
Keywords: water quality; research programs; management; us epa; planning.

75001 Development of Management Models for Stream Ecosystems. Boling, R.H. (Michigan State Univ., Soil Science Bldg., East Lansing, MI, 48824). **Project number:** K609A-403. **Contract:** R804424-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this work are to develop quantitative predictive models of woodland stream ecosystems for effective management programs and to develop a sufficient data base to parameterize the models and permit reasonable estimates of systems status from directly measurable stream variables. The research approach involves the modification of existing models for planning applications. Data required for parameter estimation will be obtained from laboratory microcosm experiments, literature surveys, and field studies. The detailed model will be condensed to provide a planning model requiring a minimum of data for calibration. Submodels describing mercury and malathion transformation kinetics will be incorporated. A final report summarizing the project will be prepared and submitted, along with a documented deck of all computer programs developed. The final report will contain instructions describing the operation and input requirements of the planning model. In general, it appears possible to reduce a rather complex ecosystem model for upland streams to a more easily used management structure without losing too much information.
Keywords: streams; aquatic ecosystems; mathematical models; management; planning; data acquisition.

75002 Small Scale Field Study for Evaluating Model Applications. Robertson, J.K. (Department of Defense, West Point, NY, 10996). **Project number:** K609A-404. **Contract:** D7-F086. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this interagency agreement is to carry out a field study and model analysis program to evaluate the performance of models proposed for use in basin planning and to define the water quality status of selected water bodies on the West Point Military Reservation. The US Military Academy will initially collect field data and EPA will analyze the data. As their expertise develops in using models, academy personnel will also analyze field data to calibrate appropriate loading and water quality models. A report containing a description of the data collected and an evaluation of the model analysis will be prepared. An analytical chemical capability has been developed at the Academy. Problems have been encountered installing flow measurement devices. A weather station has been installed.
Keywords: water quality; mathematical models; monitoring; new york; military facilities; pollution control equipment.

75003 Development of Dynamic Two-Layer Model for Stratified Estuaries. Walsh, W.P. (Raytheon Co., P.O. Box 360, Portsmouth, RI, 02871). **Project number:** K609A-406. **Contract:** R805170-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The primary objective of the project is to develop a two-layer dynamic model of estuarine hydrodynamics and water quality. The model is to be compatible for linkage with appropriate river and loading models to provide a basin planning methodology in coastal areas. A second objective is to test the estuary model on a field data set to define its performance characteristics. The approach is to complete the development of the RAMSES hydrodynamic model and link it to the RECEIV-III water quality model. In the first phase of this study, the hydrodynamic code will be tested, and its sensitivity to mode parameters determined. In the second phase, the water quality model will be extended to two-layers and tested. In the third phase, the hydrodynamic and water quality models will be linked.
Keywords: estuaries; water quality; hydrodynamics; mathematical models.

75004 Modeling for 208 Area-Wide Waste Management Planning in Non-Designated Areas. Chen, C.W. (Tetra Tech, Inc., 3700 Mt. Diablo Blvd., Lafayette, CA, 94549). **Project number:** K609A-407. **Contract:** K609A-407. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The research will develop a planning tool for water quality analysis in non-designated 208 planning regions. The tool will include a model for preliminary screening to isolate problem areas of point and non-point wastes and evaluate information for follow-up detailed modeling to assess the impact of waste management alternatives. The planning model will function with a limited data base, and will provide high and low estimates for simulation results. The output will be designed for ease of interpretation by the planner. The non-point source data base and the loading functions developed by Midwest Research Institute will be used to estimate pollutant flux from watersheds. Rivers, estuaries, and impoundments will be accommodated as well as storm water runoff. Several approaches to water quality modeling and analysis are included to offset the potential bias of any single method. The project will be useful to provide prescreening for a large area and to focus on regions not conforming to the goals of Public Law 92-500, especially because it will be easily applied with a limited data base. Substantial saving in planning cost is expected without sacrificing accuracy in isolating problem areas.
Keywords: water quality; waste management; mathematical models; planning.

75005 Evaluation of Probabilistic Techniques for Modeling Pesticide Transport and Fate. Onishi, Y. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** K609A-411. **Contract:** 68-03-2613. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The goal of this project is to develop a methodology to predict the frequency and duration of pesticide concentrations in response to variations in storm patterns, land use practices, and topographical characteristics of the watershed. The approach to be taken in this study is to link existing loading models and receiving water quality models that describe the transport and transformations of pesticides which occur throughout the sub-basin area. Appropriate statistical analysis procedures will be interfaced with the basin model to estimate the frequency of occurrence and the duration of a given concentration of pesticides in a river. A literature survey will also be conducted and criteria established to insure that the exposure analysis is compatible with toxic effects measurements currently available. The results of this project will be published in a final report which contains instructions for the use of the methodology.

Keywords: pesticides; quantity ratio; watersheds; streams; variations; mathematical models; stochastic processes; environmental transport; water quality.

75006 Symposium and Modeling of Pollutant Transport in Receiving Waters. Fisher, H.B. (Univ. of California, Berkeley, CA, 94720). **Project number:** K609A-413. **Contract:** R806425. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the symposium is to review the state-of-the-art of mathematical and physical modeling of pollutant transport in rivers, lakes, reservoirs, estuaries, and near-shore coastal areas, and the relationship between transport and biochemical models. The symposium will be under the direction of an international scientific committee and is sponsored by the Committee on Fundamentals of the International Association for Hydraulic Research and the Committee on Hydrologic Transport of Pollutants of the American Society of Civil Engineers. The scientific committee will select 12 papers to be presented over a period of three days, allowing adequate time for detailed discussion. The proceedings will be published by a commercial publishing hiouse. The proceedings are expected to constitute a state-of-the-art presentation of modeling of hydrologic systems.
Keywords: water pollution; environmental transport; mathematical models; rivers; lakes; water reservoirs; estuaries; coastal regions; planning; meetings; hydrology.

75007 Aquatic Ecosystem Modeling Package for Minicomputers. Park, R.A. (Rennselaer Polytechnic Inst., 110 8th, Troy, NY, 12181). **Project number:** K609A-414-A. **Contract:** R806299-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

An efficient, fail-safe package of environmental-specific versions of the aquatic ecosystem model CLEANER will be developed to aid in the environmental management of freshwater lakes and reservoirs. The package will include a series of streamlined, special-purpose models (micro-CLEANER) programmed to run on a minicomputer. It will also have an interactive input-output program to serve as a smart interface with other more powerful versions, such as MS CLEANER, permitting conversational-mode computer graphics. The aquatic ecosystem model CLEANER is the foundation upon which this model will be based. The principal thrust of this project will be to retain the realism and generality of the model, while at the same time simplifying the structure and programming for implementation on a minicomputer. Sensitivity analysis of CLEANER will be used to identify those aspects of the model that are insensitive in a particular aquatic environment. CLEANER will be programmed for a minicomputer, giving special attention to numerical accuracy and execution time. Environment-specific versions will be developed for several distinct types of lakes and reservoirs. A limited number of application-specific versions will demonstrate the utility of the model. A user's manual and video tape presentation explaining the use of the model will be provided.
Keywords: aquatic ecosystems; mathematical models; computers; lakes; water reservoirs; accuracy; cleaning; computer calculations.

75008 Fluvial Transport of Sediments and Nutrients from Nonpoint Sources. Baker, D.B. (Heidelberg College, Tiffin, OH, 44883). **Project number:** K609A-445. **Contract:** R805436. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this study is to investigate the transport and processing of nutrients and sediments as they move through the drainage network of a large agricultural river basin. The study will utilize a nested set of nine stream gaging/sampling stations in the Sandusky River Basin in Ohio. Detailed hydrographs, sediment graphs and chemographs will be obtained for all storm events during the study period. Mass balance computations will be made for water, sediment and nutrients as they move through the network. The wave front movement of the hydrograph will be used to separate sediment from sheet erosion and from resuspended sediment. Nutrient mass balances will be used to study processing and delivery ratios along the river. Delivery of phosphorous from inland point sources to Lake Erie will also be studied as well as the extent of annual variability in nutrient and sediment yields from agricultural watersheds. Individual watershed yield will be correlated with detailed land use/land capability data.
Keywords: sediments; nutrients; environmental transport; watersheds; ohio; seasonal variations.

75009 River Basin Validation of the Midwest Research Institute Nonpoint Calculator and Tetra Tech's Nondesignated 208 Screening Methodologies. Davis, M. (Midwest Research Inst., 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** K609A-472. **Contract:** R806315-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to test and evaluate jointly under actual field conditions the nonpoint source analysis methodology previously developed by MRI and the nondesignated 208 screening methodology previously developed by Ierta Tech. The approach is to apply the methodologies to test sites in the Chesapeake Bay and the Sandusky River Basin. A final report on technical issues related to model application and analysis of the demonstration is planned. The screening approach has been applied to the Sandusky River. The first analysis of these results has been drafted.
Keywords: rivers; mathematical models; evaluation; chesapeake bay; pollution sources; water pollution.

75010 Production, Consumption, Environmental Distribution, and Related Impact of Selected Toxic Pollutants. Wechsler, A. (Arthur D. Little, Inc., 15 Acorn Park, Cambridge, MA, 02140). **Project number:** K609A-473. **Contract:** 68-01-3857. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to conduct a feasibility study to determine if automated procedures can be developed for routine analysis of the sources and determination of the initial environmental distribution of consent decree chemicals (toxics) throughout a given river basin. Currently used or underdeveloped mass-balance techniques for estimating the loadings and predicting the initial distribution of chemical pollutants within river basins will be catalogued and evaluated for potential automation. Data/technology gaps will be identified and recommendations provided for the detailed development of such an automated mass-balance approach (including source assessment) for use by OWWM and EPA regions. Future development is contigent upon results of this study. A feasibility study was initiated in March 1979. Final report/recommendations are due August 1979. Scope of work/work plan/and plenary meetings were completed as of 1 April 1979.
Keywords: toxic materials; rivers; environmental transport; distribution; mass balance; feasibility studies; water pollution.

75011 Extraction/Separation Techniques and Sampler Evaluation. Pope, J.D. (EPA, Environmental Research Lab., College Station Road, Athens, GA, 30605). **Project number:** K713B-103. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$52,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

An automatic sampler developed under another EPA contract will be evaluated in-house for utility and application. The predominant feature of the sampler is its utilization of accumulator columns. These columns, containing materials such as XAD resins or activated carbon, will be evaluated along with various aspects of solvent extraction for the extraction/concentration of organic compounds from water. Reports on (1) evaluation and application of the automatic sampler, and (2) accumulator columns for concentrating certain types or classes of organic compounds from water will be completed. Initial performance and utility tests of the automatic sampler at both laboratory and field sites have been completed. Field tests at municipal water and waste water treatment facilities and a biosphere reserve proved satisfactory for the automatic sampler performance. Studies are being performed to determine optimum sampling parameters. A report was presented on the evaluation and field testing of the sampler at the 1979 Pittsburgh Conference.
Keywords: solvent extraction; samplers; performance testing; organic compounds; water pollution; automation; activated carbon.

75012 Separation of Polar Compounds by Liquid Chromatography. Haeberer, A.E. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K713B-104. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

Techniques, using high pressure liquid chromatography (HPLC), will be developed for the separation and analysis of polar organic compounds extracted from water. These types of compounds are quite prevalent in water and are not easily analyzed by gas liquid chromatography. Standard solutions of compounds under investigation will be spiked into both distilled water and municipal as well as industrial effluents. Extraction, separation and concentration of these pollutants will be carried out using neutral accumulator resins as well as classical shake-out techniques. The separation of various polar organics, e.g., nitrophenols and nitrosamines, will be accomplished using a variety of HPLC columns both isocratically and with solvent gradients. Where applicable, compounds will be derivatized with such reagents as dansyl chloride, NBD chloride,

and fluorescamine to lower their detection limits. Nitrophenols from standard solutions, municipal waste-water and industrial effluents have been separated and quantitated using a reverse phase ODS column with an ammonium acetate buffer-acetonitrile solvent system. Concentrations as low as 0.1 ppB and 10 ppB of a nitrophenol can be determined respectively in drinking water and finished municipal wastewater. N-nitrosamine samples are being determined with a photo-conductivity detector as well as their fluorescent derivatives. These techniques promise lower detection limits in the pico-mole range.
Keywords: organic compounds; chromatography; water; nitrophenol; nitroso compounds; amines; quantitative chemical analysis; qualitative chemical analysis.

75013 Establish GC/FTIR Techniques for Ab Initio Identification of Organic Pollutants. Azarraga, L.V. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K713B-106. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

A report on the current status of application of the Athens ERL GC/FTIR system to organic pollutant identification will be prepared. Efforts to optimize this prototype system's performance will continue. Features to be improved include the light pipe dimensions, the interface between the light pipe and the interferometer, and the software for computerized data collection and manipulation. A state-of-the-art chromatograph and current spectrometer hardware will be incorporated into the FTIR system and evaluated. Thus far, system sensitivity has been increased three orders of magnitude by proper selection of light pipe dimensions. This EPA improvement is now standard in commercial instruments. Magnetic tape data collection software has been written and implemented resulting in twice the speed of previous programs. Data base search program and reconstruction of chromatogram from interferometric data have been implemented on the GC-FT-IR system.
Keywords: interferometry; gas chromatography; organic compounds; water pollution; interferometers; design; chemical analysis; water.

75014 Develop Master Analytical Scheme for Trace Organics in Water. Pellizzari, E. (Research Triangle Inst., P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** K713B-111. **Contract:** 68-03-2704. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

Accumulators, organic liquid extractants, purge/trap, and other techniques will be investigated for volatile compounds. All major classes of compounds will be studied for recovery from wastes and clean water. A quantitation technique based on GC-MS detection will be developed. Finally, a recommended scheme for a complete analysis of volatile organics in water will be developed. Final output will include a protocol for qualitative and quantitative analysis of all volatile (gas-chromatographable) organics in surface water, effluent, and drinking water. The contractor has completed a state-of-the-art literature review for analysis of organics in water, including current information gathered from 150 people working in the area. Tentative plans were made for experiments to be performed in Phase II to actually develop the scheme. These were presented to 80 invited people at a conference to scrutinize the scheme. Then plans were modified and completed. Experimental work is now in progress.
Keywords: trace amounts; organic compounds; drinking water; quantitative chemical analysis; gas chromatography; mass spectroscopy; qualitative chemical analysis; surface waters; liquid wastes; water.

75015 Ab Initio Identification of Organic Compounds in Water. Garrison, A.W. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K713B-113. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

A delineation of analytical procedures for organic pollutant identification will be prepared. Based on each technique's probability of providing compound identifications, the protocol developed in this task will provide a plan for the most efficient use of available analytical instruments and personnel. Unidentified compounds from a broad variety of sources will be identified to establish the utility of various spectral information. Although no formal procedures have been developed, advanced analytical techniques (chemical ionization MS, high resolution MS, GC-IR) have been used to identify several ab initio compounds: ethylene glycol dinitrate (a suspect nitrosamine) in drinking water, alachlor (a pesticide) in drinking water, clofibrate in municipal sewage, and several other compounds in drinking water and industrial effluents.
Keywords: organic compounds; drinking water; qualitative chemical analysis; quantitative chemical analysis; mass spectroscopy; gas chromatography; glycols; pesticides; sewage; liquid wastes; water.

75016 Develop Master Analytical Scheme for Trace Organics in Water. Pellizzari, E. (Research Triangle Inst., P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** K713B-126. **Contract:** 68-03-2704. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

Accumulators, organic liquid extractants, purge/trap, and other techniques will be investigated for volatile compounds. All major classes of compounds will be studied for recovery from wastes and clean water. A quantitation technique based on GC-MS detection will be developed. Finally, a recommended scheme for a complete analysis of volatile organics in water will be developed. A protocol for qualitative and quantitative analysis of all volatile (gas-chromatographable) organics in surface water, effluent, and drinking water will be developed. The contractor has completed a state-of-the-art literature review for analysis of organics in water. Including current information gathered from 150 people working in the area. Tenative plans were made for experiments to be performed in Phase II to actually develop the scheme. These were presented to 80 invited people at a conference to scrutinize the scheme. Then plans were modified and completed. Experimental work is now in progress.
Keywords: trace amounts; organic compounds; surface waters; drinking water; liquid wastes; qualitative chemical analysis; quantitative chemical analysis; water.

75017 Electron Microscopy. Long, J.M. (EPA, Environmental Research Lab., College Station Road, Athens, GA, 30605). **Project number:** K713B-127. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$40,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This project will develop an analytical method, based on best current technology, for determining the asbestos fiber content and size distribution in water. After developing and publishing an interim method, new and improved techniques will be established. Methods will be developed for physical and chemical characterization of particulates. An interim asbestos method, based upon state-of-the-art, was published after applying this method on a variety of different water sources; the interim method has been revised and will be published as an EPA report.
Keywords: electron microscopy; technology assessment; asbestos; water; aerosols; particles.

75018 Gas-Chromatography Fourier Transform Infrared (GC/FTIR) Data Base. Noone, M.M. (Block Engineering, Inc., Sadtler Research Labs., 3316 Spring Garden St., Philadelphia, PA, 19104). **Project number:** K713B-144. **Contract:** 68-03-2651. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$6,000.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is the generation of a computer-readable data base of 3300 GC/FTIR reference spectra for use in the chemical identification of unknown compounds. Vapor phase spectra will be collected using GC/FTIR spectrometer system. The spectra data will conform with the Coblentz Society's criteria for GCIR spectra. Background and sample interferograms and spectra as well as the absorbance spectra will be stored in a 800 BPI, 9-track magnetic tape according to the Coblentz magnetic tape format. The first set of 1000 spectra was delivered on schedule. The collection and editing of the next set of 1300 spectra was completed, and hard copy of the spectra is being made.
Keywords: gas chromatography; infrared spectra; inventories; pollution; toxicity; chemical effluents; fourier transformation.

75019 Development of Chemical Ionization Mass Spectrometry for the Analysis of Aromatic Hydrocarbons, Phenols, and Amines in Water. Hunt, D. (Univ. of Virginia, Garrett Hall, Charlottesville, VA, 22903). **Project number:** K713B-146. **Contract:** B805790. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The goal of this research is the development of novel ionization methods for the analysis of polyaromatic hydrocarbons (PAH's), phenols, and amines in complex environmental samples by chemical ionization mass spectrometry. Preliminary results indicated that use of an oxygen/hydrogen mixture as a reagent gas in combination with pulsed positive ion--negative ion chemical ionization mass spectrometry (PPINICIMS) will afford only molecular ions on the positive ion trace and extensive structural information on the nega-

tive ion trace for PAH's in complex mixtures. Differentiation of many isomeric PAH's, phenols, and aliphatic or aromatic sulfur compounds without prior separation should also be possible with this methodology. Use of a derivatization procedure combined with GC-electron capture negative ion CIMS will be evaluated for the detection and quantitation of phenols and amines at the Femtogram level in environmental samples.
Keywords: polycyclic aromatic hydrocarbons; phenols; amines; environmental materials; quantitative chemical analysis; ionization; mass spectroscopy; water; gas chromatography.

75020 Organic Compounds in Water: a GC/MS Study. Hites, R. (Massachusetts Inst. of Tech., 77 Massachusetts Ave., Cambridge, MA, 02139). **Project number:** K713B-152. **Contract:** R806350. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this two-year grant is a feasibility study of analyzing organic compounds in rivers and defining the source of the compounds. The approach used will basically be that of gas chromatography/mass spectrometry (GC/MS) combined with sample clean-up using high pressure liquid chromatography. Where required, other analytical techniques will be utilized for ab initio identification. It can also serve as a mechanism for training EPA personnel.
Keywords: organic compounds; rivers; chemical analysis; gas chromatography; mass spectroscopy; liquid column chromatography; feasibility studies; water.

75021 Analysis of Organics on Sediments. Ellington, J. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K713B-154. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to develop analytical methods for organic compounds adsorbed on sediments. Liquid extraction and accumulator columns will be studied as means of extraction/concentration of organic compounds adsorbed on sediments. Extraction clean-up techniques will be developed as necessary. Separation of organics will be by GC for volatile compounds; later, liquid chromatography will be used for separation of non-volatiles. Identification of separated components will be by spectral fingerprinting using GC-MS, LC-MS, or GC-FTIR. Work under this task will later be expanded to include soils and sludges. Apparatus has been obtained and tested for analysis of purgeable organics on sediments by the VOA purge/trap method and by the Grob closed-loop stripping method and for solvent extractable organics by use of the polytron homogenizer.
Keywords: sediments; organic compounds; extraction; quantitative chemical analysis; gas chromatography; mass spectroscopy; liquid column chromatography; interferometry.

75022 Impacts of Sediments and Nutrients on Biological Resources in Surface Waters of the United States. Golley, F.B. (University of Georgia, Inst. of Ecology, Athens, GA, 30601). **Project number:** K609A-309. **Contract:** R804868-02. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$2,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives of this study are to assess the state of knowledge on impacts of sediments and nutrients on biota in surface waters of the United States, to indicate gaps in that knowledge, and to suggest research for the future. This will be accomplished by preparing a set of review papers and then using hierarchical modeling with matrices to identify missing information in particular areas. The final output will be a report on the state of knowledge on impacts of sediments and nutrients on biota in surface waters of the United States with suggestions for research to fill in gaps in that knowledge. A review paper has been completed entitled Impact of Sedimentation on Aquatic Biota: Review of Literature Surveyed.
Keywords: sediments; nutrients; surface waters; usa; biological effects; aquatic ecosystems; biological models.

75023 Modeling Transport and Behavior of Pesticides and Other Toxic Organic Materials in Aquatic Environments. Park, R.A. (Rensselaer Polytechnic Inst., Troy, NY, 12181). **Project number:** K760C-310. **Contract:** R804820. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The research objective is the formulation, computer implementation, and testing of a detailed, time-varying model of the behavior of organic toxicants in aquatic ecosystems. Emphasis is placed on the generation of maximum feasible physical and biological detail, to give broad applicability and discrimination among many possible target organisms. Functional descriptions of the processes affecting toxicant behavior are generated from literature information, corroborated and/or modified via bench-scale laboratory studies, and linked to an existing aquatic ecosystem model (CLEANER). This model (PEST) and a coarse-resolution steady-state model (an EXAMS model) will be validated against the results of field studies conducted under other auspices. A submodel for bioaccumulation in fishes has been completed and validated. Many of the process equations have been implemented in preliminary form, and PEST has been successfully linked to CLEANER.
Keywords: toxic materials; environmental transport; aquatic ecosystems; biological accumulation; mathematical models.

75024 Microcosm Matrix as a Test System for Pollutants: An Appraisal Using a Toxic Substance. Odum, E.P. (University of Georgia, Institute of Ecology, Athens, GA, 30601). **Project number:** K760B-342. **Contract:** R805860-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$64,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A holistic approach will be used to assess the effects of a toxic substance on ecological processes in freshwater laboratory microcosms. Two factorial experimental designs will be used: (1) a 4 x 4 matrix of static microcosms will be treated with nutrient and pollutant concentrations along two gradients; and (2) a 3 x 4 matrix of flow-through microcosms will be treated with sediment density and pollutant concentrations along two gradients. Several variables will be measured in the microcosms to describe the state of the systems at discrete points in time in terms of three integrative system parameters in total metabolic activity (energy flow), structural complexity, and nutrient flux. Data from both experiments will be used to evaluate the usefulness of microcosm matrices as test systems for potential environmental contaminants. The final output will be a report evaluating the usefulness of microcosm matrices as test systems for potential environmental contaminants. Static tests of nutrient--Cd interactions have been completed, and a report is available as a University of Georgia M.S. thesis. Planning for the second and final phase of the survey has been completed.
Keywords: toxic materials; aquatic ecosystems; biological models; cadmium; toxicity.

75025 Development and Characterization of Laboratory Model Ecosystems for Evaluating Toxic Substances, Fate and Effect. Brockway, D.L. (EPA, Environmental Research Lab., Environmental Systems Branch, College Station Road, Athens, GA, 30605). **Project number:** K760C-375. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$115,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to develop and evaluate microcosms as research tools and as screening tools for use in assessing potential environmental transport and distribution of trace pollutants. Continuous-flow and static aquatic microcosms with variations in biotic and abiotic structure will be set up to evaluate the influence of these factors on microcosm stability and replicability. Evaluative models will be developed and tested based on results from these systems. The final output of this work will be an evaluative model for predicting the concentrations of toxic substances in environmental compartments. These naturally-derived, self-developed laboratory ecosystems are at least as replicable as other microecosystems and are suitable for use in the development and testing of models. All experiments but one on methoxychlor have been completed. The data are being analyzed and a report is in preparation. The final test of methoxychlor in a new design of microcosm is in progress.
Keywords: toxic materials; environmental transport; biological accumulation; aquatic ecosystems; translocation; biological models; water pollution.

75026 Development of Methodology to Estimate Human Exposure in Toxic Substances by Drinking Water. Hedden, K.F. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K760C-468. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop a methodology of exposure analysis of a population at risk through the water route. The approach is to develop a model to follow the transport, transformation and fate of toxics within the water treatment process and distribution systems to the consumer. This will be interfaced with EXAMS and a loading model to predict exposure of a population at risk. This can later be interfaced with other media inputs for a total exposure analysis for humans.
Keywords: water pollution; aquatic ecosystems; water treatment; human populations; risk assessment; toxic materials; environmental

transport; drinking water; biological effects; toxicity; environmental exposure pathway.

75027 Energy Model and Analysis of a Cadmium Stream with a Study Correlating Embodied Energy and Toxicity Effect. Odum, H.T. (State Univ. System of Florida, Gainesville, FL, 32611). **Project number:** K760C-303. **Contract:** R806080. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

This is a proposal to use concepts of energy models to evaluate the role of toxic pollutants in aquatic ecosystems. Using the cadmium stream studies done at the Savannah River Plant as a specific example, the role of the pollutant will be simulated including its fate and its effect, directly on components and indirectly through changes in upper food chains. Energy analysis will be performed on the model determining the energy embodied in pathways, in the toxic substance, and in the effects. Using data from studies, a test will be made of the hypothesis that energy effect in adapted systems is proportional to the energy embodied in a pollutant. Also some calculations will be made on Silver Springs because of the data base as a natural system control. The possible correlation of sensitivity of an ecosystem's component to its embodied energy will be correlated. Preliminary computations of embodied and effects energies of Cd agree to a factor 4. First round of effects simulations are completed.
Keywords: toxic materials; aquatic ecosystems; environmental transport; food chains; mathematical models; energy models; cadmium; environmental exposure pathway.

75028 Comprehensive Assessment of Organics in Drinking Water. Bombough, K.J. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** K770B-015. **Contract:** 68-01-2529. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The bulk of organic material in drinking water and source water is not amenable to analysis by presently used gas or liquid chromatographic techniques. An analytical protocol is being developed to characterize these materials, particularly the non-volatile polar substances that comprise a major portion of organics in water. Techniques are being developed to extract, concentrate, and fractionate these organics with a minimum of loss and alteration of chemical structure. Fractions will be characterized by molecular weight, functional groups, etc. Specific non-volatile compounds will be identified whenever possible. Final output includes a report giving the distribution of organics in drinking water and water supplies according to volatility/molecular weight classes, along with the analysis of non-volatile organic substances that are not detected by routine methodology. An analytical protocol has been developed to fractionate the non-volatile organics in water. It has been tested with a mixture of selected organics and will be refined during the characterization of raw and finished drinking water from the New Orleans municipal water system.
Keywords: drinking water; organic compounds; separation processes; chemical analysis; volatility; purification; water pollution; monitoring.

75029 Sorption Processes in Soils and Water. Means, J. (Univ. of Illinois, Urbana, IL, 61801). **Project number:** K617B-207. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$95,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this project is to identify key sorbate-sorbent properties which control pollutant sorption (kinetic and equilibrium) to natural sediments. Empirical methods of predicting sorption constants are emphasized. The final output will be a set of predictive equations for sorption (kinetic and equilibrium) for organic pollutants in any sediment/water system. The predictive equations (kinetic and equilibrium) will be tested on field samples; bottom sediments containing pollutants will be resuspended and the pollutant release dynamics and equilibrium distribution compared with empirical predictions. To date, sediment/water equilibrium partition coefficients for hydrophobic pollutants were empirically related to octanol/water partition coefficients of the sorbate and to the particle size distribution and organic carbon content of the sediment.
Keywords: soils; water; sorptive properties; hydrocarbons; environmental transport; mathematical models; plumes; water pollution; land pollution.

75030 Interactions of Metal Ions with Organic Ligands in Natural Waters. Natusch, D.F. (Colorado State University, Department of Chemistry, Fort Collins, CO, 80523). **Project number:** K617B-214. **Contract:** R805183. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$64,000.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The general objectives of this investigation are to develop methods for the characterization of the binding of metals by organic ligands common in natural waters and to apply these methods to the determination of metal binding parameters. Specific aims include: (1) development of methods for direct sensing of metal species; (2) isolation and characterization of metal--ligand complexes; and (3) measurement of pertinent metal binding parameters for common organic ligands. The approach includes development of electrochemical, spectrochemical, chromatographic, and chemical treatment procedures to be used in combination for the characterization of metal--organic species. As the procedures evolve they are being used to study both real and simulated natural water systems. Final outputs will include a data set of stability constants for key metal--organic complexes and a mathematical treatment relating these parameters which is designed to aid in evaluating the relative importance of metal--organic interactions in natural waters. Progress to date has centered on development of several new analytical methodologies necessary for measuring the desired binding constants. These include a ring-disc electrode system for direct metal analysis, a rapid separation and analysis method for mercury, and a modified Florence and Batley metal speciation scheme.
Keywords: water pollution; chemical bonds; surface waters; ligands; organic compounds; hydrocarbons; metals.

75031 Analytical Support for Field Studies of Watershed and Basin Scale Models. Payne, W.R. (EPA, Environmental Research Lab., Environmental Systems Branch, College Station Road, Athens, GA, 30605). **Project number:** K770B-352. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide analytical support for pesticide analysis for Iowa State University and paraquat analysis for the Chesapeake Bay Center for Environmental Studies. These data will be used for further verification of the agricultural runoff management model in the coastal plain and corn belt regions.
Keywords: water quality; pesticides; water pollution; management; monitoring; quantitative chemical analysis; ecological concentration; agriculture; runoff; health hazards; environmental impacts.

75032 Effectiveness of Vegetation Buffer Strips for Controlling Sediment and Other Waste Pollutants from Disturbed Watersheds. Simons, D.B. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** K770B-427. **Contract:** R805457-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The primary objective of this study is to develop a methodology for evaluating the effectiveness of vegetation buffer strips for controlling sediment and other major water pollutants such as nitrogen and phosphorus. This methodology will be developed considering the physical significance of the governing processes which dominate the hydrologic, hydraulic, and vegetative aspects of the buffer zone. The design of the buffer strip will determine the size of zone, shape of zone, and type of vegetation in the buffer strip. This determination would be independent of the land use in other parts of the watershed. The hydrologic analysis will consider type, duration, intensity and recurrence interval of storms, infiltration rate, waters, sediment runoff, and the distribution of other major pollutants in the watershed. The hydraulic analysis will consider the rate of surface runoff, resistance to flow, sediment trapping efficiency, sediment and other major pollutants' resistance time, channelization from the upstream, and progressive head cut from the downstream end of the strip. The hydrologic and hydraulic response of the buffer strip is dependent on the geometry of the watershed. A range of conditions from flat land, intermediate land, and steep land will be investigated. The vegetation analysis will consider the type, height, density, stiffness, and natural and flow-induced vibration frequency of the vegetative cover. An engineering analysis of the sediment control efficacy will be made initially and documented in an interim report. Finally, design criteria including the developed methodology will be published. A detailed literature review and theoretical analysis of the effectiveness of buffer strips has been completed. The literature review draft final report is currently under review; the second report on the analysis is being typed. Sediments, nutrients, and temperature were evaluated.
Keywords: water pollution control; nitrogen; phosphorus; hydrology; diffusion barriers; watersheds; plants; sediments; evaluation; diffusion; water pollution.

75033 Simulation of Nitrogen Movement and Transformation in the Root Zone. Davidson, J.M. (University of Florida, Dept. of Soil Science, Gainesville, FL, 32611). **Project number:** K617A-440. **Contract:** R803607-03. **Supported by:** Environmental Protection Agency,

Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$4,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives include development and testing of a mathematical model to describe movement and transformation of nitrogen in soils. Spatial variability of selected soil physical and chemical properties will be evaluated for influence on the precision with which nitrogen distribution and movement can be predicted and measured in the field. Several sources of existing data will be utilized to test and evaluate the model. The first phase of this project was completed in March 1977. The project was extended two additional years to develop and evaluate phosphorus transport and transformation as well as organic nitrogen submodels. In addition, a two-dimensional model for water, nitrogen, and phosphorus movement to tile drains will be developed and evaluated. The nitrogen model is being expanded to include soil denitrification processes in the presence of animal manure as well as for fallow and row crop production.
Keywords: nitrogen; root absorption; environmental transport; biological pathways; biochemical reaction kinetics.

75034 Chemical Processes. Zepp, R.G. (EPA, Office of Research and Development, Environmental Research Lab., College Station Road, Athens, GA, 30605). **Project number:** K609A-202. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$139,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop techniques for using laboratory data to predict rates and products of nonbiological transformations of toxic substances in aquatic environments. Mathematical descriptions of the processes are developed that can be used in computer models to compute rates as a function of quantifiable properties of both the pollutant (e.g., its hydrolysis rate constant) and the environment (e.g., sunlight intensity, pH, sediment load). Present research includes studies of photosensitized reaction, oxidation, and effects of sediments upon photolysis and hydrolysis. The role of humic acid, fulvic acid, and algae in photosensitized reactions is being examined. The photosensitizing ability of humic acid from various sources is being examined to help define appropriate model photosensitizers. Surface-catalyzed reactions of pollutants on sediments from natural water bodies are also being studied. Model compounds are being employed to learn more about photosensitized reactions involving energy transfer and charge transfer. Results indicate that general base catalysis is an important determinant of the reaction rates of pollutants on sediments and that humic materials play an important role in photosensitized reactions of pollutants in freshwaters.
Keywords: aquatic ecosystems; photolysis; photosensitivity; water pollution; hydrolysis; sediments; mathematical models; photochemistry; environmental transport.

75035 Prediction of Microbial Transformations of Toxic Substances in Natural Waters and Sediments. Paris, D.E. (EPA, Environmental Research Lab., College Station Road, Athens, GA, 30605). **Project number:** K775B-212. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$142,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

Laboratory rate constants for microbial transformation of several toxic substances will be evaluated for their reliability in predicting the fate of these chemicals in natural systems. Microbial transformation rates will be measured in a variety of natural waters and sediments for comparison with laboratory rates. Transformations will be investigated relevant to the percentage of total microbial population active in degrading pollutants, products of degradation, and definition of procedures describing the kinetics of toxic substances in natural systems.
Keywords: water resources; ground water; sediments; biodegradation; microorganisms; metabolism; biochemical reaction kinetics; toxic materials; water pollution.

75036 Toxic Substances Model for EXAMS. Burns, L.A. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K775B-314. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is the development and validation of a computerized model for predicting exposure, fate, and persistence of toxic organic chemicals in aquatic ecosytems. The model will evaluate the combined implications of exogenous loadings, transport (internal movement and export), and in-situ transformation processes (chemical and biological) in a series of archetypal aquatic environments. EXAMS is a system for the logical derivation of the behavior of toxicants in the environment from laboratory bench-scale information (chemical rate constants, solubility, partition coefficients, thermodynamic constants, etc.), and for the analysis and synthesis of behavioral characteristics in a form of direct use in the regulatory process. The approach to this task involves the use of relatively well-corroborated unit descriptions of environmental and chemical phenomena in the context of an interactive computer system that assembles the unit processes into an ecosystem-level description of toxicant behavior. The assembled information comprises a predictive model; the forecasts of the model can be validated and can be analyzed to give an indication of the probable ambient concentration, net degradation, persistence, etc., of a given toxicant.
Keywords: toxic materials; organic compounds; aquatic ecosystems; mathematical models; environmental transport; chemical reactions; biochemical reaction kinetics; ecological concentration; solubility; thermodynamics.

75037 Toxic Substances Evaluative Models. Lassiter, R.R. (EPA, Environmental Research Lab., College Station Rd., Athens, GA, 30605). **Project number:** K775B-315. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant charactcrization and analysis.

The objectives of the project are to develop and test evaluative models for toxic substances. The project has three facets: (1) the working evaluative model must be constructed; (2) the capability of the model must be tested with controlled microcosm-type studies; and (3) the reliability of the evaluative modeling approach must be tested in the field. The work is in progress for carrying out the production of the evaluative model. The first replicate test experiment with methyl parathion has been completed.
Keywords: toxic materials; mathematical models; evaluation; parathion; toxicity.

75038 Investigate Feasibility of LC/MS for Identification of Non-Volatile Pollutants. Futrell, J. (University of Utah, Dept. of Chemistry, 1400 East 2nd Street, Salt Lake City, UT, 84112). **Project number:** K614D-108. **Contract:** R804335. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$6,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The most effective system for identification of organic pollutants in environmental water samples is the gas chromatograph/mass spectrometer. Volatility considerations with this system limit it to compounds that have a significant volatility. These compounds account for only about 1/5 of the total organic carbon in many water samples. This task will combine the separating capability of high pressure liquid chromatography (LC) with the identification capability of mass spectrometry to provide a system capable of identifying non-volatile organics by means of their mass spectra. The combination of a dense gas chromatograph and a mass spectrometer has potential; however, temperature control requirements are severe and will probably limit the application. The feasibility of ultrasonic nebulization of a liquid chromatographic effluent into a mass spectrometer with good efficiency has been demonstrated for naphthalene.
Keywords: feasibility studies; gas chromatography; mass spectroscopy; water pollution; organic compounds; carbon compounds; volatility; quantitative chemical analysis; monitoring; naphthalene; monitoring.

75039 Identification of Non-Volatile Organic Compounds Formed During Water Chlorination. Glaze, W.H. (North Texas State Univ., North Texas Station, Box 13707, Denton, TX, 76203). **Project number:** K824D-134. **Contract:** R805822-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to determine under what conditions and to what extent new organic compounds are produced by the chlorination of natural waters, municipal and industrial wastewaters, and other special waste products such as septages and sludges. The principal focus will be in the examination of higher molecular weight species and other non-volatile compounds which are not amenable to analysis by gas chromatography. Particular attention will be given to the following elements of the project: (1) development of a generalized scheme for the separation of non-volatile solutes in these types of water according to molecular size, polarity, and chemical class (if possible); (2) spectroscopic examination (MS, ir, uv, NMR, etc.) of these fractionated solutes to determine their chemical composition and molecular architecture; and (3) development of reliable and efficient HPLC methods for the separation and analysis of the non-volatile species in water according to molecular class. Methods have been developed for measurement of total organic halogen in municipal wastewaters. GC-MS techniques have been applied to the identification of about 50 chlorinated organics formed during chlorine treatment of municipal wastewaters. A protocol has been projected for use in investigating

the chemical effects of chlorination on non-volatile organics in water. Chlorination experiments have been performed to show the formation potential for chlorinated organic compounds, using biologically treated municipal wastewater.
Keywords: organic compounds; drinking water; waste water; chlorination; separation processes; chemical analysis.

75040 Study of the Mechanism and Rates of Volatization of Contaminants from Water Bodies. MacKay, D. (Univ. of Toronto, 92 College St., Toronto, Ontario M5S 1B2). **Project number:** K824D-206. **Contract:** K805150. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the project is to develop a deeper quantitative understanding of the processes by which some environmental contaminants volatilize from water bodies to the atmosphere. The final result will be a predictive equation for volatilization from natural waters. Accomplishments to date include: (1) method developed for measurement of Henry's law constants (H); (2) measurement of H for a series of hydrophobic pollutants; (3) determination of electrolyte effects of H; and (4) determination of the effect of wind speed on the liquid phase mass transfer rates for hydrophobic pollutants. Pollutant solubilities in aqueous solutions of electroytes have been determined. Pollutant sorption on sediments has been introduced into predictive volatilization equations.
Keywords: water pollution; volatility; mathematical models; mass transfer.

75041 Microbial Conversion of Deleterious Molecules: Kinetic Models for Aquatic Environments. Ollis, D.F. (Princeton Univ., Box 430, Princeton, NJ, 08540). **Project number:** K824D-213. **Contract:** R806208. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to develop a simple but general kinetic framework which describes microbial degradation trace deleterious molecules when introduced into otherwise normal aquatic environments. Chemostat operation at low dilution rates using natural, unenriched mixed populations will provide data for determining kinetic model parameters. Trace quantities of molecules typifying various pollutants (e.g., phenols, pesticides, etc.) will be introduced in a sterile feed to multiple chemostat arrangements. The model developed will include accounting for the major phenomena reported to date in the literature. The necessary equipment (chemostat, gas liquid chromatograph, etc.) has been obtained for these studies. Laboratory studies will begin in April. Literature review on biodegradation kinetics is in progress.
Keywords: phenols; pesticides; microorganisms; biodegradation; gas chromatography; biochemical reaction kinetics; mathematical models.

75042 Third Symposium on Aquatic Pollutants. Beem, D.R. (American Inst. of Biological Sciences, 1404 Wilson Blvd., Arlington, VA, 22209). **Project number:** K824D-217. **Contract:** R806666. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

A symposium on the identification and transformation of aquatic pollutants will be held October 15—17, 1979, at Jekyll Island, GA. The theme of the meeting will closely parallel those of previous such conferences (Athens, GA 1974; Amsterdam, The Netherlands, 1977). These are: (A) the identification of aquatic pollutants, including techniques of extraction and separation from the aquatic environment and application of advanced analytical instrumentation of the analysis of pollutants; and (B) the transformation of pollutants to the aquatic ecosystem by microbial, chemical, and photolytic action. Approximately 20 to 25 speakers will participate in the technical sessions. In addition to the invited papers, poster sessions will also be conducted. It is estimated that about 300 scientists from industry, government, and academia will attend the conference. Adequate time is planned for audience participation and discussion with the speakers.
Keywords: water pollution; meetings; separation processes; chemical analysis; biodegradation; weathering; photochemical reactions.

75043 Fate and Biological Effects of Polycyclic Aromatic Hydrocarbons in Aquatic Stream. Giesy, J.P. (DOE, P.O. Box A, Drawer E, Aiken, SC, 29801). **Project number:** K832B-385. **Contract:** DB-X0290. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to test the hypothesis that valid theoretical models predicting the fate of organic compounds in complex environments can be made from knowledge about the compounds obtained from simple laboratory studies and the environments in which they are released. The hypothesis will be tested in the following way: (1) a theoretical model will be developed for predicting the fate of organic compounds; (2) it will be parameterized for two dissimilar organic compounds, quinoline and benzo(a)pyrene, using the artificial streams for the test environment; (3) field studies will be completed for the two test compounds in the artifical streams and predicted fate will be compared to the actual fate; and (4) model modifications will be made as required. Fates model for quinoline and BAP has been completed. Double-label experiments to determine importance of vectors are underway.
Keywords: polycyclic aromatic hydrocarbons; biological effects; mathematical models; quinolines; benzopyrene; tracer techniques; water pollution; environmental transport.

75044 Identification of Components of Energy-Related Wastes and Effluents. Gebhart, J.E. (Gulf South Research Institute, P.O. Box 26518, New Orleans, LA, 70186). **Project number:** K625D-141. **Contract:** 68-03-2487. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$106,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); geothermal(25) **R and D categories:** Pollutant characterization and analysis.

Liquid and solid wastes from energy activities are being analyzed to identify and measure potential pollutants. Volatile and semi-volatile organic components are being analyzed by combined gas chromatography--mass spectrometry. Except for mercury and elements occurring naturally as gases, chemical elements are detected and measured by spark source mass spectrometry. Flameless atomic absorption spectrophotometry is being used to analyze mercury. To avoid work duplication, information about other current investigations of energy-related pollution is being summarized to identify information gaps and to select samples that will provide maximum information. The final report will list effluent constituents identified in this contract and will summarize pertinent previous and ongoing research programs concerning composition of energy effluents. About 150 samples have been obtained and are being analyzed. Results to date include preliminary lists of organic compounds and chemical elements detected in wastes from coal gasification, coal-fired power plants, oil refineries, coal mines, oil shale processors, and geothermal developments. The final report will also include results of analyses of coal liquefaction samples.
Keywords: liquid wastes; solid wastes; chemical analysis; gas chromatography; mass spectroscopy; mercury; absorption spectroscopy; elements; organic compounds; coal gasification plants; fossil-fuel power plants; petroleum refineries; coal mines; oil shale processing plants; geothermal energy.

75045 Development of Procedures for Development of Intermedia Transfers of Toxic Substances. Varley, W. (Arthur D. Little, Inc., 15 Acorn Park, Cambridge, MA, 02140). **Project number:** K760C-444. **Contract:** 68-03-2898. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

A toxic substance multimedia model for use in exposure assessment from existing single media models will be constructed. Existing air pollution models will be evaluated to determine the most appropriate for inclusion in a toxic substance air-water exposure assessment model, and interface the chosen air model with EPA water and runoff models to form a toxic substance multimedia model for use in exposure assessment.
Keywords: toxic materials; air pollution; mathematical models; runoff; water pollution; hydrocarbons; metabolism; toxicity.

75046 Fate and Biological Effects of Polycyclic Aromatic Hydrocarbons in Aquatic Stream. Giesy, J.P. (Savannah River Operations Office, P.O. Box A, Aiken, SC, 29801). **Project number:** K832B-385. **Contract:** D8-X0290-1. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to test the hypothesis that valid theoretical models predicting the fate of organic compounds in complex environments can be made from knowledge about the compounds obtained from simple laboratory studies and the environments in which they are released. A theoretical model will be developed for predicting the fate of organic compounds. It will be parameterized for two dissimilar organic compounds, quinoline and benzo(a)pyrene, using the artificial streams for the test environment. Field studies will be completed for the two test compounds in the artificial streams, and predicted fate will be compared to actual fate. Model modifications will be made as required.
Keywords: benzopyrene; quinolines; mathematical models; environmental transport; bench-scale experiments; aquatic ecosystems; water pollution; polycyclic aromatic hydrocarbons; biological effects.

75047 Analysis of Mathematical Models of Pollutant Transport and Dissipation. Ames, W.F. (Georgia Inst. of Tech., 225 North Ave. NW, Atlanta, GA, 30332). **Project number:** K760C-79-450. **Contract:** R 807114-02. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to perform dimensional similitude analyses and obtain exact solutions for nonlinear and stochastic models of pollutant transport, biological and chemical degradation, and dispersion in rivers and streams. The results of the analysis will be used to study the impact, control, and persistence of contaminants in rivers and streams. The approach to solving these problems will be performed using the methods of nonlinear analyses as given in the investigator's books on nonlinear problems. Specific methods will include similarity analyses and singular perturbation methods. Studies of the first two problems, in which dispersion is neglected, show them to be amenable to solution.
Keywords: water pollution; environmental transport; biodegradation; environmental impacts; mathematical models; rivers.

75500 Management and Support: Industrial Source Selection. Myers, L.H. (EPA, Robert S. Kerr Environmental Research Lab., P.O. Box 1198, Ada, OK, 74820). **Project number:** L610B-001. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop technology necessary to eliminate the discharge of all pollutants, primarily toxic pollutants, from materials processing petrochemical industry point sources. Another major objective is the development of the means necessary to eliminate the discharge or emission of pollutants for the areawide or combined point source where industrial sources are the predominant contributor. A technology research (TR) program will be conducted dedicated to a spectrum of research activities culminating in the demonstration or assessment of engineering scale technologies by extramural research demonstration grants or intramural technical assistance. An ongoing program on treatability, toxics removal, and residual management is planned. Research reports are available through NTIS.
Keywords: petrochemical plants; pollution abatement; planning; point pollutant sources; industrial wastes; research programs.

75501 Treatment of Petrochemical Wastewater for Reuse. O'Bryan, O.D. (Union Carbide Corp., P.O. Box 8361, South Charleston, WV, 25303). **Project number:** L610B-038. **Contract:** S801398. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop feasibility, design, and economic data on petrochemical wastewater upgrading and subsequent reuse by testing a pilot-scale system comprising an integrated sequence of the most promising treatment steps for upgrading biotreated petrochemical effluents for use in pilot-scale heat transfer systems. Processes comprising the treatment pilot-plant will be selected after an initial technology review, followed by bench-scale tests to develop design and feasibility data, where necessary. Need for facilities for the disposal of sludges and other by-product wastes will be considered in this study. Processes to remove the following categories of residual contaminants will be included: suspended solids, soluble organics, and soluble salts. Other objectives are to compile present quality criteria for cooling water, boiler-feed water, service water, and process water in typical petrochemical plants and to determine the effects of using lower quality water, particularly with respect to residual organic contamination; to evaluate alternative or additional operatings/process, concurrently, for incorporation in the pilot treatment system if a need for such alternatives is indicated by pilot-scale operating experience or by more precise definition of quality criteria for reclaimed water; to compare the economic and technical feasibility of alternative processes to aid in proper selection and to develop through economics an integrated treatment system capable of producing reuseable water; and to refine analytical techniques for monitoring removals achieved by the various treatment processes to permit a more precise evaluation of the processes effectiveness and to identify ways to improve them.
Keywords: petrochemicals; waste management; recycling; water pollution control; waste water; feasibility studies; design; economics; pilot plants; purification; water chemistry; water requirements; boilers.

75502 Solvent Extraction for Treatment and Recovery of Chemicals, etc. King, C.J. (University of California, Dept. of Chemical Engineering, Berkeley, CA, 94720). **Project number:** L610B-046. **Contract:** R803773. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

This grant proposal is a continuation of research being conducted for the demonstration of solvent extraction as a treatment method for wastewaters from various acetic acid manufacturing processes, as well as determination of the most attractive process configuration, choice of solvents and operating conditions. Composition of the wastewaters, equilibrium with solvent phases, efficiency of extraction in a mini-plant RDC countercurrent extractor, and regeneration of solvent by evaporation and rectification will be obtained on an experimental basis. The incentive for recovery of chemical values from the extracted pollutants will be investigated.
Keywords: solvent extraction; materials recovery; waste processing; waste water; feasibility studies; demonstration programs; water pollution control; recycling; regeneration; metals; financial incentives; economics; acetic acid; industrial wastes; manufacturing; industry.

75503 Environmental Assessment for Petroleum Refinery: Wastewaters and Residuals. Manning, F.S. (University of Tulsa, School of Engineering and Physics, Department of Chemical Engineering, Tulsa, OK, 74110). **Project number:** L610C-013. **Contract:** R805099. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA-$81,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The grantee will prepare an assessment of emissions from the petroleum refining industry. Emissions are limited to the final effluent and residuals from wastewater treatment. This will be accomplished by utilizing existing information and recognized experts pertinent to the following topics for the assessment: (1) state-of-the-art discussions on characterization of the refining industry and on treatment and control (T and C) technology; (2) rationale for characterizing the wastewater and residuals emissions; (3) available emission data; (4) environmental impact criteria based on existing regulations; (5) comparison of pollutant emissions to environmental impact criteria, and statement as to T and C; and (6) evaluation of existing and emerging T and C systems relative to acceptable emission levels, and identification of T and C research needs.
Keywords: petroleum refineries; environmental impacts; water pollution; waste water; water pollution control.

75504 Powdered Carbon-Activated Sludge: Filtration Processes for Petroleum Refinery Wastewater. Knecht, A.T. (Atlantic Richfield Co., Harvey Technical Center, 400 E. Sibley Blvd., Harvey, IL, 60426). **Project number:** L610C-018. **Contract:** R804731-01. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to determine if direct addition of powdered activated carbon (PAC) to activated sludge units, and changes in operating procedures, will significantly improve effluent quality, and to approach best available technology. The role of adsorbents in enhancing biological activity will be investigated along with their ultimate impact on sludge disposal by land application. An investigation of activated sludge treatment of refinery process wastewaters will be conducted in laboratory bench-scale systems. Side-by-side studies will be made to: (1) determine the role of adsorbents in enhancing biological treatment, and (2) determine the impact of loading variations on system performance. Additional studies will be conducted to: (1) identify hydrocarbon types which resist removal by the evaluation of biological and physical treatment programs; (2) investigate the ultimate fate of sludges generated by treatment programs in land application techniques; (3) formulate a work plan for full-scale plant evaluation of combined adsorbent-activated sludge treatment based on pilot studies; and (4) develop rough economic assessment of treatment programs investigated.
Keywords: petroleum refineries; waste water; waste processing; sludges; filtration; water pollution control; adsorbents; bench-scale experiments; removal; hydrocarbons; economics; biodegradation.

75505 Effectiveness and Cost of Activated Carbon Adsorption of Toxic Compounds from Petroleum Refinery Waste Waters. Bunks, S.C. (Oklahoma State Univ., Life Science W., Stillwater, OK, 74675). **Project number:** L610C-020. **Contract:** R805307. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

A study will be conducted to determine the adsorption capacity of activated carbon for 10 specific toxic organic compounds identified in petroleum refinery wastewaters. Adsorption isotherms and column breakthrough data on the specific toxic compounds will be utilized to predict the effectiveness of carbon adsorption treatment and the projected cost of a full scale treatment plant. In addition, fathead minnow and benthic macroinvertebrate continuous-flow bioassays of carbon-treated petroleum refinery wastewaters will be performed to determine the capability of carbon treatment to

produce a zero-toxic pollutant discharge. The aquaculture treatment mode will be observed on a pilot scale to determine its effectiveness in biologically removing toxic substances from petroleum refinery effluents. Isotherm and column breakthrough studies for the 10 compounds are nearing completion. The continuous flow bioassays are in progress. The pilot scale aquaculture treatment system is presently being set up. A draft copy of final report has been submitted for review.
Keywords: liquid wastes; activated carbon; sorptive properties; petroleum refineries; waste water; organic compounds; toxic materials; adsorption; cost; fishes; benthos; bioassay; water pollution; monitoring; aquaculture.

75506 Cyanide Removal from Petroleum Refineries. Huff, J.E. (Illinois Inst. of Technology, Graduate School, 3300 S. Federal Street, Chicago, IL, 60616). **Project number:** L610C-021. **Contract:** R804029. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA. **Related energy source:** oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to evaluate the removal of low level concentrations of cyanides in petroleum refinery wastewater by the addition of powdered activated carbon and cupric chloride to an activated sludge unit. The activated carbon and cupric chloride act as catalysts in the oxidation and destruction of the cyanides. A two-phase study will be carried out to develop the process. The first phase will consist of a bench-scale study using solutions of metal—cyanide complexes in order to determine the mechanics of cyanide destruction. The second phase will consist of bench-scale tests using actual refinery wastes. If this study develops a promising process, then a pilot-scale and/or full-scale demonstration in a refinery will be considered for further study.
Keywords: petroleum refineries; cyanides; removal; waste water; waste management; activated carbon; copper chlorides; oxidation; feasibility studies; recycling.

75507 Treatment of Oil Refinery Wastewaters for Reuse Using a Sand Filter-Activated Carbon System. Bubri, L. (B.P. Oil Corporation, Marcus Hook, PA, 19061). **Project number:** L610C-029. **Contract:** 12050GXF. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The project objectives include: (1) demonstration of the unique application of sand filtration followed by activated carbon adsorption for total treatment of refinery wastewaters; (2) demonstration of the use of two-stage centrifugation for sludge dewatering and oil recovery from the centrate; (3) investigation of the practicality of the reuse of treated effluent within the refinery; (4) collection of reliable operating data from full-scale facilities including capital and operating costs of treatment facilities; and (5) investigation of the reuse of treated effluent for cooling tower and boiler feed water makeup. The project plan will be to design, construct, and operate a refinery wastewater treatment facility consisting of sand filtration and activated carbon adsorption. The design is to be based on information gathered during prior pilot-scale evaluation and filter-activated carbon system. The project will demonstrate the feasibility and use of sand filter-activated carbon system for treatment of refinery wastewaters as an alternative to the conventional biological treatment.
Keywords: petroleum refineries; waste water; waste management; recycling; filtration; activated carbon; sand; water pollution control; resource conservation.

75508 Residual Waste Treatment Facility. Lambie, J.A. (Ventura County Regional Sanitary District, Ventura, CA). **Project number:** L610F-058. **Contract:** S803223-01. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

Ventura proposes to construct a residual waste treatment facility to dispose of industrial and domestic residual wastes which are now put into sewers or disposed of improperly. Therefore, Ventura will require control of wastes such as: (1) brines from oil production, boiler blowdown, ion exchange brines, etc.; (2) organic wastes such as cannery and frozen food trimmings, waste hulls, seeds, skins and cores; (3) toxic metal wastes from such processes as plating, etching, and cleaning; (4) nonmetallic toxics such as phenols, formaldehydes, pesticides, etc.; and (5) residual petroleum wastes such as oil sludge, tank sump pumpings, or accidental oil spills. Ventura will produce planning studies, treatability studies, treatment processes and management schemes to attempt accomplishment of these goals. A draft of the final report is under review.
Keywords: industrial wastes; municipal wastes; waste disposal; brines; petroleum industry; metals; toxic materials; phenols; formaldehyde; pesticides; sludges; petroleum residues; waste processing; waste processing plants; food industry; planning.

75509 Useful Application of Flue Gas Desulfurization Sludges in Combination with Municipal Sludges to Produce Fertile Soils. Freas, R.C. (Dravo Corp., 1 Oliver Plaza, Pittsburgh, PA, 15225). **Project number:** L610F-065. **Contract:** R803999-01. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective of the project is to find if municipal sewage sludges in addition to flue gas desulfurization sludges will result in a sludge that will support agricultural production. This will be studied in bench and actual scale by mixing and stabilization of the sludges on which agricultural growth studies will be made. The final output of the study will be the production of a final report detailing the results of an effort to produce a useful material from the two waste products by simple mixing and stabilization. A draft of a final report concludes that based on the test results obtained in the research project, flue gas desulfurization sludges and municipal sludges when properly mixed and stabilized will support vegetation. The final report has been received and is under review.
Keywords: sludges; municipal wastes; flue gas; soils; desulfurization; sewage; agriculture; mixing; uses; fertilizers; waste disposal.

75510 Nonpoint Source Sediment Production in the Colusa Basin Drainage Area. Tanji, K.K. (Univ. of California, Davis, CA). **Project number:** L770A-1-42. **Contract:** R805462-01. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

This project proposes to identify the potential nonpoint sources of suspended matter in the upland and valley floor of the Colusa Basin drainage area in the west side of the Sacramento River Basin. The upland area consists of 1700 square miles of watershed and the valley floor is devoted primarily to irrigated agriculture. A 70-mile long Colusa Basin drain conveys flood runoffs and irrigation return flows. The drain contains a significant sediment load and discharges into the Sacramento River typically raising the turbidity in this river to about 20 Jackson Turbidity Units (JTU). To the best of our knowledge, the factors contributing to or affecting the sediment load in Colusa Basin drain have not been fully ascertained as yet. The suspended matter problem is unique in that it does not settle out even under very low current velocities. This project will determine the physical, chemical, and mineralogical characteristics of the suspended and bed load materials and flow volume and current velocity to understand their transports, deposition, and resuspension along with their production. The results of this research will be useful to formulate best management practices to control erosion and minimize sediment production. Sampling sites were selected and instrumentation was installed. Data collection was coordinated with state and federal agencies operating in the project area. Special studies were coordinated with the state 208 planning program.
Keywords: sediments; suspensions; rivers; drainage; runoff; physical properties; chemical properties; environmental transport; water currents; volume; velocity; erosion.

75511 Optimization of Animal Wastes Treatment with Reference to Biotreatment, Recovery of Gas, Proteins and Agricultural Utilization of Effluents. Oleszkiewicz, J.A. (Research Institute on Environmental Development, Wroclaw Division, Wroclaw, Poland). **Project number:** L770D-F002. **Contract:** JB-5-534-7. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The project will attempt to optimize the existing treatment system for a large hog farm and evaluate the production of bio-gas, production of protein, and the production of yeast from the wastes. Also, land application of the effluent will be evaluated for possible ground and surface water contamination. The project will produce a report detailing the processes investigated, their efficiencies and the economics of each system. The initial laboratory scale work is complete. Field modifiation of the test treatment plant is scheduled for late 1978.
Keywords: agricultural wastes; nutrients; water pollution; manures; swine; single cell protein; yeasts; production; waste product utilization; biodegradation; animal feeds; proteins; water pollution abatement.

75512 Comparison of Four Dairy Manure Management Systems. Martin, R.O. (Agway, Inc., Research and Development, P.O. Box 1333, Syracuse, NY, 13201). **Project number:** L770D-059. **Contract:** R804349. **Supported by:** SEE CODE- 9504943 Robert S. Kerr Environmental Research Lab. (EPA), Ada, OK (USA). **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project will study and compare four different management systems for dairy manure over a 3-year period. Total cost, energy use, nutrient loss, efficiency of nutrient utilization for corn

production, and environmental effects of each system will be compared from the data collected during this study period. Five 3-acre treatment areas will be utilized with one defined manure management system assigned to each area. Work is on schedule with data collection to end in November 1979.
Keywords: manures; agricultural wastes; waste management; maize; production; waste product utilization; environmental impacts; data; nutrients; feasibility studies; economics; fertilizers; comparative evaluations; runoff; water pollution abatement; cultivation techniques.

75513 Fate of Toxics and Organics Compounds in Land Treatment. Enfield, C.G. (EPA, Robert S. Kerr Environmental Research Lab., Ada, OK, 74820). **Project number:** L822C-067. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: (1) evaluate the transport of selected organics through soils under laboratory conditions; (2) develop volatilization, sorption, and degradation models to predict movement through soil profiles; and (3) determine whether added organics modify treatability of major constitutents in wastewater. Wastewater will be applied to closed environmental chambers simulating land wastewater treatment systems. Selected organics will be injected in wastewater streams, and their fate monitored with time and space. Data collected will be used to develop models predicting transport of specific pollutants.
Keywords: organic compounds; bench-scale experiments; soils; adsorption; environmental transport; waste water; toxic materials; water pollution; land pollution; monitoring.

75514 Investigation of a Technique to Identify Sources of Nitrate in Ground Water. Jones, D.C. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** L824C-005. **Contract:** 2804378. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to perform a series of field and laboratory determinations in order to assess the general feasibility of using stable nitrogen isotope ratios to delineate the source(s) of nitrate pollution in ground water. Ground water and/or pedologic and geologic media will be collected from ten geographical areas to characterize the effects of septic tanks, animal feedlots, spray irrigation of domestic wastewater, fertilized agricultural land, and possibly other sources of nitrate contamination. Emphasis will be placed on acquiring sufficient numbers of samples to obtain statistically significant results. The samples containing various nitrogen species will be processed in a manner to assure quantitative conversion of nitrate to nitrogen gas, and then analyzed as to 15N/14N ratios on a Nier-type double-collecting, 60 degrees-sector gas source mass spectrometer. The results will be analyzed to ascertain whether isotopic ratios of nitrogen from a waste source are the same in different geographic regions, and whether sources of nitrate contamination are generally statistically differentiable on the basis of N isotopic ratios. Conclusions will be a description of advantages and limitations of the isotopic ratio technique as a general evaluation tool for delineating and differentiating nitrate pollution sources. The final report has been received from the contractor and sent to the technical information coordinator for approval and publication.
Keywords: contamination; ground water; water pollution; monitoring; nitrates; pollution sources; tracer techniques; feces; waste disposal; nitrogen; nitrogen 15; nitrogen 14; isotope ratio.

75515 Organic Indicators of Groundwater Pollution. Black, D. (Oklahoma State Univ., 107 Whitehurst Hall, Stillwater, OK). **Contract:** R804613. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to determine the usefulness of biochemical and organic indicators of groundwater pollution. Literature analysis and method development will be followed by laboratory and field testing to identify biochemical and organic indicators of groundwater pollution. This project is in two parts: (1) biochemical indicators - investigate the use of ATP, nucleic acid, proteins, organic phosphates and enzymes as indicators, and develop extraction and analysis techniques; and (2) organic indicators - study sorption, retention, and modification of organic compounds that are added or arise by microbial or chemical action, predict fate of such compounds, and develop analytical techniques. Particular effort was directed toward developing methods of improved sensitivity for detecting protein, lipopolysaccharides, DNA, organic phosphates, and lactate dehydrogenase in environmental samples. Fluorescence procedures appeared especially promising in DNA and lactate dehydrogenase assays. Work on methods for recovering ATP from soils and subsoils was also continued, with emphasis on evaluation of the effectiveness of various extraction procedures. Procedures employing boiling water, boiling buffers, and cold acids as extractants have thus far received some study, while work on procedures using various organic solvents is just beginning. A manuscript based on the survey of available literature on enzymes and other selected biochemicals in soil and ground water was completed, and reviews of this work were requested from eight qualified persons or groups external to the grantee's program. Most of these reviews have now been received, and revisions to the manuscript are under way. This paper should be of general interest and usefulness because it includes an extensive compilation and evaluation of methods reported in the literature for analyzing a number of biochemical substances in soil and water.
Keywords: ground water; water pollution; organic compounds; indicators; atp; nucleic acids; proteins; organic phosphorus compounds; enzymes; chemical analysis; removal; monitoring; dna; fluorescence; dehydrogenases.

75516 Characterization and Treatment of Aqueous Wastes from Petroleum Refinery Fluid Catalytic. Burks, S.L. (Oklahoma State Univ., Stillwater, OK, 74075). **Project number:** L610F-027. **Contract:** R806798-01. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this research are to: (1) characterize the wastewaters from a minimum of 5 fluid catalytic cracking units by GC/MS for the priority pollutants; (2) compare the treatment effectiveness of a full-scale biological lagoon pretreatment with pilot-scale filter/activated carbon, aerated lagoon/filter activated carbon, and macroreticular resin pilot plant; and (3) compare bench-scale treatability on ozonation with macroreticular resins, activated carbon, and aerated lagoon effectiveness. Pilot studies on sites at a refinery to determine treatment effectiveness for filter/carbon and resin systems will be performed. Ozonation will be conducted at bench-scale and compared to pilot data. Characterization of catalytic cracker effluents will be with GC/MS and approved EPA methodology.
Keywords: petroleum refineries; waste water; catalytic cracking; gas chromatography; mass spectroscopy; activated carbon; filters; waste processing; aeration; ozone; comparative evaluations; water quality.

75517 Efficient Production of Methane from Water Hyacinth Juices Using Anaerobic Digestion Filters. Wolverton, B.C. (National Aeronautics and Space Administration, Biloxi, MS, 39529). **Project number:** L822C-054. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

An efficient method for producing energy from plant juices extracted from water hyacinth (Eichhornia crassipes) biomass harvested from wastewater aquaculture treatment systems will be developed. Laboratory experiments will be conducted to determine optimum size, configuration, microbial surface, digestion time, etc., of anaerobic digestion filters to provide biogas containing a high percentage of methane from plant juices.
Keywords: methane; biosynthesis; anaerobic digestion; water hyacinths; waste water; aquaculture; filters.

75518 Ground Water--Mineralogy Relationships for In Situ Oil Shale Retorting. Fitzpatrick, J.E. (Univ. of Denver, University Park, Denver, CO, 80210). **Project number:** L832B-05. **Contract:** R807125. **Supported by:** Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to develop a state-of-knowledge document relating overburden mineralogy with alterations in ground-water quality. Existing literature is reviewed to determine state of current research concerning mineralogy and ground-water quality.
Keywords: ground water; mineralogy; oil shales; in-situ retorting; water quality; environmental impacts.

76000 Response of Plants to Air Pollution. Weinstein, L.H. (Boyce Thompson Inst. for Plant Research, Inc., 1086 N. Broadway, Yonkers, NY, 10701). **Project number:** M602-001. **Contract:** R804513-03. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to determine whether concurrent exposure to mixtures of hydrogen fluoride and ozone or hydrogen fluoride and nitrogen dioxide produces interactive effects (antagonism or synergism) on the growth, yield, or accumulation of fluoride by vegetation; (2) to provide quantitative estimates of the effects of ambient oxidants on the growth, development, and yield of economically-important plants; and (3) to provide quantitative estimates of

the effects of ambient rainfall and simulated acidic rain on the growth, development, and yield of crop plants. Field exposure chambers, greenhouses, and controlled environment chambers specially designed for these studies will be used to expose vegetation to controlled concentrations of pollutants. Dose-response relationships will be determined to provide a basis for the development of predictive models. It was found that: (1) yields of beans and tomatoes are reduced by ambient oxidants occurring in Yonkers, New York; (2) sulfur dioxide may lower or have no effect on the accumulation of fluoride in plants exposed simultaneously to hydrogen fluoride and sulfur dioxide depending on the plant species and pollutant concentrations; and (3) repeated exposure to simulated acidic rain causes necrotic lesions on susceptible herbaceous plant species when pH values are less than 3.4 and on needles of eastern white pine trees when pH values are less than 2.6.
Keywords: hydrofluoric acid; ozone; nitrogen dioxide; synergism; acid rain; rain; vegetables; sulfur dioxide; ph value; pines; trees; plants; biological effects; environmental impacts.

76001 Potential Impact of Acidified Precipitation on Element Cycling and Production in Southern Appalachian Deciduous Forest. Haines, B. (Univ. of Georgia, Graduate School, Athens, GA). **Project number:** M602-002. **Contract:** R805305-01. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to determine the effects of simulated acid rain on nutrient cycling and the productivity of selected deciduous forest species. Experimental work involving the effects of simulated acidic rain on roots, leaves, and soils form the basis for the modeling effort. Six species of trees are involved.
Keywords: forests; acid rain; nutrients; biological pathways; environmental impacts; biological effects; productivity; roots; soils; leaves.

76002 Impact of Oxidant Air Pollutants on a Western Coniferous Forest Ecosystem. Taylor, O.C. (Univ. of California, Riverside Campus, Riverside, CA, 92502). **Project number:** M602-002. **Contract:** R805410-02. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is a continuance of a grant research program to determine the effect of long term exposure to ambient oxidant air pollutants on a western coniferous forest ecosystem and to develop predictive models for the system. A report which will help set national secondary air quality standards adequate to protect the environment is planned.
Keywords: air pollution; forests; terrestrial ecosystems; air quality; mathematical models; environmental impacts; oxidizers; biological effects.

76003 Develop Analytical Methodologies Useful for Environmental and Energy Research Problems. Fassel, V.A. (Dept. of Energy, 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** M600-005. **Contract:** D8-F0245. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The DOE will furnish the services of a mutually acceptable scientist, on-site at CERL, to: (1) participate in existing programs at CERL in development of analytical methodologies useful for environmental and energy development research problems; (2) utilize advanced technologies such as plasma emission spectroscopy, ESCA and AES, mass spectroscopy (computerized), and others (all anticipated as essential tools in the chemistry problems inherent in environmental and energy resource problems); and (3) participate in development work in chemical dissolutions and separations, as well as environmental sample chemical analysis where special handling problems occur, e.g., saline waters, waters with particulate content, and sample type preservation problems.
Keywords: measuring methods; personnel; water chemistry; research programs.

76004 Plant Systems Research to Strengthen Scientific Basis for Air Quality Control Strategies and Establishing Secondary Air Quality Standards. Tingey, D.T. (EPA, Environmental Research Lab., Corvallis, OR, 97330). **Project number:** M602-007. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental effects assessment.

The objective is to strengthen the scientific basis of air quality control strategies and secondary air quality standards. The major emphasis will focus on delineation of chronic (low level, long term) effects of criteria pollutants (O3, SO2, NOx) and mixes on agricultural, horticultural, and forest productivity as well as fundamental biological processes which result in reduced yields, decreased quality and general decline of natural ecosystems. This will be achieved through field, greenhouse, and laboratory research directed toward relating sensitive plants to long term chronic decline in productivity and quality of individual species which can be translated to economic and whole ecosystem impacts. The final output will provide necessary input to development and further refinement of air quality control strategies and for updating air criteria documents in accordance with schedules set forth by the Assistant Administrator for Air and Waste Management. Revised data base for new secondary air quality standards for photochemical oxidants has been updated.
Keywords: air quality; air pollution control; ozone; sulfur dioxide; nitrogen oxides; forests; productivity; mixtures; agriculture; crops; environmental impacts; plants.

76005 Development of a Protocol for Testing Effects of Toxic Substances on Plants. Thompson, C.R. (Univ. of Califorina, Riverside Campus, Riverside, CA, 92502). **Project number:** M602-009. **Contract:** R806270-01. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to develop a protocol for assessing the potential phytotoxicity of various chemicals on plants by measuring stress ethylene evolution. This project will focus specifically on the application of measured doses of water soluble compounds on the foliage. The final output is to be a report that will assist us in preparing a total protocol for assessing phytotoxicity.
Keywords: toxicity; chemical effluents; ethylene; toxic materials; biological effects; plants; aqueous solutions.

76006 Develop and Validate a Terrestrial Microcosm Ecosystem for Studies of Ecosystem Routes, Rate and Movement of Substitute Chemicals. Gillett, J.W. (EPA, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M714F-001. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$209,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to provide testing protocols to manufacturers of pesticides for the specific purpose of assessing the ecological impact of these chemicals on man and his environment. In addition, the microcosm program serves actively in reviewing the initial scientific and mini-economic reviews of candidate substitute chemicals, the basic background documents of SCP process, and related reviews critical to the registration/preregistration procedures. Results include development of a conceptual model of the transport of pesticides through the environment.
Keywords: terrestrial ecosystems; environmental transport; chemical effluents; metals; pesticides; biological models.

76007 Ecological-Biological Effects and Interactions of Pesticides in a Soil-Plant-Water Microcosm. Lichtenstein, E.P. (Univ. of Wisconsin, Madison, WI, 53706). **Project number:** M714-002. **Contract:** R804920-02. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine the potential effects of pesticides used for plant protection on, as well as their interaction with, other pesticidal or environmental chemicals in biological systems. In accomplishing the objective, the following studies will be made: (1) the biological effects and interactions of pesticides on plants grown in selected microcosms as affected by a number of environmental conditions such as rain, temperature, air humidities, plant pathogens, soil types, and the presence of residues of different groups of pesticides in the soil; (2) the fate of a 14C-labelled insecticide in the soil of the terrestrial part of the microcosm as affected by various environmental conditions; (3) the qualitative and quantitative composition of run-off water from the soil; and (4) the effect of pesticide contaminated run-off soil water on biological systems in water as affected by various environmental conditions.
Keywords: pesticides; biological effects; plants; rain; temperature dependence; humidity; soils; runoff; insecticides; residues; environmental transport; water pollution.

76008 Comparatives Ecological Effects of Selected Candidate Substitute Pesticide Chemicals Using a Suitable Terrestrial Microcosm. Gillett, J.W. (EPA, Environmental Research Lab., 200 SW 35th St., Corvallis, OR, 97330). **Project number:** M714-003. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives, as part of the overall evaluation of terrestrial microcosm systems, are to compare the fate and effects of a variety of chemicals and to develop methods diagnosing the nature and degree of ecosystem impacts or effects consistent with the disposition of candidate substitute pesticides. Final output is to be a report

that will permit the Office of Pesticide Programs and other agency groups to evaluate the applicability of terrestrial microcosms to problems associated with the enforcement of Sec. 3, FIFRA. To date, a microcosm workshop and evaluation has taken place.
Keywords: terrestrial ecosystems; chemical effluents; pesticides; environmental impacts; biological pathways; environmental transport.

76009 Determine Response of Aquatic Ecosystems to Physical Factors Influencing Pollutant Transport and Retention. Callaway, R. (EPA, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M819-001. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$250,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to determine the physical factors affecting algal assay procedure (AAP) results in estuaries; use existing data to provide a physical basis for understanding indicated individual ocean and river sources of nutrient limitation or stimulation and their longitudinal and vertical extent; and determine mechanisms affecting the distribution of particulates and changes as indicated by size distribution, physical-chemical composition and accretion-erosion processes occurring over river-estuary, within-estuary and estuary-ocean regimes. Final output will be reports in support of Sections 404, 208, 314, 307(A) and 316 of 92-500. Results include development of coastal circulation model to determine flushing of pollutants. Adaptation of NOAA 2-D (longitudinal--vertical) model to EPA computer facilities has been completed, as has processing of all 1977--1978 physical-chemical data.
Keywords: aquatic ecosystems; biological models; water pollution; environmental transport; bioassay; algae; seas; rivers; nutrients; water pollution control.

76010 Determine Pollutant Behavior and Ecosystem Response Associated with Marine Waste Disposal Practices and Coastal Zone Use. Callaway, R. (EPA, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M819-002. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$260,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine chemical-physical behavior and marine ecosystem responses to perturbations associated with municipal wastewater discharge, diffuse source inputs, and disposal of dredge spoils. Reports which will aid regional offices in reviewing dredge material discharge permits and aid in establishing wastewater regulations for coastal outfalls will be written. Results include development of initial dilution zone for sections 403C and 301H.
Keywords: coastal regions; aquatic ecosystems; pollution; environmental transport; land use; waste management; municipal wastes; ground disposal; environmental impacts.

76011 Develop and Apply Laboratory and Field Methods for Quantitative Assessment of the Effects of Pollution on Marine Communities. Swartz, R. (EPA, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M819-003. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$270,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to determine the effects on community structure of different assemblages in different provinces to identify indices which are most useful in quantitative impact assessment; and to determine the efficacy of biomathematical indices of various structural parameters (diversity, dominance, richness, spatial-temporal heterogeneity) as criteria of the impact of the pollution in marine ecosystems. Reports to aid this agency and the Corps of Engineers in their respective assignments under Section 404 will be compiled. Results to date include development of the community benthic bioassay for use in evaluating ocean disposal dredge material and publication of sampling guideline reports on benthic recovery after dredging, including impact of seafood cannery outfalls on the benthos, sediment, and water quality.
Keywords: water pollution; biological effects; aquatic ecosystems; marine disposal; dredging; sediments; bioassay; biological models; metabolism.

76012 Development and Validation of the Echinoderm Fertilization Bioassay for Testing Toxic Substances. Stuber, Q.J. (Univ. of Washington, School of Fisheries, Seattle, WA, 98105). **Project number:** M819-005. **Contract:** R805839-01. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The research objective is the development of an echinoderm fertilization bioassay for routine testing of toxic substances. This will include: (1) definition of the required equipment and methods; (2) determination of the interaction of salinity, dissolved oxygen, temperature, and pH on test results; (3) effects of variation in sperm and egg densities; (4) determination of the best statistical analysis; and (5) comparison of sperm sensitivity of sea urchins and sand dollars.
Keywords: echinoderms; fertilization; bioassay; toxic materials; biological indicators.

76013 Determine Nature and Extent of Impact on Aquatic Ecosystems from Oil and Other Natural Resource Development in Arctic and Subarctic Environment. Gordon, R. (EPA, Office of Research and Development, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M820-003. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$541,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Laboratory and field studies will be conducted to establish baseline conditions and to determine the nature and extent of the impact on cold climate aquatic ecosystems from development of natural resources such as oil and natural gas. The resultant pollutants will be evaluated for their effects on freshwater organisms, and the responses of these organisms to pollutant stress. Reports on characterization and control assessment of pollutants will provide guidelines and recommendations for realistic regulatory and management controls.
Keywords: aquatic ecosystems; petroleum; environmental transport; energy source development; arctic regions; petroleum industry; natural gas industry; biological stress; alaska oil pipeline; environmental impacts.

76014 Determine the Toxic Effects of Selected Inorganic Pollutants on Western Aquatic Species. Garton, R.G. (EPA, Environmental Research Lab., Western Fish Toxicology Station, 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M820-004. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$271,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is determination of relationships between pollutant concentration and ecological effects. Single-toxicant and complex wastes will be used in laboratory research using a variety of aquatic organisms. Field studies will be conducted to corroborate laboratory data, using as indices, ecological effects levels, tissue toxicant levels, and toxicant concentrations and forms. Output will be reports which will be directly applicable to Sections 208 and 304(A) of PL 92-500. In addition, results will constitute specific input to regional and state agencies for water quality standards. Methodology developed will be applicable to Section 10 of PL 94-469. Report on the determination of toxic effects of copper, cadmium, and zinc on Pacific salmonid fishes has been written.
Keywords: aquatic organisms; sensitivity; inorganic compounds; toxicity; metabolism; western region; aquatic ecosystems; water pollution; ecological concentration; regional analysis; copper; zinc; cadmium; fishes; invertebrates; algae; waste management; water pollution abatement.

76015 Determine the Toxic Effects of Selected Organic Pollutants on Western Aquatic Species. Garton, R.G. (EPA, Office of Research and Development, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M820-005. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$309,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to assess the effect of pollutant stresses on disease susceptibility of aquatic species; (2) to survey the potential organic pollutants in the western US and determine the criteria for these pollutants in accordance with Section 304(a); and (3) to design, develop and apply bioscreening techniques to define the effects of organic compounds, primarily from non-point and non-renewable energy waste sources upon selected algae, invertebrates and vertebrates. The research is directed towards the establishment of sound scientific basis for compliance of the legislative mandates outlined in Sections 104(20), (6), 105(D), 208, and 304(E) (2) of PL 92-500. Resulting publications will assist regulatory and land use planning agencies in the management of organic pollutants entering aquatic systems from non-point and point sources.
Keywords: organic compounds; aquatic organisms; aquatic ecosystems; western region; toxicity; pacific northwest region; diseases; etiology; mutagen screening; algae; invertebrates; vertebrates; fishes; herbicides; biological stress.

76016 Develop Short Term on Sublethal Screening Tests for (1) Class to Toxic Substances and (2) Identified Toxicants as Specified. Garton, R.G. (EPA, Environmental Research Lab., Western Fish Toxicology Station, 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M820-006. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$125,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A set of toxicity testing methods will be developed and used to test important organic and inorganic pollutants. These methods should be a combination of quick tests, sensitive tests, and tests for ecological effect. An important part of the research will be assessment of each test in relation to the others, in terms of which is most sensitive; how much confidence can one put in results of a test; and, how reliable is each test in assuring protection of the environment. The battery of tests developed will provide a means for setting criteria for toxic substances and will be evaluated in terms of both steady and non-steady state pollutants. Reports which will assist agency and other assigned personnel in testing to establish safe levels of toxic substances will be written. Results include (1) developing a method for chronic Daphnia bioassays used by the Office of Toxic Substances for screening; (2) Daphnia chronic tests undergoing round-robin verification; (3) flow through Daphnia chronic test being developed; and (4) acute test protocols for fathead minnow and rainbow trout undergoing round-robin verification.
Keywords: mutagen screening; toxic materials; inventories; organic compounds; inorganic compounds; ecology; sensitivity; toxicity; measuring methods; biological indicators; optimization; ecosystems; biological models.

76017 Assess Potential Ecological Damage in Cold Climate and from Crude Oil. McFadden, T.T. (Army Cold Regions Research and Engineering Lab., Corvallis, OR). **Project number:** M820-007. **Contract:** D8-F0395. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA. **Related energy source:** oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the contract is to evaluate the rate and extent of oil movement in and over the soil active layer, and to determine transport pathways, fate of pollutants, and degradation by-products, following a simulated spill of hot crude oil.
Keywords: oil spills; environmental impacts; environmental transport; layers; soils; permafrost.

76018 Investigation of Benthic and Fish Communities of Stotts and Eagle Creeks as Related to MIP. Gammon, J. (DePauw Univ., School of Liberal Arts, Greencastle, IN, 46135). **Contract:** R806184-01. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to establish baseline biological conditions and to evaluate the effect of non-point source pollution controls on freshwater fish and benthic invertebrate populations. Final output is to be a report that will evaluate the change in stream communities resulting from best management practices implementation and subsequent reduction in nonpoint source pollution.
Keywords: pollution sources; fishes; benthos; baseline ecology; invertebrates; pollution control; management; biological effects; aquatic ecosystems; water pollution.

76019 Assess the Contribution of Nutrients and Other Pollutants from Nonpoint Sources and Their Effects on Aquatic Ecosystems. Rittal, W. (EPA, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M820-013. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$778,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to conduct laboratory and field studies to evaluate the effects of typical nonpoint source pollutants on aquatic ecosystems and, in a broader sense, to evaluate the influence of various watershed activities on these ecosystems. Sediments have the highest priority as they are the primary non-point source problem and also serve as the media for transporting other non-point source pollutants into aquatic ecosystems. Outputs include identification and evaluation of nature and extent of pollutants originating from non-point sources; determination of effects of pollutants on stream ecosystems; and determination of the level of control of non-point sources required to minimize or eliminate biological effects. Model implementation program sites have been selected for monitoring and development of monitoring plans.
Keywords: nutrients; water pollution; biological effects; aquatic ecosystems; biological models; chemical effluents; inventories; water pollution control; monitoring; baseline ecology.

76020 Evaluate Petroleum Effluent Discharges for Impacts on the West Coast and/or Estuarine Ecosystems. Randall, R.C. (EPA, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M831-001. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$15,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to (1) develop existing and modified versions of assays for response indications of lethal and sublethal stress effects by biochemical, electrophoretic, and/or other analytical procedures which will permit the evaluation of fish, algae, benthos, and other marine organisms for short term or sublethal stress effects of petroleum processing waste discharges; (2) determine the chemical components of the process waste streams and test to see which ones and/or combinations of components are harmful or not harmful to the marine environment; (3) by use of a chem screen approach, determine the sublethal and lethal stress effects in selected staghorn sculpin tissues by monitoring sculpin cytochrome P-450, ATPase, arylhydrocarbon hydroxylase, asparite amino transferase, lactate dehydrogenase, acetyl cholinesterase, glutathione-s-transferase, and beta glucuronidase; (4) evaluate impacts on primary producers by the use of the marine algal assay procedure and the ecolgen; and (5) evaluate enzymatic impacts in other species as required. A procedure has been developed that will detect and quantify sublethal stress in the marine staghorn sculpin. The precision sample preps and analytical techniques have been determined for the chem screen protocol. The marine algal assay procedure and ecologen have been evaluated to the point where toxicity data may now be collected.
Keywords: petroleum industry; waste management; water pollution; environmental effects; environmental impacts; plankton; invertebrates; aquatic organisms; western region; pacific northwest region.

76021 Effects of Controlled Sulfur Dioxide Fumigation on Primary Producer and Invertebrate Consumers in a Mixed Prairie Ecosystem. Dodd, J.L. (Colorado State Univ., National Resources Ecology Lab., Fort Collins, CO, 80573). **Project number:** M831-003. **Contract:** R805320-03. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA. **Related energy source:** Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to investigate the effects of sulfur dioxide on photosynthesis respiration and water relations of the dominant species and biomass dynamics and primary production of the entire plant community. Invertebrate consumer investigations will focus upon population dynamics of grasshoppers and single sample assessment of nematode and micro-arthropod populations. Final output is to be a report that develops the capacity to predict the ecological impacts of coal-fired power plant emissions before damage occurs.
Keywords: sulfur dioxide; air pollution; photosynthesis; respiration; aquatic ecosystems; nematodes; grasshoppers; fossil-fuel power plants; coal; environmental impacts; population dynamics; biological effects.

76022 Use of Lichens as Indicators and Predictors of Air Pollution. Euevsman, S.R. (Montana State Univ., Bozeman, MT, 59715). **Project number:** M831-004. **Contract:** R805367-03. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives of this project are to determine the effects of low-level SO2 stress on lichen health and condition and to characterize lichen communities in the Colstrip area. Observations of effects of low-level SO2 stress on photosynthetic rates of Usnea hirta and Parmelia chlorochroa will be made at the zonal air pollution systems on Custer National Forest. Observations on lichen communities in the Colstrip vicinity will include determination of anatomical condition and sulfur content for comparison with baseline data and characterization of species composition of lichen communities on the soil and on ponderosa pine trunks in the Colstrip area for comparison with baseline data.
Keywords: sulfur dioxide; air pollution; biological indicators; lichens; photosynthesis; biochemical reaction kinetics; forests; environmental impacts; trees; pines.

76023 Monitoring Plant Community Changes Due to Fossil Fuel Power Plants in Eastern Montana. Taylor, J.E. (Montana State University, School of Agriculture, Department of Animal and Range Science, Bozeman, MT, 59715). **Project number:** M831-005. **Contract:** R805391-02. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$41,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to continue to monitor air pollution effects upon native grasslands vegetation in areas affected by fossil fuel power plants and on areas artificially stressed with air pollution; to supply baseline inventory information, including aerial photography and its interpretation to a variety of scientists, land users, and managers in Southeastern Montana; and to provide rigorous data for simulation models which can be used to predict bioenvironmental changes due to fossil fuel power generation in other areas. A report that helps develop the capacity to predict the ecological impacts of coal-fired power plant emissions before damage occurs will be written.

Keywords: plants; communities; fossil-fuel power plants; environmental impacts; montana; air pollution; air quality; biological effects; tolerance; flue gas; fly ash.

76024 Development of a Protocol to Assess the Effects of Western Coal Conversion Activities in a Terrestrial Ecosystem: Colstrip. (EPA, Environmental Research Lab., 200 SW 35th St., Corvallis, OR, 97330). **Project number:** M831-006. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to characterize the impact of air pollutants on a total ecosystem basis. It is imperative that methods be developed that can predict bioenvironmental effects of air pollutants from coal-fired power plants prior to construction. By studying a broad range of interacting variables, the research will isolate some variables as sensitive and reliable measures of terrestrial air pollution resulting from western coal conversion activities. Final output is to be a protocol that will be used by federal, state, and local government agencies, as well as the industrial community, in assessing the ecological impact of new energy development. Results to date are the third interim report and final field data collection in progress.
Keywords: air pollution; environmental impacts; terrestrial ecosystems; aquatic ecosystems; fossil-fuel power plants; coal.

76025 Investigation of the Bioenvironmental Impact of Fossil Fuel-Fired Plants in the Fort Union Basin. Gordon, C.C. (University of Montana, School of Arts and Sciences, Department of Botany, 770 Eddy Street, Missoula, MT, 59801). **Project number:** M831-007. **Contract:** R805610-01. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$65,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Within a zonal air pollution research site, the effects of sulfur and fluoride on selected plants, animals, and insects will be determined. A report that helps develop the capacity to predict the ecological impacts of coal-fired power plant emissions before damage occurs will be written.
Keywords: fossil-fuel power plants; environmental effects; biological effects; sulfur dioxide; fluorides; plants; animals; insects; coal; flue gas; metabolism.

76026 Development of a Protocol to Assess the Effects of Western Coal Conversion Activities in a Terrestrial Ecosystem: Colstrip. Preston, E.M. (EPA, Office of Research and Development, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M831-006. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA-$237,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the project is to characterize the impact of air pollutants on a total ecosystem. It is imperative that methods be developed that can predict bioenvironmental effects of air pollutants from coal-fired power plants prior to construction. By studying a broad range of interacting variables, the research will isolate some variables as sensitive and reliable measures of terrestrial air pollution resulting from western coal conversion activities. A protocol will be established that will be used by federal, state, and local governmental agencies, as well as the industrial community, in assessing the ecological impact of new energy development.
Keywords: coal; combustion products; fossil-fuel power plants; chemical effluents; air pollution; environmental impacts; terrestrial ecosystems.

76027 Methodology Development for Siting Power Plants. Lauenroth, W.K. (Colorado State Univ., Natural Resources Ecology Lab., Fort Collins, CO, 80523). **Project number:** M831-008. **Contract:** R806016-02. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to develop methods for incorporating ecological effects information into the coal-fired power plant siting process. The methodology is to be applied to the Northern Great Plains or other similar regions for the purpose of classifying all parts of the region according to their anticipated reduction in value resulting from the air pollution impact from coal-fired power plants. The final output is a report that helps develop the capacity to predict the ecological impacts of coal-fired power plants emissions before damage occurs.
Keywords: fossil-fuel power plants; coal; site selection; air pollution; environmental impacts.

76028 Oil Spills on Permafrost Underlain Tundra Slopes. Johnson, L.A. (DOD, Cold Regions Research and Engineering Lab., Building 4070, Fort Wainwright, AK, 99703). **Project number:** M820-014. **Contract:** D9-F0744. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine the environmental effects of oil spills in a permafrost environment. The approach is to measure the thawing of perafrost, oil movement, plant community, soil chemistry, and microbiological parameters.
Keywords: oil spills; environmental impacts; permafrost; thawing; dispersions; plants; soil chemistry; microorganisms; arctic regions; biological stress.

76029 Impact of Energy Development in Yampa. Shirazi, M.A. (EPA, Environmental Research Lab., 200 SW 35th St., Corvallis, OR, 97330). **Project number:** M820-023. **Contract:** D9-X0750. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to develop and demonstrate a methodology for assessing the consequences of various land use alternatives on water quality and quantity aspects of aquatic and riparian habitats and watershed systems. The approach is to use reservoir/stream flow models to predict probable changes in the usable habitat for different life stages of fishes in Yampa River. The fisheries impact will be related to land use alternatives in the basin.
Keywords: water quality; land use; aquatic ecosystems; watersheds; habitat; fishing industry; environmental impacts; utah; rivers; fluid flow; energy source development; mathematical models; coal; water pollution.

76500 Identification of Residue-Forming Hazardous Organic Chemicals in Fish from US Waters. Kuehl, D.W. (EPA, Office of Research and Development, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N607A-001. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$114,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objective is to provide the most up to date GC/MS facility for an ongoing program of monitoring environmental samples for trace organics. This will provide EPA with an early warning system of new environmental problems. The approach will be to develop and maintain the facility, provide quality control to in-house projects, and develop methods and techniques for analysis of environmental samples. A report on trace organics in fish from 5 regions of the U.S. was completed in October 1979, and will be available in the EPA series.
Keywords: chemical effluents; organic compounds; hazardous materials; toxicity; fishes; usa; surface waters; trace amounts; pesticides; environmental transport; metabolism; ecological concentration; chemical analysis; tolerance; water quality.

76501 Relative Toxicity of Selected Industrial Effluents as Determined by a Sublethal Fish Test and a Daphnia Acute Lethal Test. Neiheisel, T.W. (EPA, Newtown Fish Toxicology Station, 3411 Church Street, Cincinnati, OH, 45244). **Project number:** N608A-008. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The objectives are to determine the relative toxicity and no effect concentrations of treated effluents from different industrial sources using a sublethal cough, fish respiratory response test, and an acute lethal Daphnia test; and to predict from the cough test concentrations of the treated effluents safe for the aquatic environment. Cough tests with bluegill sunfish and static acute lethal toxicity bioassays with Daphnia pulex will be conducted in the laboratory on 3 to 5 grab samples of effluent from 10 industrial plants. Relativity to toxicity and no effect concentrations will be determined. For those effluents where the cough response test is most sensitive, safe environmental concentrations will be predicted based on the no effect test concentrations and consideration of plant operation and waste treatment variability. Results will include a report classifying the effluents tested according to their source, type of treatment, and their relative toxicity as determined by the cough test and Daphnia lethal acute test; and a prediction of environmentally safe concentrations for selected effluents which could be used in future field verification studies.
Keywords: toxicity; invertebrates; daphnia; fishes; mutagen screening; industrial wastes; physiology; water pollution.

76502 Aquatic Toxicity Data on RPAR and Other High Priority Pesticides. Spehar, R. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N714A-001A. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to obtain toxicity information needed by OPP for decision making related to the RPAR process and other environmental hazard evaluations. The approach is to obtain names of compounds of greatest interest to OPP and conduct appropriate aquatic organism exposures with them. Tests will include acute and chronic bioassays, bioaccumulation tests, and tests of certain physical properties such as solubility and persistence. Work is nearly complete on five RPAR herbicides, and several tests with additional compounds have recently started.

Keywords: toxic materials; toxicity; bioassay; biological accumulation; physical properties; herbicides; solubility; aquatic organisms.

76503 Methods Calibration Studies for Final Evaluation of Screening Methods Needed by OTS. Lemke, A. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N715C-003. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop and verify techniques for evaluating environmental effects of toxic substances. These tests are ORD's participation in round-robin in-house and contract methods validation tests for OTS. The approach is to develop and award contracts for round-robin studies for calibration of bioaccumulation tests with the fathead minnow and two toxic substances.

Keywords: fishes; toxic materials; comparative evaluations; biological accumulation; biological effects; calibration; water pollution.

76504 Methods Calibration Studies for Final Evaluation of Screening Needs by OTS. Stephan, C.E. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N715C-004. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop and verify techniques for evaluating the environmental effects of toxic substances. These tests are ORD's participation in round-robin in-house and contract methods validation tests for OTS. The approach is to refine bioaccumulation test methods for fish and toxic substances. The method has been formulated.

Keywords: toxic materials; comparative evaluations; fishes; biological accumulation; water pollution; biological effects; toxicity.

76505 Methods Calibration Studies for Final Evaluation of Screening Methods Needed by OTS. Lemke, A. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N715C-005. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop and verify techniques for evaluating environmental effects of toxic substances. These tests are ORD's participation in round-robin in-house and contract methods validation tests for OTS. The approach is to conduct bioaccumulation tests on fathead minnow and three toxic substances (materials to be of high, low, and medium bioconcentration potential) as ORD participant in the round-robin contract and in-house validation tests.

Keywords: toxic materials; comparative evaluations; biological accumulation; fishes; biological effects; water pollution.

76506 Methods Calibration Studies for Final Evaluation of Screening Methods Needed by OTS. Lemke, A. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N715C-006. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop and verify techniques for evaluating environmental effects of toxic substances. These tests are ORD's participation in round-robin in-house and contract methods validation tests for OTS. The approach is to conduct acute static and flow-through toxicity tests with fathead minnows, rainbow trout, Daphnia magna, and two toxic substances (silver and endosulfan). Renewable static chronic tests on Daphnia magna and the two toxic substances were conducted.

Keywords: fishes; trout; daphnia; comparative evaluations; toxicity; silver compounds; organic sulfur compounds; toxic materials; biological effects; water pollution.

76507 Dispersion and Fate of Contaminants in a Stratified Lake. (Case Western Reserve Univ., 2040 Adelbert Rd., Cleveland, OH, 44106). **Project number:** N769-038. **Contract:** R805716. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The research objective is to understand the fate of contaminants in large lakes especially during stratification. The fate of nutrients and trace metals as affected by dispersion in the lake and by biochemical transformations in the sediments will be studied in detail. The emphasis is on mathematical modeling and lab experiments.

Keywords: elements; trace amounts; nutrients; environmental transport; lakes; stratification; sediments; mathematical models.

76508 Flux of Organic Toxins and Major Nutrients in Large Lake Systems. Smith, V.E. (Cranbrook Inst. of Science, 500 Cone Pine Rd., Bloomfield, MI, 48013). **Project number:** N769-048. **Contract:** R806597-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The movement and fate of toxic organic substances, principally chlorocarbons, in Saginaw Bay, Lake Huron, and Lake Erie will be studied. Samples of water, suspended particles, phytoplankton, zooplankton and fish will be collected and analyzed.

Keywords: toxic materials; organic chlorine compounds; lake huron; lake erie; environmental transport; sampling; particles; phytoplankton; zooplankton; fishes.

76509 Assessment of Entrainment and Impingement of Yellow Perch. Jensen, A.L. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** N769-050. **Contract:** R806159-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The research objectives are to review stack assessment and entrainment and impingement models for their assumptions, to relate the impact of power plants and yields of yellow perch, and to evaluate the feasibility of modifying and applying conventional fisheries models for analysis of environmental impact. Field data will be tested against conventional yield and power plant impact models.

Keywords: fishes; power plants; entrainment; impingement; mathematical models; reviews; environmental impacts; cooling systems.

76510 Ichthyoplankton Losses in Western Lake Erie in 1975--1977. Patterson, R.L. (Univ. of Michigan, Ann Arbor, MI, 48104). **Project number:** N769-051. **Contract:** R806565-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Impacts on fish populations in western Lake Erie by power plants using open cycle cooling technology are investigated. Data to be used in the study were obtained in larval fish surveys in 1975, 1976, and 1977 by the Michigan Department of Natural Resource and the Ohio Center for Lake Erie Research. Estimates are obtained for (a) total numbers of larval fishes entrained in 1975-77, (b) number of equivalent adults lost to the fish populations, and (c) number of equivalent adults lost to the more important fisheries. Number of equivalent adults lost will be calculated from the larval fish data. Analysis for yellow perch has been completed.

Keywords: power plants; open-cycle cooling systems; biological effects; fishes; entrainment; impingement; mortality; lake erie; ichthyoplankton.

76511 Development of an In Vivo Fish Gill Preparation for Studying the Uptake of Toxic Chemicals. McKim, J.M. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N775-001. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The research objective is to develop an in vivo fish gill preparation with which the movement of a toxic chemical in the aqueous environment can be monitored as it moves across the blood-water interface of a fish's gill. The rate of movement of the chemical from the water into the blood, and the environmental, biological, and physio-chemical factors affecting this movement have a direct bearing on the toxicity and bioconcentration of chemicals in the aquatic animals. A living fish model will be developed that will allow accurate measurements to be made on the movements of toxic chemicals across the respiratory surface. The model will be utilized to collect data on the mechanisms controlling the inward and outward movement of toxics across the respiratcry epithelium. The capabilty to collect waste products to allow for a complete pharmacological work-up on several toxics will be developed. Results to date include: (1) techniques being developed; (2) equipment needs

being filled; and (3) a review of the literature in the area of fish gill structure-function being initiated.
Keywords: gills; fishes; in vivo; tissue cultures; uptake; hazardous materials; biological models; toxicity; biological accumulation.

76512 Acid Effects to Fathead Minnows and Macroinvertebrates in Outdoor Experimental Channels. Fischer, J.A. (EPA, Environmental Research Lab., Box 500, Monticello, MN, 55362). **Project number:** N820A-003. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The research objectives are to evaluate the impact of acidified water in the outdoor experimental channels to fathead minnows and the macroinvertebrate community and to assess chemical changes and metal mobilization in the soil and water. Two channels will be dosed with acid pH levels of 4.8 and 6.0 along with a third channel as a control. Reproduction of fathead minnows is expected to be inhibited at least in the lowest pH channel and changes are expected in macroinvertebrate population with metal mobilization over 4-to-5-month study period.
Keywords: aquatic ecosystems; acidification; biological effects; aquatic organisms; reproduction; ph value.

76513 Effect of Temperature on Experimental Stream Ecosystems. Hokanson, K.E. (EPA, Office of Research and Development, Monticello Ecological Research, Box 500, Monticello, MN, 55362). **Project number:** N820A-004. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$114,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to describe the effects of waste heat on physical, chemical, and biological dynamics in outdoor experimental ecosystems. Responses on weight, diversity, life history, and emergence of invertebrates and production and growth of fish will be measured. Samples will be taken to measure diel changes in dissolved oxygen, total gas pressure, nitrogen, pH, and alkalinity as well as documenting changes with other selected water chemistries. Three reports are to be published: (1) description of experimental channels and facility; (2) effects of temperature on invertebrate community (in preparation); and (3) thermal effects to fish populations and trophic relations (most of data analysis completed).
Keywords: waste heat; thermal effluents; aquatic ecosystems; thermal pollution; biological effects; aquatic organisms; plankton; invertebrates; fishes; ecology; productivity; species diversity; population dynamics; temperature effects; temperature monitoring; water quality; data acquisition.

76514 Integrating the Toxic Effects of Complex Effluents that Vary in Time, Concentration, and Components. Pickering, Q.H. (EPA, Newtown Fish Toxicology Station, 3411 Church Street, Cincinnati, OH, 45244). **Project number:** N820A-009. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop simple and rapid methods, using fish bioassays, to biologically characterize a complex effluent (mixture) of known chemical characteristics that varies in components and concentration ratios. Three phases of work are planned: (1) to conduct bioassays to integrate variable toxic components; (2) to conduct bioassays to integrate variable exposure concentrations; and (3) to conduct bioassays to integrate variable components and concentrations. A report will be issued describing the use of fish bioassays as a means of integrating the exposure history of aquatic organisms to complex wastes that vary in time and composition.
Keywords: toxicity; chemical effluents; monitoring; water quality; fishes; bioassay; water pollution.

76515 Determination of Toxic Characteristics of Complex Effluents with Algal and Macroinvertebrate Bioassays. Robinson, E.L. (EPA, Newtown Fish Toxicology Station, 3411 Church St., Cincinnati, OH, 45244). **Project number:** N820A-010. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The research objective is to determine the utility of using algal assays and bioassays with aquatic environment. Acute and chronic bioassays are being conducted with algae and macroinvertebrates to determine the toxicity of a number of complex and variable wastes. An assessment of the toxicity of a complex waste on a small laboratory ecosystem consisting of an algae, a macroinvertebrate and a fish is planned. These tests will become part of a battery of tests available for biologically evaluating complex and variable wastes.
Keywords: toxic materials; wastes; aquatic organisms; bioassay; biological effects; algae; aquatic ecosystems.

76516 Effects of Toxicants on Ecosystem Processes in Laboratory Microecosystems. Hedtke, S.F. (EPA, Newtown Fish Toxicology Station, 3411 Church St., Cincinnati, OH, 45244). **Project number:** N820A-011. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study has been undertaken to determine the sensitivity and suitability of changes in ecosystem processes due to stress as toxicological endpoints. A series of laboratory aquatic microecosystems simulating small ponds will be stressed with a toxicant. The effect of the toxicant on ecosystem processes such as photosynthesis, respiration, and decomposition will be determined. In addition, a carbon budget for each system will be compared to determine sensitive components. The ecosystem will also be stressed with a toxicant and the effect of the toxicant on the organic waste assimilation capacity of the system will be studied.
Keywords: aquatic ecosystems; toxic materials; environmental effects; biological indicators; photosynthesis; respiration; decomposition.

76517 Toxicity Reduction by Various Pilot-Scale Municipal and Industrial Waste Treatment Systems. Horning, W.B. (EPA, Newtown Fish Toxicology Station, 3411 Church St., Cincinnati, OH, 45244). **Project number:** N820A-012. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

One objective of this study is to biologically evaluate the toxicity of effluent from pilot-scale municipal and industrial waste treatment systems designed and operated by MERL and IERL-Cincinnati at the testing and evaluation facility in Cincinnati. A second objective is to determine the reduction in waste toxicity by the pilot-scale treatment systems. The approach involves testing raw and treated wastes with fish and invertebrates. The tests will include: (1) acute fish and invertebrate toxicity tests, (2) embryo-larval fish tests, (3) invertebrate life-cycle tests, (4) algal tests for growth stimulation and inhibition, and (5) other short-term tests that may be appropriate.
Keywords: waste water; waste processing plants; toxicity; algae; aquatic organisms.

76518 Development of Chronomid Embryo: First Instar Test Procedure. Anderson, R.L. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-615. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The research objective is to determine the most responsive life stages of Tanytarsus dissimilis to toxicant exposures. The embryo and larva stages of Tanytarsus dissimilis will be exposed for periods of less than a week to the organic compounds dinosib and diuron. Proper physical conditions, variation in hatch and embryo survival will be examined.
Keywords: insects; biological indicators; pesticides; biological effects; survival curves; toxicity; life cycle.

76519 Plant Growth Monitoring for Effluent Testing. Walbridge, C.T. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-016. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objective is to develop a biological probe for effluents. The approach is to determine the feasibility of using an electronic micrometer to detect changes in plant stem diameter caused by pollutants.
Keywords: plant stems; plant growth; water pollution; monitoring; aquatic organisms; chemical effluents.

76520 Toxicity of Selected Phenols to the Fathead Minnow Eggs and Fry. Phipps, G. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-017. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to determine the toxicity of 4 to 6 selected phenols over various periods up to 28 days to various life stages from the one-day old fertile egg to the 28-day old juvenile and to determine if these correlate with previous findings on 30 to 40 day juveniles. Maximum acceptable toxicant concentration (MATC) will be compared with partition-coefficients and other structural parameters to examine structure activity relationships.
Keywords: eggs; phenols; toxicity; biological effects; maximum permissible concentration; fishes; water pollution.

76521 Develop and Evaluate Aquatic Toxicological Methods to Improve Predation Capability and Estimate Acceptable Concentrations of Toxic Substances. Holcombe, G. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-018. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA. **Related energy source:** general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine 96-hour and 192-hour acute toxicity of 12 chlorinated aliphatic hydrocarbons and 4 to 6 pesticides to 30-day-old fathead minnows to determine chemical structure activity correlations. Acute toxicity of each compound will be defined by calculating 24-, 48-, 72-, and 96-hour LC50S along with other LC50S throughout the 192-hour test to define the shape of the toxicity curve.

Keywords: chlorinated aliphatic hydrocarbons; pesticides; toxicity; fishes; water pollution; metabolism.

76522 Effects of Suspended Fine Particles (Red Clay) on the Availability and Toxicity of Metals and Synthetic Organic Chemicals to Fathead Minnows. Thomann, V.R. (Manhattan College, Bronx, NY, 10471). **Project number:** N820A-019. **Contract:** R803680. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$106,000.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this study are to determine if a common fine sediment such as red clay can affect the toxicity of metals such as copper and cadmium or synthetic organic compounds such as endrin and pentachlorophenol. The importance of test chemical-clay particle interactions on toxicity and bioaccumulation will be studied by bioassays performed with filtered lake water with and without red clay added. The acute toxicity to juvenile fathead minnows will be determined from five concentrations of each test chemical. Chemical tests will be performed to determine the degree to which each toxicant is sorbed or bound to the particles. Tissue residues for organic chemical exposures will be measured in order to determine if suspended inorganic particles facilitate the uptake of lipophilic compounds. Dosing methods have been developed and copper exposures completed. Sorption of copper to clay particles was found to result in greatly reduced toxicity.

Keywords: clays; toxicity; metals; organic compounds; availability; fishes; metabolism; environmental transport; sediments.

76523 Determination of Hydrogen Cyanide. Broderius, S. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** X1820A-020. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

An analytical method for the direct determination of microgram/liter concentrations of molecular hydrogen cyanide will be developed.

Keywords: hydrocyanic acid; quantitative chemical analysis; microanalysis; water pollution; measuring methods; water.

76524 Biologically Available Forms of Toxic Elements in Natural Waters. Poldoski, J.F. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-022. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine relationships of forms of various elements in natural water to their rate and degree of uptake by Daphnia magna for the purpose of establishing a rapid screening test.

Keywords: daphnia; elements; uptake; metabolism; biochemical reaction kinetics; water; aquatic organisms.

76525 Effect of Different pH, Dissolved Oxygen, and Suspended Solid Levels on Cough Frequency of Bluegill Sunfish and Brook Trout. Carlson, R.W. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N830A-024. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This work will determine the influence of some common water quality variables (pH, dissolved oxygen, suspended solids, etc.) on the cough frequency of fish. The influence of these variables will then be related to the interpretation of cough frequency measurements with complex effluents.

Keywords: fishes; water quality; ph value; biochemical oxygen demand; suspensions; solids; biological effects; communications.

76526 Biomass to Provide Toxicity Data on Fish and Invertebrates on Four Classes of Hazardous Organic Chemicals Found in U.S. Drinking Waters. Veith, G. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N802A-026. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA. **Related energy source:** general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This study is designed to measure the toxicity and metabolic relationships between selected aquatic animals and mammals as the first step in evaluating the use of pollutant sensitive aquatic animals as an early warning system for the protection of higher animals including man. Phase I will determine similarities and differences in the metabolism of selected xenobiotics between mammals and aquatic organisms. Phase II will compare the degree and order of sensitivity between daphnids, embryo-larval fish and mammals exposed to the same chemicals. Phase III will evaluate a fish, model for determining environmental carcinogens. The development of chemical and biological methods and the development of test apparatus to meet occupational health requirements has been completed and initial bioassays with both fish and invertebrates will begin this quarter.

Keywords: bioassay; toxicity; aquatic organisms; hazardous materials; drinking water; biological indicators; evaluation.

76527 Development of Toxicity Tests with the Early Life Stages of Fish. Christensen, G.M. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820M-028. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$382,000.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this research are to further develop existing methods for toxicity tests with the early life stages of fish and to shorten the time required for these tests from several months to several weeks, making them more feasible for on-site testing and for screening large numbers of toxic chemicals. The approach will involve the development of more suitable endpoints of effect through in-depth embyrological, physiological, biochemical and histological measurements throughout the embryo-larval early juvenile period of development. Current work is involved with early morphological development, and the early development of selected enzyme systems in a warmwater fish exposed to toxic chemicals.

Keywords: toxicity; fishes; population dynamics; metals; organic compounds; pesticides.

76528 Renewal of Water Temperature Studies at the US EPA Monticello Field Station. Stefan, H. (Univ. of Minnesota, Mississippi River and 3rd Ave., Minneapolis, MN, 55414). **Project number:** N 608A-084. **Contract:** R804736-01. **Supported by:** Environmental Protection Agency, Monticello, MN (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide information on the water and soil temperature regimens in experimental outdoor channels where biological experiments are conducted. Together with measuring various weather parameters, a mathematical model will be developed to provide and predict inputs and outputs of heat energy. Field data is subjected to statistical and regression analysis to give information on longitudinal water temperature gradients, diurnal water temperature fluctuations, vertical stratification, longitudinal dispersion, and rate of surface heat losses.

Keywords: heat transfer; soils; water; weather; temperature effects; mathematical models; temperature effects; daily variations; biological stress; thermal effluents.

76529 Determination of Thermal Preference of Three Genetic Stocks of Largemouth Bass. Magnuson, J.J.; Medvick, P. (Univ. of Wisconsin, Madison, WI, 53706). **Project number:** N-608A-096. **Contract:** R-805583-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA. **Related energy source:** Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Work will be to determine thermal preference of each of three genetic stocks of largemouth bass (Micropterus salmoides). Stocks are to be (1) northern (Minnesota or Wisconsin); (2) mid-United States (Tennessee); and (3) southern (Louisiana). Small (9 to 10 cm) largemouth bass, Micropterus salmoides will be used with equal numbers from northern, midstates, and southern populations. They will be acclimated to 20 degrees C, a 12-12 hour photoperiod and Madison city water for a period of at least 2 weeks. A longer period will be utilized if the original holding temperature was higher than 25 degrees C. Nine aquaria, 57 liter, are equipped with selection apparatus developed by Niell and Magunson (1974) and Beitinger, et al, 1974. Electronic monitoring and control equipment permits the fish to select the temperature of the aquaria and records the activity and temperature at ten minute intervals.

Keywords: striped bass; temperature effects; behavior; genetic variability; biological adaptation; thermal effluents; thermal pollution; water pollution.

76530 Effects of Temperature on Growth and Survival of the White Sucker. Weller, M.W. (Univ. of Minnesota, Minneapolis Campus, Minneapolis, MN, 55455). **Project number:** N608A-107. **Contract:** R804501-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to determine growth rate of white suckers under different temperature regimens and constant response curves related to food consumption, and to evaluate relationship of optimum temperature to incipient lethal temperatures. Growth and mortality rates are measured by slowly increasing temperatures (0.5% per day) with different size groups. Ultimate upper incipient lethal temperature is also recorded. Results are to be analyzed in a form suitable as input into ecosystem modeling.
Keywords: temperature effects; survival curves; fishes; population dynamics; animal growth; aquatic ecosystems; thermal pollution; biological effects.

76531 Development and Testing of Automatic Fish Tracking and Monitoring System for the Monticello Ecological Research Station, Monticello. Kueckel, V.B.; Sinitt, D.B. (Univ. of Minnesota, Minneapolis Campus, Minneapolis, MN, 55455). **Project number:** N608A-122. **Contract:** R805290-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(40); oil and gas(30); nuclear fission(30) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to develop a system for automatically monitoring and recording the movements of fish in physical and chemical gradients in outdoor experimental channels. The approach is to evaluate types of radio transmitters that can be placed internally in several fish species. Suitable radio frequencies and antenna for recording movement responses on strip chart recorders must also be devised for continuous recording.
Keywords: fishes; physiology; behavior; chemical effluents; biological effects.

76532 Identification of Mechanisms, Rates of Change and Recycling Processes for Pollutants. Glass, G.E. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N625A-089. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The broad objective of this program is to determine those pathways and processes which cause chemical compounds and elements to become environmental pollutants. Specific tasks are underway to identify generally applicable examples of mobilization and recycling processes that cause drinking water contamination from lead pipes and mine tailing (absestiform minerals) and chemical effects in stream and lakes from atmospheric deposition of pollutants. The approach is to determine causal relationships in the mechanisms and recycling processes of pollutants. Both field monitoring of specific sites and laboratory experiments are conducted. Data are being collected and synthesized for evaluating potential acid rain impacts.
Keywords: environmental exposure pathway; chemical effluents; drinking water; lead; pipes; asbestos; air pollution; water pollution; recycling; atmospheric chemistry; water chemistry; waste management; mineral cycling.

76533 Effects of Lowered pH (Acid Rain) on Gametogenesis of Certain Freshwater Fishes Indigenous to the BWCA. McCormick, J.H. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-030. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Through examination of pre-spawning gonads of indigenous fishes the extent of possible reproductive impairment associated with the acidification currently extant in the BWCA waters will be determined by introducing fathead minnows into the Monticello experimental channels where they will be exposed to several pH regimes.
Keywords: acid rain; fishes; reproduction; ph value; gonads; water pollution; coal industry; environmental effects.

76534 Organic Chemical Toxicity to Embryo/Larval Fish at Lowered Dissolved Oxygen Concentrations. Carlson, A.R. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-031. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

How chronic toxicity of 1,2,4-trichlorobenzene to several species of freshwater fish is affected by lowered dissolved oxygen concentrations will be studied using embryonic and larval stages of the fathead minnow and two other freshwater fishes at three DO concentrations and several levels of 1,2,3-trichlorobenzene.
Keywords: chemical effluents; toxicity; fishes; oxygen; ecological concentration; organic chlorine compounds; tolerance; water pollution.

76535 Toxicity of Several Chlorinated Benzenes to the Fathead Minnow. Carlson, A.R. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-032. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The toxicity of chlorobenzene, dichlorobenzene, tetrachlorobenzene, pentachlorobenzene, and hexachlorobenzene to embryonic and larval stages of the fathead minnow will be determined. Fish embryo-larva exposures of at least 28 days duration will be used to predict the chronic toxicities of the five listed chlorinated benzenes.
Keywords: fishes; toxicity; organic chlorine compounds; tolerance; benzene; aromatics.

76536 Renewal Studies of Oxygen Production, Loss, Exchange and Transport in the MERS Field Channels. Stefan, H. (Univ. of Minnesota, Mississippi River and 3rd Ave., Minneapolis, MN, 55414). **Project number:** N820A-034. **Contract:** R805678-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This program will evaluate existing methods and develop new methods to measure photosynthesis and community respiration in the outdoor experimental channels. Assumptions previously made are further evaluated in the production and respiration measurements in ambient, thermal and acidified channels. This will provide MERS a working procedure to measure community responses. Procedures include empirical measurements for reaeration coefficients, wind effects, channel morphology, longitudinal coefficients, community photosynthesis respiration, and saturation concentrations of dissolved oxygen.
Keywords: oxygen; environmental transport; photosynthesis; respiration; water pollution; environment; biological models.

76537 Develop Methods for Identification and Concentration Measurement of Fine Particles in Aquatic Organisms. Batterman, A.R. (EPA, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N820A-035. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to develop, evaluate, and use electron microscope procedures for identification and concentration determination of fine particles, including asbestos fibers, in tissue from aquatic organisms that have been exposed to such fine particles. Low temperature ashing or enzymatic hydrolysis of tissue followed by resuspension on a nuclepore filter and preparation for electron microscope observations will be done.
Keywords: asbestos; fibers; particles; tissues; aquatic organisms; electron microscopy; enzymatic hydrolysis; water pollution; measuring methods.

76538 Toxic Effects on the Aquatic Biota from Coal and Oil Shale Development. Thurston, R.V. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** N831-0002. **Contract:** R803950-03. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objective of this research project is to provide predictive information with regard to potential toxicants to the aquatic environment resulting from coal and oil shale extraction and conversion. The specific objectives are to identify and quantify those chemical products of coal and oil shale extraction and conversion which may reach surface waters, and to determine by both field studies and laboratory bioassays the degree to which those chemicals may be acutely or chronically toxic to fishes and aquatic invertebrates, or may become involved as part of the food chain. Four categories of energy development are being considered: coal mining, coal combustion, coal gasification and liquefaction, and oil shale extraction and processing. Potential toxicants to the aquatic environment are being identified by a combination of field, laboratory, and literature studies, as well as by information gained from cooperative input from other energy-related research programs. Concurrent chemical and biological laboratory and field bioassays as well as

aquatic distribution studies dictate what additional or alternate emphasis is required in the laboratory and field chemical studies. **Keywords:** oil shale industry; coal industry; toxicity; aquatic ecosystems; surface waters; bioassay; fishes; aquatic organisms; food chains; coal mining; combustion products; coal gasification; coal liquefaction; environmental impacts; monitoring; chemical effluents.

76539 Critical Review and Evaluation of Research on the Impact of Energy-Related Wastes on the Aquatic Environment. Chappell, W.R.; Damrauer, C. (Univ. of Colorado, 1100 14th St., Denver, CO, 80202). **Project number:** N831-0003. **Contract:** R805921-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this proposed work is to critically review completed and on-going research related to the impact of energy-related wastes on the aquatic environment. The specific outputs of the work will be annual state-of-the-art documents that will describe the present state of the research and critical areas where research is needed in order to provide a data base for decision makers.
Keywords: aquatic ecosystems; biological models; waste management; technology assessment; decision making; information systems.

76540 Chemical and Biological Characterization of Oil Shale Processing and Coal Conversion Effluents. Skogerboe, R.K. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** N831-0006. **Contract:** R806051-02. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant characterization and analysis.

The overall objective is to provide predictive information about the effects of pollutants from oil shale processing and coal conversion on surface waters and the aquatic biota. The three areas of investigation include: (1) chemical characterization of effluents and byproducts associated with each of the above energy development areas; (2) field surveys and analyses of aquatic organisms in streams which are, or may be, impacted by these effluents; and (3) laboratory bioassays of known and potential toxicants associated with these effluents.
Keywords: oil shale processing plants; coal gasification plants; coal liquefaction plants; chemical effluents; surface waters; water pollution; aquatic organisms; by-products; chemical analysis; baseline ecology; bioassay; toxicity; forecasting; environmental effects.

76541 Coal Fired Steam Plants: Human and Environmental Exposure to Air and Water Pollutants. Chesters, G. (Univ. of Wisconsin, Madison Campus, Madison, WI, 53706). **Project number:** N831-0007. **Contract:** R880035-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

To document the impact from construction and operation of a coal-fired power generating station, researchers at the University of Wisconsin have been conducting a three-year research program on the impact of coal-fired power plants on the environment. The study was undertaken at Columbia Power Generation Station near Portage, Wisconsin. The station, because of its location and design, is representative of a large number of existing and proposed power generating facilities throughout the United States. Analysis of its impact, therefore, has broad relevance for evaluating potential impact on air and water systems at other sites. While previous work was mainly directed towards documenting environmental changes, the present proposal is focused on human exposures to air and water pollutants resulting from coal combustion. The proposal is less site specific in that it seeks to assess the transferability of data and models to other proposed sites. To meet these goals the project is divided into four major sections. These include (1) effects of coal-fired generating stations on air quality; (2) effects of coal-fired generating stations on water quality; (3) wetland on aquatic ecology around the Columbia Power Generating Station; and (4) data integration, assessment, and transferability. The first three efforts involve field and laboratory experiments around the Columbia Power Generating Station. The fourth effort is designed to capitalize on previous project data, proposed work, and data from other sites in an effort to arrive at human and environmental exposures to air and water pollutants. The first year will see an emphasis on the first three subprojects, whereas the second year effort will be intensified in terms of data integration and assessment.
Keywords: fossil-fuel power plants; coal; human populations; air pollution; water pollution; environmental impacts; health hazards.

76542 Determine the Impacts of Long Range Transport of Air Pollution in the Boundary Waters Canoe Area. Craven, J. (Forest Service, 633 W. Wisconsin Ave., Miluaukee, WI, 53203). **Project number:** N831-0008. **Contract:** 09-F0731. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of this agreement is to provide assistance in the sampling and analysis by aircraft of the snow pack, lakes and streams of the Boundary Waters Canoe Area (BWCA) and surrounding area of northern Minnesota to determine the impacts of long range transport of air pollution. The Forest Service is providing logistical support for the sampling and analysis program and providing field and laboratory data for snow, stream and lake samples.
Keywords: air pollution; water pollution; monitoring; minnesota; water resources; water quality; snow; streams; lakes.

76543 Effects of Precipitation and Solutes on the Surface and Ground Water Quality in the Filson Creek Watershed Area. Seigel, D. (DOI, 702 Post Office Bldg., St. Paul, MN, 55101). **Project number:** N831-0009. **Contract:** D9-F072. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of this agreement is to analyze and interpret data from 1976 to 1979 for the Filson Creek Watershed Area concerning the effects of precipitation and solutes on surface and ground water quality. Data concerning the effects of water quality of precipitation on the Filson Creek Watershed Area of northern Minnesota will be gathered, quality assured, interpreted and reported for publication. Sets will include, but will not be limited to, USGS data from 1976 to 1979, and USEPA data from 1978 to 1979. Informational categories will include methodology, hydrology, geology, soils, vegetation, water quality, statistical and mass flow and balance computations of solutes.
Keywords: precipitation scavenging; air pollution; water quality; minnesota.

76544 Chemical Analysis of Water Quality Samples in the Boundary Waters Canoe Area. Tholen, M. (Forest Service, Winton, MN, 55796). **Project number:** N831-0010. **Contract:** 09-F0583. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of this agreement is to assist in the chemical analysis of water quality samples related to the assessment of possible impacts on the BWCA and surrounding area from atmospheric deposition of pollutants. The Forest Service is providing chemical analyses of lake samples at the Forest Service Laboratory, Winton, Minnesota.
Keywords: water quality; water chemistry; environmental impacts; air pollution; lakes; minnesota; sampling.

76545 Detection of Mutagenic/Carcinogenic Alteration in Fish and its Application to Human Health. Hinton, D.E.; Trump, B.F. (Univ. of Maryland, 1420 N. Charles St., Baltimore, MD, 21201). **Project number:** N831-0011. **Contract:** R804866. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In vitro bioassay methods will be developed and tested to detect mutagenic and carcinogenic properties of aquatic pollutants in fish. The approach will include activation of procarcinogens with microsomal enzymes of fish, rat and man. Mutagenicity will be tested using bacterial strains. Carcinogen binding studies will be performed in cultured cell lines from fish, rat and man. Finally, in vivo testing in the fish and rat will be done. The research is intended to lead to improved methodology for detection of water-borne carcinogens.
Keywords: fishes; mutagenesis; carcinogenesis; health hazards; biological models; bioassay; water pollution.

76546 Ammonia Toxicity to Fishes. Thurston, R.V.; Russo, R.C. (Montana State Univ., Bozeman, MT, 59715). **Project number:** N882-0001. **Contract:** R805636-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The effect of fluctuations in ammonia concentrations on freshwater fish will be determined to prepare a criterion document for the chemistry and fate of ammonia in aquatic environments and its effects on aquatic organisms. Acute and embryo/larval tests with several patterns of diurnal and other examples of fluctuating ammonia concentrations will be conducted. The criterion document preparation will require the collection and critical review of appropriate world literature and coordinate in the drafting of a total document with ECAO-Cincinnati.

Keywords: fishes; toxicity; ammonia; sensitivity; water pollution; water chemistry.

76547 Assessment of Energy-Related Toxicant Stress in an Engineered Ecosystem. Boling, R. (Michigan State Univ., East Lansing, MI, 48824). **Project number:** N831-0013. **Contract:** R806214-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the environmental parameters to measure in order to better assess the effects of a toxicant on an aquatic ecosystem. The ecosystem is held in a desirable range by manipulation of physical variables. A toxicant is introduced and the effect on the biological communities is determined.
Keywords: water pollution; toxic materials; biological effects; aquatic ecosystems; contamination.

77000 Chemical Studies Directed Towards Ecological Damage Assessment of Petroleum Discharges into the Marine Environment. Quinn, J.G.; Hoffman, E.J. (Univ. of Rhode Island, Administration Building, Kingston, RI, 02881). **Project number:** P608C-11. **Contract:** R805477. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to conduct analytical chemical studies in support of ecological damage assessment of acute and chronic discharges of petroleum into the near-shore marine environment. These studies will include the following: (1) chemical analyses of petroleum compounds in selected samples of water, sediments and organisms using a variety of analytical procedures (e.g., column, thin-layer, and gas chromatography, infrared spectroscopy, and combined gas chromatography--mass spectroscopy); (2) development of new methods and modification of existing procedures in support of toxicological and field studies; and (3) participation with other laboratories in the development and intercalibration of standard reference materials and methods for petroleum analysis. Samples will be collected from selected spills of opportunity and sites of chronic oil discharges. The basic analyses of these samples will involve extraction, isolation of petroleum compounds by column and/or thin-layer chromatography, and analysis by gas chromatography using packed metal columns and glass capillary columns. Selected sample extracts will also be analyzed by infrared spectroscopy and combined gas chromatography--mass spectroscopy. In combination with field evaluation and laboratory toxicological investigations, the proposed research will allow a highly integrated, multidisciplinary study of the fate and effects of oil on the marine ecosystem.
Keywords: environmental effects; water pollution; petroleum; chemical analysis; water; sediments; aquatic organisms; toxicity; oil spills; aquatic ecosystems; hydrocarbons; chromatography; spectroscopy.

77001 National Marine Pollution Monitoring Program. Goldberg, E.D. (University of California, Dept. of Chemistry, P.O. Box 1529, La Jolla, CA, 92038). **Project number:** P608C-12. **Contract:** R804215-01. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A surveillance of four collectives of pollutants in the U.S. coastal waters is being carried out by measurements of their concentrations in two groups of sentinel organisms--mussels and oysters. The pollutant species include heavy metals (lead, cadmium, mercury, zinc, silver, copper, and manganese), chlorinated (Pu-238, Pu-239, Pu-240, Cs-137, Am-241, and Sr-90) and petroleum hydrocarbons (allanes, cycloalkanes, aromatics including 2, 3, 4, and 5 ring polynuclear condensed species). About 120 sites on the west, east, and gulf coasts are sampled once a year and a west and east coast site monthly. During the 1976 sampling season, varying degrees of pollution in U.S. coastal waters were indicated by elevated levels of one or more pollutants in the bivalves. For example, the high levels of DDT and its metabolites in mussels from San Pedro, California, area reflect high inputs of the pollutant from a manufacturer's discharge. High polychlorinated biphenyls were found in mussels in San Francisco Bay, San Pedro Harbor, and in the New York—Boston coastal zones. The oysters in Galveston Bay indicated high levels of petroleum pollution. In none of the localities investigated was pollution evident simultaneously from all four sets of pollutants.
Keywords: water pollution; monitoring; aquatic ecosystems; evaluation; biological models; invertebrates; lead; cadmium; mercury; zinc; silver; copper; manganese; biological effects.

77002 Persistence Limits: A Management Strategy for Natural Marine Ecosystems. Perez, K.T. (EPA, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-14. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$270,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to establish persistence limits for natural marine ecosystems under various anthropogenic stressors. A persistence limit is the perturbed state from which an ecosystem can return to its original quasi-equilibrium state once the perturbation is relaxed. The approach consists of the reduction of large scale system to a smaller scale, microcosm method. Previous studies have not established the validity of this experimental method. Replicate 150 liter microcosms are maintained under realistic regimes of light, water, turbulence, temperature, benthic surface area, and water turnover time. The tanks are manipulated by varying one or more of the above environmental factors and/or the addition of a stress agent (e.g., treated sewage). The systems responses are measured in terms of phytoplankton numbers, species composition, chlorophyll and primary productivity levels; zooplankton numbers and species composition; nutrient levels; benthic structure and function; and total system metabolism. At the same time the natural system being simulated is also being monitored. The validity of the perturbed behavior in the experimental systems is dependent upon the correspondence between the unperturbed tank systems and the natural system. Final outputs will include: (1) physical and biotic complexity necessary for the reduction of a natural marine ecosystem; (2) persistence limits for a large scale marine ecosystem using the microcosm method; and (3) an evaluation of the validity of other methods used in the establishment of persistence limits. Experimental simulation conditions (biotic and physical) significantly affect the dynamic behavior of experimental microcosms. Realistic simulations result in microcosm convergence of systems variables relative to the natural system being simulated; unrealistic simulations result in divergence. Using 15 years of field data, we have shown that a natural marine system is non-linear. This finding raises questions concerning the validity of the results of mathematical models which assume a linear response.
Keywords: aquatic ecosystems; biological models; management; biological stress; waste management; biodegradation; purification.

77003 Effects of Oil on Reproductive Stages of Marine Macroalgae. Steele, R.L. (EPA, Office of Research and Development, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-15. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine effects of various oils on reproduction of marine macroalgae. Toxicological bioassays will be conducted exposing the reproductive stages of several species of brown and red macroalgae to various levels of several oils. Experiments are designed, carried out, and analyzed in accordance with standard procedures in toxicoloical studies. Output will be data on toxic effects of oil suitable for use in determining water quality criteria. Two ppB of No. 2 fuel oil, JP-4, JP-5, or Willimar crude oil prevented fertilization of Fucus endentatus apparently due to toxic effect on sperm viability. Laminaria saccharina spores did not germinate at oil concentrations above 20 ppB.
Keywords: petroleum; reproduction; algae; aquatic ecosystems; toxicity; spermatozoa.

77004 Development of Chronic/Life Cycle Bioassays Methods. Gentile, J.H. (EPA, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-17. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$180,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Whole/partial life cycle bioassays will be developed that permit assessment of pollutant impact on growth, survival, and reproduction of fish, annelids, molluscs, and crustaceans. Research objectives include identification of sensitive species and life stages, development of exposure systems that reflect natural pollutant-organism encounter, appropriate substratum and quality control. Relationships between sublethal parameters of behavior, energetics, growth and reproduction are being evaluated. Development and evaluation of design criteria for polychaete studies have been completed and were published. Currently evaluation of reproduction in a sediment system is underway which will complete the developmental aspects of this task. Mysid whole life cycle capabilities have been thoroughly evaluated and will be expanded to include offshore species. Current research involves comparing short term behavioral and energetic responses to growth and reproduction. Fish embryo-larval assays are continuing, with effort being directed toward utilizing two more test species.
Keywords: bioassay; biological effects; metals; organic compounds; pesticides; aquatic ecosystems.

77005 Modulating Environmental Variable Bioassay System. Voyer, R.; Gentile, J.H. (EPA, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-19.

Supported by: Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop a flow-through bioassay system that allows for multiple fixed and modulating salinities and temperature. The system can be externally driven through stored (tape) information or real time using microprocessor to control values, flows, etc. The applications of this system include: laboratory studies using real time salinity/temperature conditions rather than the usual single fixed conditions; the incorporation of salinity/temperature extremes into routine screening bioassays; and the use of this system for effluent and mixed waste testing in laboratories remote from field site but with site temperature and salinity profiles. The bioassay system has been completed for salinity studies and will be evaluated before a temperature mode is added. Data has been collected and is being analyzed for one toxicant with the larvae of two fish species. Systematic evaluation of this system will be initiated using fish embryo-larvae, mysid shrimp, and molluscs for selected classes of pollutants.
Keywords: bioassay; shrimp; larvae; salinity; temperature effects; toxicity; metals.

77006 Effects of Thermal Addition on Marine Fouling Community Dynamics. Miller, D.C.; Scott, J. (EPA, Office of Research and Development, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-20. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$40,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The project objective is to supplement the existing data base for marine water quality criteria for temperature. Of particular interest are the consequences of long-term, low-level thermal elevations on marine systems. Attention is given here to the indirect effects of prolonged thermal addition on interspecific relationships and dynamics of the fouling community. Ceramic panels are submerged in replicated tanks maintained at 0, 2, 4, and 6 degrees C over the natural temperature cycle. Field-developed and laboratory-developed communities are monitored monthly by a nondestructive 75-point sampling technique to document community structure. Life cycle aspects of community dominants are recorded from the community plates or other special study plates, providing data on spawning and larval recruitment and growth rates, attainment of reproductive maturity, and senescence. The completed project is expected to illustrate ways that subtle, yet prolonged thermal addition can affect biological systems. Growth, reproduction, and recruitment are the processes expected to be differentially influenced at the species level. The principal community commodity affected by these shifts is expected to be space available for growth and settlement. Species and community energetics may also be influenced by thermal addition and contribute to shifts in the structure and/or function of the indigenous community. There was good diversity on larval plates in this laboratory system, but as the community developed, only three or four species remained as dominants. Dramatic effects were seen at 6 degrees, with a total shift in community dominance and loss of the normal space occupier, Ciona intestinalis. At 4 degrees, the dominance shift was not as great, but a loss of stability was evident, as animal numbers fluctuated widely. Effects at 2 degrees C were not as clear cut, but by the second summer, a reduced Ciona dominance was evident relative to the temperature group.
Keywords: thermal pollution; water pollution; biological effects; biological fouling; ceramics; growth; reproduction; habitat; population dynamics; biological stress; aquatic ecosystems; waste heat; thermal effluents.

77007 Behavioral and Physiological Indices of Pollutant Stress in Zooplankton and Invertebrate Larvae. Miller, D.C.; Liang, W.; Pechenik, J. (EPA, Office of Research and Development, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-21. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$100,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to elucidate a series of sublethal behavioral and physiological parameters to quantify pollutant stress in zooplankton and motile invertebrate larvae. Parameters to be studied include patterns and rates of swimming, feeding, growth and energy budget, and histology. Behaviors are recorded on video tape and shifts in behavioral patterns are quantified by computerized analysis of the tape. Images of study organisms are expressed as x-y coordinates for each video frame and then analyzed on a time basis to calculate such variables as linear velocity, angular velocity, direction of travel, and rate of change of direction. Behaviors of interest are those which are clearly typical of the field situation and which can be related to population success. Response to environmental cues which influence water column position (vertical migration) of estuarine forms, or swimming responses to sex pheromones are two cases in point. Metabolism feeding, assimilation, and growth rates are determined to construct an energy budget for dosed and non-dosed organisms. These budgets are utilized, along with long-term developmental success, to interpret observed shifts in motile behavioral response. Final output will be a series of sublethal stress indices which quantitatively describe effects of pollutants on physiological or sensory systems requisite to survival, growth or reproduction. Studies to date with zooplankton (Mysidopsisbahia) and larvae of several species (Balanus spp; Cancer spp; Crepidula fornicata) indicate that these behavioral and energetics sub-lethal parameters demonstrate adverse toxicant effects (to copper and petroleum hydrocarbons) at one to two orders of magnitude below that indicated by general growth or developmental parameters alone.
Keywords: behavior; physiology; biological stress; zooplankton; invertebrates; larvae; copper; petroleum; hydrocarbons; growth; reproduction.

77008 Development of a Benthic Bioassay System Employing Natural Assemblages. Davis, W. (EPA, Office of Research and Development, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-22. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$40,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objective of this research is to develop a benthic bioassay system with an ecologically meaningful set of sub-lethal response parameters for the deposit-feeding fauna (e.g., Nephtys, Yoldia, and Nucula). Initial research tasks include development of techniques to quantify sub-lethal effects of pollutant stress on these three dominant benthic deposit feeders, and examination of certain biological aspects (growth rates, reproductive seasons, feeding, and burrowing rates, metabolic rate/temperature relationship, laboratory food requirements) which are requisite to intelligent design of a future laboratory benthic bioassay system. The final test system will be used for the routine bioassay testing of an array of organic, inorganic, and mixed contaminants which may impact the benthos. Development of the definitive laboratory benthic bioassay system will require size experiments to define optimum size and configuration of the test unit, adoption of criteria to assess achievement of chemical equilibria benthic sediments, and determination of methods to establish the benthic fauna and to achieve uniform flow-through toxicant dosing. Whole system responses will also be explored as additional indices of pollution stress to supplement the single species indices cited above. Burrowing and feeding rates and behavior and growth have been measured and described for the polychaete Nephtys incisa by direct observation of thin aquaria or indirectly while held in laboratory in-situ sediment set ups. Observations made over the full annual temperature range (0 to 24 degrees, at 6 degree increments) were compared with field benthic observations and collections of the worm. Whole animal metabolism was measured seasonally in the laboratory to provide an energetic base line.
Keywords: bioassay; benthos; aquatic ecosystems; water pollution; toxicity; biological models.

77009 Coastal Environmental Assessment Station. Phelps, D.K.; Galloway, W.B. (EPA, Office of Research and Development, Science and Technology Division, S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-30. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$131,000.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The primary objective of the Coastal Environmental Assessment Station (CEAS) project is to develop methodology for the direct assessment of the impact of anthropogenic input to the coastal environment on marine organisms, especially organisms which are part of the food chain to man. Field verification of laboratory bioassays will be provided. Mytilus edulis are used as indicators of the anthropogenic input to coastal waters. A standard station is established in a clean area to be used as a reference point against which impacted areas can be compared. Mytilus from the same population are introduced to the standard and impacted areas and held in baskets for an appropriate period of time after which various indicators of pollution, such as metals or hydrocarbon body burdens, physiological indices, cytogenetic defects, or histopathology, are measured in parallel fashion on the two (or more) groups. Differences in response to these standard measurements indicate exposure to differing environmental stresses. The CEAS concept has been tested in Narragansett Bay, RI, where initial studies have shown clear differences in metal body burdens between groups of Mytilus held for four weeks in various parts of the estuary. High body burdens in organisms held in impacted areas as compared to those held at the clean standard station are paralleled by a much lower potential for growth as indicated by physiological indices. Ongoing work is designed to evaluate the use of Mytilus as an indicator of impact using other stress indices and in other geographic areas.

Keywords: coastal regions; environmental impacts; food chains; bioassay; biological indicators; baseline ecology; water pollution.

77010 Oil Spill Response Research, North Atlantic Coast (Norfolk, VA to Eastport, ME). Payne, R.R. (EPA, Office of Research and Development, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-33. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$100,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

Major oil spills provide unique opportunities to investigate and design effective methods for field sampling, measurement and assessment of ecological damage to marine and estuarine systems sensitive to oil pollution. The investigations will ultimately provide practical and scientific bases for defining the character and extent of short- and long-term environmental damage from these accidents. This activity is designed to provide the necessary environmental and biological data required for making management decisions concerning responsibility for damage from all releases in coastal regions; limitations and requirements for control technology related to oil spills; and provision of information necessary for regulatory and enforcement actions. The research is designed to evaluate the applicability of present sampling and field measurement techniques under adverse conditions posed by major spills and to develop improved methods or protocols as appropriate. The work includes: (1) preplanned sampling and measuring regimes for different coastal habitats; (2) field experiments and laboratory analysis to evaluate short- and long-term effects of spilled oil on sensitive life stages of selected organisms; (3) ecological studies on benthic ecosystems; (4) sampling and analysis of petroleum in the water column and bottom sediments and in pelagic and benthic organisms; and (5) statistical analysis of sampling and measuring methods.
Keywords: oil spills; environmental effects; aquatic ecosystems; sampling; data analysis; comparative evaluations; data acquisition; regional analysis; biological models; accidents; petroleum; statistical models; measuring methods.

77011 Bioaccumulation Kinetics of Marine Invertebrates. Zaroogian, G.; Gardner, G. (EPA, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-37. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$72,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to define the bioaccumulation and depuration kinetics for a variety of pollutants by marine molluscs and crustaceans. Organisms are chronically exposed to pollutants at low concentrations from 1 to 20 weeks and examined for uptake, depuration, histopathological damage, and effects on reproduction. These studies are designed to address pollutant impact at both the ecological and human health levels. Pollutants under study include arsenic, copper, cadmium and petroleum hydrocarbons with inclusion of chlorinated organics in the next year. The hydrocarbon studies will be initiated in fall of 1978. Results of metal bioaccumulation studies are available in published and unpublished manuscripts from the project leaders.
Keywords: aquatic organisms; invertebrates; metabolism; biological accumulation; metals; organic compounds; pesticides; toxicity; water pollution.

77012 Effects of Thermal Additions on the Dynamics of Fouling Communities at Beaufort, NC. Kirbysmith, W.W.; Sutherland, J.P. (Duke University, Marine Lab., Durham, NC, 27706). **Project number:** P625A-01. **Contract:** R803856-03. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$70,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Funds are requested for the construction of a laboratory system which will provide running seawater at ambient temperature and at 2 degrees C, 4 degrees C, and 8 degrees C above ambient. Fouling development and changes in fouling community structure will be followed at each temperature for several years on clay tile plates (232 cm-sq) submerged in October 1975 and April 1976. Larval recruitment at each temperature will also be monitored. Parallel experiments will be conducted simultaneously on plates submerged under the Duke Marine Lab Dock. Data will be used to determine the effect of heated effluents on community structure and function.
Keywords: microorganisms; temperature effects; thermal pollution; water pollution; seawater; clays; biological fouling; thermal effluents.

77013 Develop, Refine and Validate Tests for Assessing Toxicity and Bioaccumulation in Marine Environments. Gentile, J.H. (EPA, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P715-38. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are the development and verification of toxicological testing techniques for evaluating the environmental effects of toxic substances. Research includes: validation of existing testing methods, both acute and chronic, for representative fish, annelid, crustacean, and molluscan species; and development of new procedures for additional species, critical life-forms, and developing predictive capabilities relating data from short-term studies to long-term chronic effects.
Keywords: monitoring; toxicity; biological accumulation; aquatic ecosystems; biological stress; metals; pesticides.

77014 Further Development and Application of In Vitro Mammalian Cell Assays for Detection and Assessment of Genetic Toxicants. Malcolm, A.R. (EPA, Office of Research and Development, Genetic Toxicology Section, S. Ferry Road, Narragansett, RI, 02882). **Project number:** P775-31. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$200,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A battery of in-vitro mammalian cell assays utilizing different cell lines and various end points (gene mutation, DNA repair, cytogenetic parameters, and cell transformation) is being validated and further developed for application. Final outputs include (1) a series of improved tests for identification and assessment of genetic toxicants, (2) extension of the data base on diverse classes of chemicals, (3) problem identification, and (4) application of tests to special problems involving comparison of end points. A procedure for the induction and isolation of nutritional mutants in CHO cells was found to be unsuitable at the present time as an assay for mutagens because of poor mutant cell recovery. An assay employing the HGPRT locus in CHO cells has been validated with several, standard, direct-acting mutagens for gene mutation. In addition, positive results have also been obtaind with standard compounds in assays for DNA repair and sister-chromatid exchange using the same cell line. Validation studies of induced mutation by direct-acting compounds at the HGPRT locus in CHO cells have been completed; similar studies with compounds requiring metabolic activation are in progress. Validation studies with compounds which are direct-acting and with others requiring metabolic activation are in progress for other assays involving sister chromatid exchange, DNA repair, and oncogenic transformation.
Keywords: animal cells; bioassay; genetic effects; toxic materials; information systems; mutagens; dna; biological repair; sister chromatid exchanges.

77015 National Marine Pollution Monitoring Program (Mussel Watch). Phelps, D.K. (EPA, Environmental Research Lab., S. Ferry Rd., Narragansett, RI, 02882). **Project number:** P775-28. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

The project is intended to develop methodologies for biomonitoring pollutant build-up in marine coastal areas, to develop a basis for interpretation of data so obtained, and to demonstrate the utility of such methodologies in the field. A combination of in-house and extramural effort is used to generate data, implement analytical quality control procedures, and to experimentally determine the effects of key environmental variables on bioaccumulation of significant pollutants by field-exposed bivalve molluscs.
Keywords: water pollution; monitoring; seawater; biological accumulation; molluscs; biological indicators.

77016 Petroleum Hydrocarbon Analysis of Marine Systems. Rogerson, P.; Norwood, C. (EPA, Environmental Research Lab., S. Ferry Road, Narragansett, RI, 02882). **Project number:** P608C-36. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Techniques to measure various classes of petroleum hydrocarbons in marine systems are being developed and applied. Samples of tissue and sediment are digested with caustic and then extracted with organic solvents. Sample cleanup and fractionation is accomplished by column chromatography with analysis by capillary column gas chromatography and GC/MS. Data is fed back into the biological programs with new and innovative analytical methodology published in the open literature.
Keywords: hydrocarbons; aquatic ecosystems; sampling; water pollution; quantitative chemical analysis; monitoring; environmental impacts; petroleum deposits; offshore sites; petroleum industry.

77017 EPA Mussel Watch Grants. Martin, J.H. (San Jose State Univ., 125 South 7th Street, San Jose, CA, 95192). **Project number:** 8775-40. **Contract:** R807110. **Supported by:** Environmental Protection

Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective of the proposed research is to monitor trace metals in transplanted mussels and their exposure water around San Francisco Bay. It will address the question of a correlation between the levels of those heavy metals in the transplanted mussels and the levels measured in seawater at the transplanted sites. Additionally, development of methods for the analysis of silver in seawater and intercalibration with other scientists on levels of various other metals in mussel tissue will be undertaken.
Keywords: molluscs; monitoring; san francisco bay; metals; water pollution; seawater; correlations; removal; silver.

77018 U.S. National Mussel Watch. Risebrough, R. (Bodega Bay Inst., Berkeley, CA). **Project number:** P775-14. **Contract:** R807223. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective is to participate in the National Mussel Watch Program to determine the extent and magnitude of chemical changes in the coastal zones of the United States. Mussels will be used as indicator organisms of chemical changes in local coastal water. Samples will be analyzed at the Bodega Marine Laboratory for various synthetic organic compounds and for petroleum. Data on identified compounds detected will be stored electronically for subsequent referral. In selected instances, local marine water will be sampled at the time of mussel collection to determine the nature of the partitioning of organic pollutants between the dissolved and particulate phases of seawater and the indicator organism.
Keywords: coastal regions; molluscs; biological indicators; usa; chemical effluents; organic compounds; petroleum; seawater; water pollution; physiology.

77019 Mussel Watch: Extension to Historical Records and the Novel Pollutants. Goldberg, E. (Univ. of California, P.O. Box 1529, La Jolla, CA, 92038). **Project number:** P775-42. **Contract:** R806805. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The research objectives are to assess the use of the shells of bivalves (mussels, oysters, and clams) as recorders of heavy metal levels of the environments in which the organisms lived and to assess the use of Pu-241 concentrations in bivalves as an indicator of transuranic leakage from facilities of the nuclear fuel cycle. Both goals will attempt to extend the use of bivalves as sentinel organisms in ascertaining the levels of pollution in coastal ocean waters. The shell analyses for Ag, Cd, Cu, Ni, Pb, and An will be compared with the previously made analyses for these metals on the soft tissue for samples collected during the 1976 to 1978 period of the Mussel Watch Program.
Keywords: molluscs; biological indicators; elements; plutonium 241; fuel cycle centers; water pollution; coastal waters; shells; chemical composition.

77020 Mussels and Oysters as Biological Indicators of Radionuclide Pollution. Bowen, V.T. (Woods Hole Oceanographic Institution, Main St., Woods Hole, MA, 02543). **Project number:** P775-43. **Contract:** R807181. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objectives are to establish a more secure basis for the use of sessile molluscs as biological accumulators for radiochemical pollution monitoring and for the interpretation of mollusc analyses; and to clarify the evidence for some local hot spots of pollution that might be inferred from the existing three years of monitoring data. The approach will include monthly collections of mussels or of oysters at 9 or 10 places selected from the existing network and annual collections at about 15 other places. A series of transplantation experiments will be conducted, both from more to less polluted locations and the reverse and from coast to coast. Algae, sediment, and suspended matter samples will be taken from as many as possible of the bivalve sampling locations. All samples will be analyzed radiochemically for 137-Cs, 239-Pu, 240-Pu, and 241-Am, and for Cm and 238Pu, if measurable.
Keywords: oysters; molluscs; biological indicators; radionuclide migration; water pollution; biological accumulation; algae; sediments; suspensions; sampling; radioecological concentration; radiochemical analysis; cesium 137; plutonium 238; plutonium 239; plutonium 240; americium 241; curium 238.

77500 Water Quality and Eutrophication Studies in Santa Rosa Sound in the Proximity of Escambia and Santa Rosa Counties, Florida. Moshiri, G.A. (University of West Florida, Dept. of Biology, Pensacola, FL, 32504). **Project number:** Q608C-Q002. **Contract:** R805366-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$23,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

The proposed project is intended to monitor water quality parameters over a period of two years and will give detailed information concerning the present water quality status of Santa Rosa Sound, Escambia—Santa Rosa Counties, Florida. From bi-weekly field samples, water quality parameters will be measured against a background of physico-chemical data. These parameters include BOD, inorganic and organic carbon, algal cell counts and types, and bacterial numbers and sizes. The major types of phosphate and nitrogenous species will be determined and correlated with algal population composition and primary production rates (to be measured in situ by the 14C technique). The effects of nitrogen-phosphorus enrichment on algal productivity will be determined by employing the primary productivity measurements technique on in-situ cultures on a seasonal basis. In addition to the regular sampling regimen, dual studies will be conducted to delineate daily trends in water quality parameters. Pilot investigations will be conducted periodically to indicate areas needing further investigation. It is anticipated that the information obtained from the proposed study will aid in the establishment of recommendations for the improvement of water quality in Santa Rosa Sound.
Keywords: water quality; eutrophication; florida; monitoring; phosphates; nitrogen oxides; nitrates; ecological concentration.

77501 Mathematical Models of Fates of Pollutants in Estuaries. O'Connor, D.J. (Manhattan College, Dept. of Civil Engineering, 4513 Manhattan College Parkway, Bronx, NY, 10471). **Project number:** Q608C-Q011. **Contract:** R804563-03. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$140,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is the quantification of the inter-relationships among physical, chemical, and biological variables of estuarine systems, including analysis of two-layered estuarine transport, effects on suspended solids and salinity, adsorption/desorption mechanisms for hazardous substances, and food chain implications. A mathematical model characterizing estuarine transport will be developed. This model will be verified using field data for velocity profiles and salinity and solids distribution. A model describing estuarine transport has been developed. Specific application will be made to the James River Estuary in order to address kepone contamination problems.
Keywords: water pollution; mathematical models; environmental transport; estuaries; aquatic ecosystems; biological models; salinity; solid wastes.

77502 Novel Techniques for Concentration and Separation of Toxic Substances from Estuarine Waters. Klein, E. (Gulf South Research Inst., 8000 Gulf S. Research Inst. Ave., Baton Rouge, LA, 70808). **Project number:** Q608C-Q014. **Contract:** R805656-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Methods for the separation, concentration and identification of xenobiotics with mutagenic/carcinogenic properties from the estuarine environment will be developed.
Keywords: estuaries; water pollution; carcinogens; mutagens; separation processes; qualitative chemical analysis; water.

77503 Role of Sediments in the Storage, Movement, and Biological Uptake of Kepone in Estuarine Environments. Huggett, R.J. (Virginia Inst. of Marine Science, Gloucester Point, VA, 23062). **Project number:** Q608C-Q016. **Contract:** R804993-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The program will study the following aspects of kepone in the James River, Virginia: (1) the distribution of kepone in bottom sediments of the James River will be determined; (2) the routes of sediment transport below Hopewell will be delineated; and (3) major sediment sinks will be located and the rates of sediment deposition at these sites will be determined.
Keywords: sediments; water chemistry; kepone; biological accumulation; metabolism; uptake.

77504 Oil and Hazardous Substance Spill Ecological Damage Assessment Research Coordination. Davis, W.P. (EPA, Gulf Breeze Environmental Research Lab., Bears Bluff Field Station, P.O. Box 368, Johns Island, SC, 29455). **Project number:** Q608C-Q120. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$150,000.

Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objectives of this project are to effect research coordination of oil and hazardous substance spill ecological damage assessment by: (1) developing portable sampling and analysis capability (fluorometry) for the South Atlantic, Gulf of Mexico, and U.S. territories in the Caribbean; (2) establishing information base and rapport with state, regional, and Federal agencies and academic institutions presently responding to or concerned with spills of petroleum and hazardous/toxic materials; and (3) compiling and evaluating existing methodologies for ecological damage assessment and modifying techniques to be applicable to spill contingency response.

Keywords: petroleum; hazardous materials; oil spills; aquatic ecosystems; water pollution; toxicity; biological models.

77505 Feeding, Reproduction and Habitat Selection of Lobster (Homarus americanus): Effects of Drilling Mud in Laboratory and Field Situations. Atema, J. (Boston Univ., 755 Commonwealth Ave., Boston, MA, 02215). **Project number:** Q608C-106. **Contract:** R806630. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to determine the biologically significant effects of chemical pollutants on behavior of marine animals; and to determine the effects of drilling mud on feeding, molting, mating, predator escape, shelter behavior, and substrate selection of lobsters. The research will be achieved by two kinds of research: (1) controlled laboratory experiments and (2) seminatural environment and field observations. Toxicity tests for sub-lethal effects will be completed.

Keywords: reproduction; food chains; habitat; lobsters; drilling fluids; toxicity; petroleum; physiology.

77506 Design of Experiments, Statistical Analyses, and Evaluation of Aquatic Research Data. Domey, R.G. (Univ. of Texas, 7703 Floyd Curl Dr., San Antonio, TX, 78284). **Project number:** Q625A-Q018. **Contract:** R805007-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide consulation on designs of research analysis of aquatic research data, including evaluation and interpretation of research results when required. The approach is mathematical/statistical accompanied by appropriate graphic representation. Certain preliminary pilot statistical programs have been tested and the results are on file at the Environmental Research Laboratory, Gulf Breeze, Bears Bluff Field Station, P.O. Box 368, Johns Island, South Carolina.

Keywords: aquatic ecosystems; biological models; experiment planning.

77507 Food Webs, Populations, and Productivity in a Southeast Coastal Marine Marsh. Chamberlain, N.A. (Charleston College, Charleston, SC, 29401). **Project number:** Q625A-Q019. **Contract:** R804688-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objective is to study the productivity and trophic relationships among the marsh organisms. Under consideration (among other studies) are habitat selection and trophic relationships of: amphipods, fishes, and fish larvae in the upper marsh; intertidal and subtidal benthic crustacea; and fishes of the larger creeks.

Keywords: aquatic organisms; amphibians; fishes; crustaceans; population dynamics; baseline ecology; southeast region; coastal regions; food chains; aquatic ecosystems.

77508 Investigation of the Ecological Effects of Residual Ozone to Selected Estuarine Species. Burton, D.T. (Academy of Natural Sciences of Philadelphia, 19th and The Parkway, Philadelphia, PA, 19103). **Project number:** Q625A-Q020. **Contract:** R804683-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to study the ecological effect of residual ozone to selected estuarine species. We propose to determine the toxicity of residual ozone, both lethal and sublethal effects, to selected commercially and/or recreationally important estuarine finfish and shellfish species and their life stages under various environmental conditions. We will also compare the toxicological effects of residual ozone to those chlorines which are being determined on the same species and life stages under the same experimental regimes set forth above.

Keywords: toxicity; ozone; fishes; crustaceans; chlorine; aquatic organisms; estuaries.

77509 Isolation and Study of Chloro-Organics Resulting from Chlorination of Seawater. Carpenter, J.H. (Univ. of Miami, 4600 Rickenbacker Cswy., Miami, FL, 33149). **Project number:** Q625A-Q021. **Contract:** R803893-03. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The chlorine-containing and bromine-containing organic compounds that are formed when chlorine is added to seawater will be identified. Initial emphasis would be placed on study of reaction conditions that occur during power plant operations. Total organic halogenated compounds yield would be measured. The reaction products would be fractionated, using selective solubility and thin layer chromatography. Characterization would be carried out using gas chromatographic-mass spectral techniques and additional characterization would be based on uv and ir spectra with NMR for special cases.

Keywords: chlorine compounds; bromine compounds; organic compounds; chlorination; seawater; chemical reactions; power plants; gas chromatography; mass spectroscopy; nuclear magnetic resonance.

77510 Effects of Drilling Mud Constituents on the Sedimentary Microflora and the Base of the Marine Benthic Food Web. White, D.C. (Florida State University, Department of Biological Science, 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** Q625A-Q025. **Contract:** R806143-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$5,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Few studies hae been done which evaluate the environmental effects of drilling muds discharged by offshore oil rigs. Although the effects of drilling mud on the structure of benthic communities have been documented, controlled laboratory experiments are needed. In the proposed research, experiments will be conducted which will use special laboratory tanks containing a directional water current to assess the effects of at least four selected drilling mud components on benthic organisms. These experiments will be conducted in cooperation with the EPA Environmental Research Laboratory at Gulf Breeze, Florida.

Keywords: drilling fluids; aquatic ecosystems; biological effects; toxicity; biological models; offshore sites; water pollution; florida; offshore operations; environmental impacts; petroleum industry; natural gas industry.

77511 Environmental Effects of Offshore Drilling and Oil on the Marine Environment. Schuh, N. (Dept. of Defense, Navy Coastal Systems Lab., Panama City, FL, 32407). **Project number:** Q625A-Q044. **Contract:** D7-01134. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The work to be conducted includes the conduct of research to: (1) determine the environmental effects of offshore oil extraction, and (2) assess the effects on the marine environment of bunker C fuel derived from shale oil. In order to simulate the conditions of the marine environment, the use of the Stage I offshore platform owned and maintained by the Naval Coastal Systems laboratory, Panama City, Florida, will be used.

Keywords: drilling; environmental impacts; petroleum industry; offshore sites; petroleum; shale oil.

77512 Sublethal Effects of Chlorine on Marine Vascular Plants and Decapod Crustaceans. Roberts, M.H. (Virginia Inst. of Marine Science, Gloucester Point , VA, 23062). **Project number:** Q625A-Q045. **Contract:** R803872-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to define effects of continous exposure to chlorine on larval development, juvenile growth, and reproductive parameters, for two selected marine Decapod crustaceans, Panopeus herbstii and Pagurus longicarpus. Additionally, the effects of the chlorine on development of the coot clam, Mulinia lateralis, and blood serum constituents of the blue crab, Callincetes spaidus, will be studied.

Keywords: chlorine; water chemistry; aquatic organisms; crustaceans; chronic exposure; physiology; biological effects; toxicity.

77513 Effects of Chemicals Used in Offshore Oil and Gas Drilling Operations on Marine Organisms. Richards, N.L. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q625A-Q070. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Effects of drilling fluids on aquatic species will be determined by toxicity tests on organisms from the Gulf of Mexico and New England. Potential organism and ecosystem damage as a result of oil and gas drilling activities will be assessed. Methods have been developed for testing drilling fluids and their components.
Keywords: aquatic organisms; sensitivity; drilling fluids; metabolism; offshore sites; petroleum industry; natural gas industry; environmental impacts; toxicity; chemical effluents.

77514 Determine the Dynamics of Dispersion and Dissipation in Marine and Estuarine Waters and the Effects on Marine and Estuarine Organisms. Davis, W.P. (EPA, Bears Bluff Field Station, P.O. Box 368, Johns Island, SC, 29455). **Project number:** Q625A-Q147. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$199,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Halogenated compounds formed when chlorine is added to seawater will be identified. Initial emphasis will describe the inorganic and organic reactions which lead to long lasting by-products. Followup studies will investigate the complex and physical chemical fate of identified compounds in simulated and natural marine ecosystems, including complexing with sediments or uptake and bioaccumulation organisms. Analytical capability will be applied both to on-site experiment investigations and community studies by the Bears Bluff Field Station of the Environmental Research Laboratory, Gulf Breeze, Florida.
Keywords: diffusion; mathematical models; water pollution; estuaries; seas; aquatic organisms; physiology; organic chlorine compounds; uptake; biological accumulation; ecological concentration.

77515 Microbial Degradation of Hydrocarbons in Experimental Microbial Ecosystems. Pritchard, H. (EPA, Office of Research and Development, Gulf Breeze Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q625A-Q148. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$25,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to determine the fate of hazardous organic compounds, including petroleum hydrocarbons and pesticides, both singly and in combination, in marine ecosystems. Microbial degradation rates and products of pesticides and pesticide-hydrocarbon mixtures will be determined and used in establishing regulatory criteria and guidelines. Tests will be conducted using highly refined continuous culture systems.
Keywords: biodegradation; microorganisms; hydrocarbons; organic compounds; hazardous materials; waste management; environmental effects; aquatic ecosystems; pesticides; petroleum; environmental transport.

77516 Cycling of Xenobiotics Through Estuarine and Marine Sediments. Dasaro, C.N. (University of West Florida, Department of Biology, Pensacola, FL, 32504). **Project number:** Q625F-Q001. **Contract:** R804458-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$110,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

This research will examine a mechanism of cycling various xenobiotics in and through estuarine and marine sediments. A lugworm, Arenicola cristata (Polychaeta: Arenicolidae), will b% studied to define and quantify movement of compounds through the sediment as a result of reworking and biological accumulation. Behavioral bioassays, designed to examine the effects of xenobiotics on the interactions between a predator and its prey, will be developed. A grass shrimp, Palaemonetes pugio, will serve as prey, while either the pinfish, Lagodon rhomboides, or the Gulf killfish, Fundulus grandis, will be used as predators. Other behavioral assays will test the ability of exposed pinfish to avoid the flounder, Paralichthys albigutta, and the responses of pinfish to gradients of xenobiotics in a specially designed system that automatically records, graphs and compares activity.
Keywords: mineral cycling; estuaries; aquatic ecosystems; biological models; sediments; behavior; bioassay; fishes; vertebrates; invertebrates.

77517 Susceptibility of Genetically Defined Stock of Fish to Chemical Carcinogens. Kallman, K.D. (Osborn Labs. of Marine Sciences, Boardwalk and W. 8th St., Brooklyn, NY, 11224). **Project number:** Q625F-Q015. **Contract:** R805389-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The effects of a number of polycyclic aromatic hydrocarbons (PAH), which are significant pollutants in the natural environment, will be studied in genetically defined stocks of fish of xiphophorus and rivulus. Many of these compounds are involved in chemical carcinogenesis in mammals. Our aim is to determine whether strain differences exist in susceptibility to PAH-induced carcinogenesis and whether this can be correlated with the degree of heterozygosity. Some of the genetically defined stocks may become sensitive indicators for certain kinds of pollutants.
Keywords: fishes; sensitivity; carcinogens; genetic variability; polycyclic aromatic hydrocarbons; biological effects; toxicity.

77518 Rivulus marmoratus: an Investigation of Its Potential as a Cancer Research and Chemical Carcinogen Screening Organism. Koenig, C.C. (College of Charleston, Charleston, SC, 29401). **Project number:** Q625F-Q017. **Contract:** R805469-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to develop and test methodology to use genetically defined strains of marine fish as laboratory and field exposure to screen potential environmental mutagenic, teratogenic and carcinogenic compounds. Using controlled cultures of isogenic homozygous clones of a naturally hermaphroditic fish species, bioassay procedures for compounds with mutagenic, teratogenic, and carcinogenic properties will be established, and a sister-chromatid-exchange technique for selected marine fish species for in vitro and in vivo tests will be perfected. Hundreds of individuals and exposures to five selected test substances have been underway. Sister-chromatid exchange has been tested and suitable fishes are being selected via karotyping. Tissue culture techniques are being mass tested.
Keywords: carcinogens; biological indicators; fishes; mutagenesis; bioassay; mutagen screening; tissue cultures.

77519 Detection of Carcinogenicity of Oils in Sea Water: Use of Hybrid Fish and Food Chains. Humm, D.G. (Univ. of North Carolina, Chapel Hill, NC, 27514). **Project number:** Q625F-Q022. **Contract:** R804650-03. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to develop and validate a quick in vivo screening method for carcinogens. This will be done by the use of hybrid fish that have a high incidence of neoplasia to develop genetically modified fish that are indicators of carcinogens. Preliminary results indicate that such crosses are possible and may have validity as a quick-screen tool.
Keywords: fishes; food chains; petroleum; toxicity; seawater; petroleum industry; environmental impacts.

77520 Genetic Variation and Resistance to Carcinogens in Natural Waters. Schultz, R.J. (Univ. of Connecticut, Storrs, CT, 06268). **Project number:** Q625F-Q027. **Contract:** R805195-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to evaluate the feasibility of using isogenic fish to detect carcinogens. The validated bioassay system would be used to test the carcinogenic properties of compounds from petroleum and shale oil. This is done by using isogenic fish to detect carcinogens in order to establish the optimum test system for quick-screen in vitro toxicity testing. Neoplasia has been observed in preliminary experiments. The methods will be validated.
Keywords: genetic variability; carcinogenesis; biological models; fishes; biological indicators; toxicity; bioassay; tolerance.

77521 Toxic, Sublethal and Latent Effects of Selected Petroleum Hydrocarbons and Barium Sulfate on Marine Organisms. Rao, K.R. (University of West Florida, Department of Biology, Pensacola, FL, 32504). **Project number:** Q625F-Q029. **Contract:** R804541-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$47,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This investigation will examine the toxic, sublethal and latent effects of certain polycyclic aromatic hydrocarbons and barium sulfate on larval and adult stages of selected invertebrates and fish. Experiments are designed to determine the effects of these compounds on crustacean molt cycles, regenerative limb growth, respiration, heart rate, and histology and ultrastructure of selected tissues. Studies are aimed at determining the uptake by marine organisms of these pollutants from water and bioaccumulation through aquatic food chains. By using a combination of autoradiographic and conventional analytical techniques, the sites and extent of accumulation of pollutants in marine organisms will be determined.
Keywords: petroleum; toxicity; barium sulfates; aquatic organisms; uptake; food chains; water pollution; biological effects; chemical

analysis; biological accumulation; fishes; invertebrates; offshore operations; petroleum industry.

77522 Effects of Petroleum Compounds on Estuarine Fishes. Martin, B.J. (University of Southern Mississippi, School of Science and Technology, Department of Biology, Hattiesburg, MS, 39401). **Project number:** Q625F-Q030. **Contract:** R804527-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective of this project is to produce information useful in dealing effectively with the deterioration in biological quality of the aquatic environment that seems to invariably occur in any region where the human population is increasing.
Keywords: petroleum; hydrocarbons; estuaries; fishes; aquatic ecosystems; metabolism; human populations; biological effects; environmental effects; biological models; monitoring.

77523 Industrial Effluent Source Assessment. Walsh, G.E. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** 0625G-Q083. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to develop methods for evaluation of the potential impact of complex liquid industrial waste effluent on aquatic organisms. When the methods are checked by another laboratory, a manual for chemical and biological analyses of effluents will be published. EPA's Annapolis field office collects waste from potential polluters and ships them to Gulf Breeze. Bioassays are done with algae and mysids. Toxic waste is fractionated chemically into organic and inorganic portions which are then subjected to bioassay. Subfractions of the toxic fraction are also tested for bioactivity. In the future, wastes will be shipped to a contractor for confirmation and possible modification of our analytical protocols. In-house development of analytical procedures for chemical fractionation and laboratory bioassay is nearing completion. Wastes may be toxic to algae and animals and may also stimulate algal growth. Also toxicants may mask effects of alga growth stimulants, which are found after fractionation. Toxicity is most often found in the heavy metal portion, but the organic fraction of some wastes is toxic.
Keywords: aquatic organisms; industrial wastes; chemical effluents; algae; shrimp; bioassay; manuals; toxicity; animals; metals; hydrocarbons.

77524 Effects Assessment: Chronic Toxicity (Fish). Hansen, D.J. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q063. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Data developed in this project will be used to assess the chronic effects of pesticides on marine fishes. The results of these tests will be integrated with other effects assessment testing to evaluate the impact of selected pesticides on marine organisms. Entire life-cycle, partial life-cycle, or embryo/juvenile tests will be conducted using the sheepshead minnow. Effects on survival, growth, or reproduction will be used to assist in predicting no effect concentrations. In some instances there will be overlap in tests used and pesticides selected with those in the project entitled Rapid Tests to Predict Chronic Toxicity to Marine Fish. Results of these tests and other projects where there is effects assessment testing will be combined for each pesticide into a final report on that pesticide.
Keywords: toxicity; chronic exposure; fishes; pesticides; biological effects; organic chlorine compounds; bioassay.

77525 Rapid Tests to Predict Chronic Toxicity to Marine Fish. Hansen, D.J. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q064. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The project seeks to determine if certain tests can be substituted for life-cycle tests of marine fish without significant loss in interpreting the environmental risk of pesticides. The results of partial life-cycle or entire life-cycle tests with the marine sheepshead minnow will be contrasted with results of embryo/juvenile tests with this fish, with reductions in acetylcholine esterase inhibition in organosphosphate or carbamate exposed sheepshead minnows, and with results of life-cycle tests with freshwater fishes. If correlations exist the: (1) embryo/juvenile tests can be substituted for life-cycle tests; (2) ACHE measurements might be predictive of chronic effects in the laboratory and in the field; and (3) results of tests on fishes from one aquatic environment might be useful in predicting environmental risk of pesticides in the other aquatic environment. Entire life-cycle or partial life-cycle tests have been conducted using sheepshead minnows and endrin, heptachlor, toxaphene, kepone, methoxychlor, malathion, diazinon, trifluralin, pentachlorophenol, chlordane, and carbofuran. Tests with guthion and EPN are underway. Tentative results of embryo/juvenile tests predict maximum acceptable toxicant concentrations (MATC) in life-cycle tests within a factor of five or less for 67% of the chemicals tested. Impaired reproduction and 27% ACHE inhibition occur concurrently with diazinon exposure. Incomplete results of tests with EPN and guthion also show significant reductions of ACHE and reproductive potentials. Application factors and MATC limits for those chemicals where data on freshwater and marine fish exist compare favorably.
Keywords: toxicity; chronic exposure; fishes; bioassay; pesticides; water pollution; organic chlorine compounds.

77526 Development of a Flowing Water Carcinogen Assay System Utilizing Fish and Aquatic Invertebrates. Couch, J.A. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q068. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to provide information on the fate and effects of carcinogens in the aquatic environment and to develop carcinogen assays utilizing aquatic species to supplement mammalian assays. Flow-through and static systems for exposing aquatic organisms to carcinogens or suspect chemicals will be designed; marine and freshwater species will be selected and tested for their responsiveness and sensitivity to known or suspect carcinogens; oncogenic sensitivity of aquatic species and standard mammalian test species to known carcinogens will be compared; and uptake, bioconcentration, and metabolic data on carcinogens in aquatic animals will be obtained. A fish carcinogen assay exposure system has been designed and constructed and is now being tested in long-term exposures of fishes to the pesticide trifluralin, a suspect carcinogen. Reports on the use of oysters as bioindicators of carcinogens as demonstrated experimentally in the laboratory are in press. Research on the fate and effects of asbestos on fish has been planned and is beginning.
Keywords: carcinogens; bioassay; fishes; aquatic organisms; invertebrates; sensitivity; uptake; pesticides; biological accumulation; asbestos; toxicity.

77527 Effects Assessment: Methods Development of New Invertebrate Test Species. Tyler-Schroeder, D.B. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q075. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to find replacement or supplemental invertebrates to be used in life-cycle toxicity tests or larval development exposures and to develop culture and exposure techniques. This is done by reviewing all invertebrate toxicity literature for fresh and salt water environments, beginning a 96-hour acute flow-through test with juveniles or larvae, and proceeding to life-cycle culture work based on sensitivity and ease of handling. Preliminary work with flow-through systems controlling salinity and temperature using blue crab larvae, Callinectes sapidus, exposed to kepone has been accomplished.
Keywords: invertebrates; bioassay; preferred species; toxicity; data compilation; molluscs; kepone; seawater; fresh water; biological indicators; water pollution; hydrocarbons.

77528 Life-Cycle Toxicity Testing with the Grass Shrimp, Palaemonetes pugio. Tyler-Schroeder, D.B. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q076. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop techniques for life-cycle toxicity testing of the grass shrimp, Palaemonetes pugio. The method should be written for others' use and tested by another laboratory. Results with several chemicals are to be compared with those from other estuarine life-cycle toxicity tests currently in use. Laboratory culture techniques are necessary to provide the larval and juvenile animals for acute and chronic flow-through toxicity tests. This is done by the flow-through exposures begun with sexually immature juvenile animals, time allowed for maximum uptake of chemical by shrimp, and reproduction induced with photoperiod/temperature regime. Effects examined include survival, growth, number of females spawning per concentration, number of eggs laid per female per concentration, number of larvae hatching per female per concentration, and larval development to metamorphosis. Methods for life-cycle toxicity test, acute static test, and laboratory culture were developed and published in bioassay procedures for the Ocean Disposal Permit Program Manual (EPA-600/9-78-010, March 1978) and in the scientific

literature (ASTM symposium). Extramural run of test is being conducted. Endrin data used in water quality criteria documents, and other chemicals tested are RPAR/OPP chemicals, trithion and temik.
Keywords: life span; toxicity; pesticides; shrimp; sensitivity; bioassay.

77529 Rapid Assessment Static Toxicity Tests (Developmental EC50 and LC50 Tests). Borthwick, P.W. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q077. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to identify sensitive fish and macroinvertebrates and implement toxicity test procedures based on sensitivity to toxics, availability, economic and environmental importance, and ability to culture, to include a battery of short-cut static toxicity tests. This is done by (1) incorporating ASTM procedure for mollusk larvae 48-h EC50 into routine battery of tests during spawning season using the eastern oyster (Crassostre virginicu); (2) conducting tests with a fish other than sheepshead minnows (e.g., spot, Leiostomus xanthurus) and a penaeid shrimp (Maricultured postlarvae, Penaeus sp.); and (3) attempting to culture and test marine mysid shrimp (Etamysidopsis swifti). Acute static toxicity of eight pesticides (EPN, acephate, methyl parathion, temik, DEF, phorate, mocap, trithion) to wild-caught spot and maricultured shrimp postlarvae (Penaeus stylirostris) is 90% complete; eastern oyster maturation tests to produce out-of-season embryos for 48-h and EC50 test were discontinued as not feasible. Seasonal embryo production from April to August was studied. Tests were conducted on selected chemicals using oyster embryos. Attempt to culture marine mysids (Metamysidopsis swifti) is 20% complete.
Keywords: toxicity; fishes; invertebrates; sensitivity; oysters; shrimp; pesticides; bioassay; water pollution.

77530 Acute Static Toxicity Tests (Routine): RPAR, RPAR-Alternate, and Others. Borthwick, P.W. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q078. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to improve and standardize toxicity test protocol for mysid shrimp (Mysidopsis bahia) and sheepshead minnows (Cyprinodon variegatus) for routine determination of the toxicity of OPP chemicals, expressed as the 96-hour acute static LC50. An efficient system will be developed to provide laboratory-reared 1-day old mysid shrimp and 28-day old sheepshead minnows on a weekly basis in a controlled laboratory environment, using a standard feeding and disease control program and quarterly reference toxicant tests for quality assurance. These two species comprise our present battery of acute static toxicity tests. Acute static toxicity studies of 8 pesticides (EPN, acephate, methyl parathion, temik, DEF, phorate, mocap, and trithion) are 90% complete. Acute static toxicity studies of 8 OPP pesticides (ambush, bolero, bolstar, BUX, dursban, fentrifanil, larvin, and pydrin) and marine grade cresote are 30% complete.
Keywords: toxicity; bioassay; manuals; shrimp; fishes; pesticides; hydrocarbons; water pollution.

77531 Diving Support. Patrick, J.M. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q079. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to provide support as needed for periodic placement, surveillance, maintenance and retrieval of equipment, insitu testing, animal collecting, underwater photography, and visual observations. This is done by developing an underwater diving program to assist estuarine and marine research activities with particular attention to safe diving practices. Logistical and underwater tactical and working support for energy-related research program in the Gulf of Mexico has been provided. Additional program responsibilities include: periodic maintenance of underwater structures and pumping systems at Sabine Island, collection of live specimens, and underwater photography as requested.
Keywords: petroleum; petroleum industry; natural gas industry; gulf of mexico; bioassay; diving operations; environmental impacts.

77532 Aquatic Community Bioassays. Ivey, J.M. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q080. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) to determine simultaneously the relative sensitivity to toxic organics and energy related compounds of many different types of estuarine microbenthic organisms developing in a natural community situation; (2) to compare results on energy compounds with concurrent field studies in the Gulf of Mexico; and (3) to continually develop the test to increase its application as a measure of toxicity. This is done by allowing planktonic larvae in flowing seawater to colonize sand in a group of replicate aquaria. After about 8 weeks, the number and species of macroinvertebrates exposed to various concentrations of the test compounds are compared statistically to those in unexposed aquaria. Toxic concentrations and types of animals affected in laboratory and gulf field situations are compared. Organisms present, toxicant effects, and statistical treatments of various test modifications are compared. Since May 1976, two insecticides and five energy related compounds have been tested in benthic bioassays. The effects on the number and species of macroinvertebrates that developed in estuarine communities have been determined for pentachlorophenol, sevin, dowicide G, barite, aldacide, surflo-B33, and lignosulfonate drilling mud. In addition, such parameters of toxicity as effects on growth, particularly sensitive taxonomic groups of organisms, and changes in community structure by phyla were also determined for various of the compounds. It was found that barite or drilling mud incorporated into the sand affected community structure by physically altering sediment granulometry rather than by direct toxicity alone. Studies on the relative toxicity of three biocides used in offshore oil drilling (dowicide G, aldacide, and surflo-B33) provided data on preferred use in the environment.
Keywords: bioassay; benthos; sensitivity; toxicity; insecticides; drilling fluids; animal growth; sediments; soil mechanics; petroleum industry; natural gas industry; pesticides.

77533 Mysid Bioassays. Hamaker, T.L. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q081. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine chronic effects of selected toxicants on the estuarine mysid shrimp, Mysidopsis bahia. Twenty-eight day entire life-cycle tests with selected toxicants are conducted on Mysidopsis bahia to determine their effects on survival and reproductive success (number of progeny per female during multiple broods). In 1976, ERL-Gulf Breeze investigators first successfully used the estuarine mysid shrimp, Mysidopsis bahia, throughout its life cycle (14 to 17 days) in toxicological studies. Mass culture methods were developed to meet the demand for mysids as a test species. To date, 96-hour toxicity tests and entire life-cycle tests have been conducted with mysids using one metal (cadmium) and twelve pesticides (DEF, diazinon, dimilin, EPN, guthion, kepone, leptophos, methyl parathion, phorate, sevin, toxaphene, and trithion). The mysid chronic test was successfully used to test dimilin, a new insecticide that interferes with the formation of an insect's exoskeleton. Reproduction in mysids was affected by exposure to particularly small amounts of dimilin. In addition, life cycle tests using sediments indicated that turbidity affected the reproductive success of mysids. The 96-hour toxicity tests and life-cycle tests with mysids demonstrated a sensitivity to cadmium and the pesticides that was equal to or greater than the sensitivity displayed by other estuarine biota. Methods of culturing Mysidopsis bahia have been published as have some results of the toxicity tests.
Keywords: bioassay; shrimp; chronic exposure; reproduction; pesticides; cadmium; toxicity; sensitivity; water pollution; biological effects.

77534 Exposure Assessment: Bioconcentration. Schimmel, S.C. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q085. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to develop a protocol and to conduct bioconcentration studies using estuarine animals. Chemicals of concern are organic chemicals designated by program offices. Results will be written in manuscript form and submitted to professional journal and program offices. The standard bioconcentration test consists of the exposure of an estuarine fish species or oyster species to a known concentration of test material. Organisms are removed periodically and analyzed for the material during the exposure period until steady-state (equilibrium) is reached. A depuration phase follows, and decline of residues is observed. The bioconcentration tests have been completed on the insecticides trithion and EPN using the estuarine fishes Lieostomus xanthurus and Lagodon rhomboides. The bioconcentration factor for trithion was approximately 600x; that for EPN was 700x. Two long term bioconcentration studies were conducted to determine: (1) the bioconcentration factor (BCF)

of two insecticides (EPN and trithion) at steady-state; (2) the time to steady-state during uptake; and (3) the time to 90% depuration during the depuration phase. In the EPN study, Lagodon rhomboides was exposed to the chemical for 26 days followed by an 8 day depuration period. The BCF was approximately 700x and no EPN was detectable in tissues after 8 days in pesticide-free seawater. Leiostomus xanthurus was exposed to trithion for 15 days and a BCF of 600x was determined at steady-state and 90% depuration occurred after 5 days in trithion-free seawater. The final report is due September 1979.

Keywords: biological accumulation; fishes; oysters; insecticides; toxicity; seawater; mathematical models; biological models; organic compounds.

77535 Effects Assessment: Acute Toxicity. Schimmel, S.C. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q086. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Using at least four species of estuarine animals (including fishes, crustaceans, and molluscs) 96-hr toxicity tests will be conducted on an undetermined number of toxic chemicals. Results of these studies will be calculated in the form of LC50 values. These results will be written as final reports and submitted to professional journal and program offices. Acute toxicity test procedures used will be those recommended by ASTM or standard methods. All LC50 or EC50 values will be accompanied by their respective 95% confidence interval. All routine tests will be conducted under flowing seawater conditions. Acute toxicity tests have been completed on various estuarine animals with the following pesticides: trithion, phorate, methyl parathion, DEF, and EPN. Acute (96 hr) toxicity tests were conducted on several pesticides using estuarine animals.

Keywords: toxicity; biological effects; fishes; molluscs; crustaceans; chemical effluents; seawater; pesticides; aquatic organisms; sensitivity; metabolism.

77536 Basic Research on Early Life Stages of Estuarine Fishes. Schimmel, S.C. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q094. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop culture techniques for at least one estuarine fish species to be used in embryo/juvenile toxicity tests. This is done by conducting basic tests to spawn eggs and sperm; culturing the embryos in the laboratory; determining optimum temperature and salinity regimes; and then conducting toxicity tests using these early life stages and various toxic organic chemicals. Spawning procedures have been devised for three fish species: Leiostomus xanthurus, Lagodon rhomboides, and Serranus subligarius. The resulting larvae have not survived beyond 9 days for any of the three species. Testing is continuing.

Keywords: fishes; cultivation techniques; aquaculture; reproduction; toxicity; pesticides; hydrocarbons; metals; biological models; juveniles.

77537 Development of Methods and Protocols for Exposure Assessment of Toxic Organics in Estuarine Environments. Bourquin, A.W. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q096. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to provide methodology and protocols for predicting the fate of toxic organics in estuarine systems based on tier testing procedures and on laboratory test systems which allow extrapolation to real-life aquatic situations. Level I testing involves development of rapid screening tests which provide preliminary information on detoxification, biodegradation, and tranformation and orientation guidelines for subsequent testing. Level II testing provides a laboratory testing method simulating natural estuarine conditions to evaluate the potential for specific environmental processes to affect the fate of toxic organics relative to standard test chemicals. Level III testing provides laboratory testing methods simulating natural estuarine conditions which quantitatively evaluate rates, extent, and capacities of degradative processes on toxic organics vending to exposure-concentration predictions. Level I test is in development. Menthyl parathion (MPS) is reference chemical and EPN is first test chemical. Level II test is an estuarine coring system developed using MPS and dimilin, kepone, pentachlorphenol and carbary. Level III test is a continuous-flow laboratory system developed using MPS. Compounds tested relative to MPS include kepone and dimilin.

Keywords: toxicity; pesticides; kepone; aquatic ecosystems; biological models; water chemistry; water pollution; biodegradation; biological accumulation.

77538 Characterization of Unique Properties of Marine Sediments and Their Impact on the Fate of Toxic Organics. Pritchard, P.H. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q097. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to determine the role of marine sediments and their associated microflora in controlling and affecting chemical hydrolysis, sorption/desorption processes and biodegradation, particularly as the results relate to improving and implementing the tiered fate testing program. This is done by studying actual marine sediments in laboratory systems utilizing experimental designs which permit examination of the biological, chemical, and environmental parameters affecting the formation of bound residues on sediments, the kinetics of adsorption processes to sediments, and the mechanisms and kinetics of biodegradation processes. Laboratory systems containing actual media have been designed and are presently in operation. A method has been developed, using kepone as the test compound, to reproducibly measure adsorption/desorption rates and partition coefficients to sediment. Environmental factors such as organic matter type, microbial activity and anaerobic conditions are being tested for their effect on the irreversible binding of methyl parathion to sediment detritis. The mechanisms of pentachlorophenol biodegradation in sediment are being investigated. Experiments have shown that benzoic acid is an excellent compound for measuring microbial activity and biodegradation potential in sediments.

Keywords: toxicity; organic compounds; water chemistry; sediments; kepone; organic chlorine compounds; phenols; biodegradation; microorganisms; parathion.

77539 Development of Hazard Assessment Protocols for Evaluating Toxic Organics Entering Estuaries. Bourquin, A.W. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714-Q098. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide an integrated hazard assessment program which will evaluate, on a relative basis, the quantitative and qualitative information generated from exposure and toxicity studies to better facilitate decision-making processes within EPA program offices and other governmental agencies. This will be done by employing tier testing protocols and mathematical models in fate and effects programs to generate hazard assessment predictions. Results are expansion of existing statistical model for bioaccumulation and depuration to include multiple pesticide exposure concentration. Mathematical modeling of microcosms and fate processes studied therein has been initiated. James River estuary model has been brought inhouse to aid in generating exposure concentration predictions.

Keywords: toxicity; pesticides; water chemistry; biological models; statistical models; health hazards; biological effects; biological accumulation; hydrocarbons; estuaries; water pollution.

77540 Effect of Chlorinated and Dechlorinated Seawater on the American Oyster, Crassostrase virginica. Middaugh, D.P. (EPA, Bears Bluff Field Station, P.O. Box 368, Johns Island, SC, 29455). **Project number:** Q714-Q109. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.

Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) determine the toxicological and physiological effects of chlorinated, chlorinated-dechlorinated, and NA2S2O3 treated seawater on the American oyster, Crassostrase virginica; (2) measure condition index and respiration of exposed oysters; and (3) measure CHBR3 (Bromoform) concentrations in oysters exposed to chlorinated and chlorinated-dechlorinated seawater. This approach will include long-term low-level flow-through tests with adult oysters and subsamples taken at fixed time intervals for measurement of parameters as stated above. Basic tests have been completed. Initial data under analysis is both statistical and chemical.

Keywords: seawater; chlorine; toxicity; oysters; chlorination; removal; environmental impacts; physiology; respiration; sulfur compounds; sodium compounds; bromoform.

77541 Methods for Conducting Laboratory Tests with Embryos and Larvae of the Atlantic Silverside, Menidia menidia. Middaugh, D.P. (EPA, Bears Bluff Field Station, P.O. Box 368, Johns Island, SC, 29455). **Project number:** Q714-Q114. **Supported by:** Environmen-

tal Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine optimum procedures for conducting toxicity tests with embryos and larvae of the Atlantic silverside, Menidia menidia. A system for stimulating total inundations in intertidally spawning Menidia will be developed, as well as procedures for maintaining and feeding embryos and larvae during acute and chronic (partial life history) toxicity tests. Observations made in the field will be used to design laboratory tests which simulate natural conditions (tidal inundations, salinity, temperature, photoperiod and light intensity conditions) which Menidia embryos and larvae normally encounter. Addition of toxicants or other environmental perturbations will provide information on potential detrimental effects during the early life history of the Atlantic silverside. A field study of the life history of Menidia menidia was conducted during 1976--1978. Information from this study is being used to simulate field conditions in the laboratory. Equipment is being purchased and set up. Menidia embryos and larvae have been successfully cultured in the laboratory. Assessment of apparatus for conducting acute and partial life history tests is underway.
Keywords: toxicity; bioassay; biological indicators; aquatic organisms; biological models; reproduction; water quality.

77542 Development of Standard Methods for Spawning Menidia menidia in the Laboratory. Middaugh, D.P. (EPA, Bears Bluff Field Station, P.O. Box 368, Johns Island, SC, 29455). **Project number:** Q714-Q115. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to develop methods, holding systems, spawning substrates, etc., required for successful natural spawning by the Atlantic silverside, Menidia menidia, in the laboratory. Development of methods for spawning Menidia in the laboratory will enable investigators to rapidly assess the effects of environmental perturbations on reproductive success. Data from field observations made during 1976--1978 on photoperiod, water temperature, and tidal control of spawning in Menidia will be used in modeling these factors in the laboratory. Spawns probably can be induced at specific times, thus allowing toxicity tests with adults (for reproductive potential) as well as acquisition of embryos and larvae for acute or chronic (partial life history) tests. Equipment purchase and set-up is underway. Menidia embryos from field spawned adults have been successfully cultured. A cooperative program of methods development for embryos/larvae tests is now underway with investigators at the Environmental Research Laboratory, Gulf Breeze.
Keywords: reproduction; aquatic organisms; biological models; toxicity; water pollution; bioassay.

77543 Effects of Pollutants on Microbial Activities in Estuarine Surface Films. Ahern, D.G. (Georgia State University, Dept. of Biology, 33 Gilmer Street SE, Atlanta, GA, 30303). **Project number:** Q714A-Q004. **Contract:** R804477-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$10,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

Studies of the rates of bioaccumulation and/or degradation of select hydrocarbons, pesticides and chlorinated aromatics by representative surface slick microorganisms are in progress. Minimal mutagenic and inhibitory concentrations of these compounds are being determined for various physiological groups. Attempts are underway to develop assay organisms for the biodetection of potentially harmful chemicals in estuarine waters.
Keywords: microorganisms; metabolism; estuaries; pesticides; biodegradation; biological accumulation; hydrocarbons; biochemical reaction kinetics; surface waters; physiology; oil spills; biological effects.

77544 Determine the Pesticide-Microbial Interactions in the Estuarine Environment. Bourquin, A.W. (EPA, Gulf Breeze Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714A-Q149. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$108,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: isolate naturally occurring estuarine microorganisms; expose them to varying concentrations of selected pesticides in the laboratory; determine pesticide effects on growth rates; identify degradation products; expose microorganisms to pesticides in combination with commonly occurring petroleum hydrocarbons; determine effects on growth rate; identify pesticide and hydrocarbon breakdown products; identify, in naturally occurring estuarine oil slicks, microbial degradation and degradation products of pesticides; incubate selected pesticides in natural seawater, sterile and non-sterile, at varied salinities and temperatures and under light and dark conditions; and determine the effects of these parameters on pesticide degradation rates and products formed.
Keywords: pesticides; microorganisms; biodegradation; biochemical reaction kinetics; estuaries; aquatic ecosystems; biological models.

77545 Biodegradation of Chlorinated Dibenzofurans and Dibenzodioxins. Gibson, D.T. (University of Texas, Dept. of Microbiology, 200 West 21st Street, Austin, TX, 78712). **Project number:** Q714B-Q003. **Contract:** R804525-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$28,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this proposal are to isolate microorganisms capable of metabolizing dibenzo-p-dioxin, dibenzofuran and some of their chlorinated derivatives. The organisms will be used to elucidate the mechanisms used by microorganisms to degrade this group of compounds. The approach will rely heavily on the isolation of mutant strains that accumulate biodegradation products in the culture medium. These products will be isolated and identified by conventional techniques of organic chemistry. Current plans call for the use of enrichment culture technique for the isolation of different microbial species. Cultural conditions will be established for the accumulation of different biodegradation products. Selected strains will be treated with nirosoguanidine, and organisms that accumulate significant quantities of metabolic products will be used to establish biodegradative reaction sequences.
Keywords: biodegradation; organic chlorine compounds; microorganisms; metabolism; biochemical reaction kinetics; benzofurans; organic oxygen compounds.

77546 Toxicity Testing: Inter-Laboratory Comparison with Marine Animals. Parrish, R. (EG and G, Inc., Route 6, Box 1002, Pensacola, FL, 32507). **Project number:** Q715-Q005. **Contract:** 68-03-0721. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The American Society for Testing and Materials has adopted a standard practice for conducting basis acute toxicity tests with fish, macroinvertebrates and amphibians. It has been proposed that EPA use this document as a basis of any testing program which may be required of potential polluters in the TOSCA program. The TOSCA program requires each permit holder to do their own testing of new products and report the results. The need, therefore, is for a series of comparison tests allowing the permit enforcement people to make a judgment of the performance based on a data set gathered under similar conditions. The contract will provide such a data base and no other contracts are in existence which would provide this information. The contract will provide data sets on one inorganic and one organic chemical of interest with one species of fish and two invertebrates. The tests are to be conducted according to the ASTM method in marine waters. The data provided will become the basis for judging the performance of permit holders conducting tests. Testing has been completed and the final report submitted.
Keywords: toxicity; aquatic organisms; fishes; invertebrates; amphibians; water pollution; biological effects; pesticides; metals; hydrocarbons; estuaries; bioassay.

77547 Toxicity Testing: Inter-Laboratory Testing with Marine Animals. Ward, T. (Energy Resources Co., Inc., 185 Alewife Brook Pkwy., Cambridge, MA, 02138). **Project number:** Q715-Q006. **Contract:** 68-03-2722. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The American Society for Testing and Materials has adopted a standard practice for conducting basis acute toxicity tests with fish, macroinvertebrates and amphibians. It has been proposed that EPA use this document as a basis of any testing program which may be required of potential polluters in the TOSCA program. The TOSCA program requires each permit holder to do their own testing of new products and report the results. The need, therefore, is for a series of comparison tests allowing the permit enforcement people to make a judgment of performance based on a data set gathered under similar conditions. The contract will provide such a data base and no other contracts are in existence which would provide this information. The contract will provide data sets on one inorganic and one organic chemical of interest with one species of fish and two invertebrates. The tests are to be conducted according to the ASTM method in marine waters. The data provided will become the basis for judging the performance of permit holders conducting tests.
Keywords: toxicity; bioassay; aquatic organisms; fishes; invertebrates; vertebrates; amphibians; water pollution; biological effects.

77548 Toxicity Testing: Inter-Laboratory Comparison with Marine Animals. Walker, B. (Gulf Coast Research Lab., P.O. Box AG, Ocean Springs, MS, 39564). **Project number:** Q715-Q007. **Con-**

tract: 68-03-2723. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The American Society for Testing and Materials has adopted a standard practice for conducting basis acute toxicity tests with fish, macroinvertebrates and amphibians. It has been proposed that EPA use this document as a basis of any testing program which may be required of potential polluters in the TOSCA program. The TOSCA program requires each permit holder to do their own testing of new products and report the results. The need, therefore, is for a series of comparison tests allowing the permit enforcement people to make a judgment of performance based on a data set gathered under similar conditions. The contract will provide such a data base and no other contracts are in existence which would provide this information. The contract will provide data sets on one inorganic and one organic chemical of interest with one species of fish and two invertebrates. The tests are to be conducted according to the ASTM method in marine waters. The data provided will become the basis for judging the performance of permit holders conducting tests. Results have been submitted on static portions of the contact requirement.
Keywords: toxicity; bioassay; aquatic organisms; hydrocarbons; metals; water chemistry.

77549 Toxicity Testing: Inter-Laboratory Comparison with Marine Animals. Barber, A. (New England Aquarium Corp., Central Wharf, Boston, MA, 02110). **Project number:** Q715C-Q008. **Contract:** 68-03-2724. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The American Society for Testing and Materials has adopted a standard practice for conducting basis acute toxicity tests with fish, macroinvertebrates and amphibians. It has been proposed that EPA use this document as a basis of any testing program which may be required of potential polluters in the TOSCA program. The TOSCA program requires each permit holder to do his own testing of new products and report the results. The need, therefore, is for a series of comparison tests allowing the permit enforcement people to make a judgment of performance based on a data set gathered under similar conditions. The contract will provide such a data base and no other contracts are in existence which would provide this information. The contract will provide data sets on one inorganic and one organic chemical of interest with one species of fish and two invertebrates. The tests are to be conducted according to the ASTM method in marine waters. The data provided will become the basis for judging the performance of permit holders conducting tests. Results have been submitted on static portions of the contract for all species.
Keywords: toxicity; bioassay; water pollution; aquatic organisms; fishes; invertebrates; vertebrates; amphibians; hydrocarbons; metals; biological effects.

77550 Fate, Transport, and Transformation of Toxics: Significance of Suspended Sediment and Fluid Mud. Nichols, M.M. (Virginia Inst. of Marine Science, Gloucester Point, VA, 23062). **Project number:** Q771-Q124. **Contract:** R806002. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide new data concerning the extent of contamination and fate of selected heavy metals and halogenated hydrocarbons in suspended sediment and fluid mud of the Chesapeake Bay. In addition, the impact of river floods and spring tides in determining the distribution of suspended sediment will be evaluated.
Keywords: environmental transport; toxicity; metals; organic halogen compounds; sediments; chesapeake bay; mathematical models; hydrocarbons; toxic materials; drilling fluids.

77551 Biogenic Structure of Chesapeake Bay Sediments. Boesch, D. (Virginia Inst. of Marine Science, Gloucester Point, VA, 23062). **Project number:** Q771-Q125. **Contract:** R805982. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine the contribution of benthos in bioturbating the substratum and in augmenting the rate of exchange of dissolved materials across the sediment-water interface. The vertical and horizontal distribution of the benthos will be related to the substrate composition. In addition, geochemical profiles will be developed and related to certain infaunal indicator species.
Keywords: chesapeake bay; sediments; benthos; water pollution; environmental transport; biological indicators; metals; toxicity; physiology.

77552 Investigation of Organic Pollutants in the Chesapeake Bay. Huggett, R.J. (Virginia Inst. of Marine Science, Gloucester Point, VA, 23062). **Project number:** Q771-Q135. **Contract:** R806012. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The objectives are to sample the water column, sediment, and biota for a selected group of toxic organic compounds of recognized significance in the Chesapeake Bay and its tributaries; and to determine concentration patterns (increasing, decreasing, or stable) for previously undetermined organic compounds that may be accumulating in the Bay and tributaries.
Keywords: chesapeake bay; monitoring; hydrocarbons; organic compounds; ecological concentration; water quality; toxicity; aquatic ecosystems.

77553 Monitoring Particle: Associated Toxic Substances and Suspended Sediment in Chesapeake Bay. Gross, M.G. (Johns Hopkins Univ., 34th and Charles Sts., Baltimore, MD, 21218). **Project number:** Q771-Q139. **Contract:** R805959. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

This project is designed to provide an understanding of the importance of suspended sediment in the movement of toxic substances to improve their control and regulation in Chesapeake Bay. Data will be obtained on distribution, characteristics, and transport of suspended matter in Chesapeake Bay to support planning activities, regulatory actions, and to assist in the design of monitoring program for particle-associated toxic substances.
Keywords: particles; aerosols; toxicity; sediments; chesapeake bay; toxic materials; water chemistry; monitoring.

77554 Separation of Compounds with Anti-Carcinogenic Properties from Marine Invertebrates. Chang, C.W. (Univ. of West Florida, Pensacola, FL, 32504). **Project number:** Q775-Q040. **Contract:** R806108-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective of a multi-disciplinary team project is to determine which carcinogens, mutagens, and teratogens accumulate in aquatic species. Chemical fractionation procedures will be used to separate genotoxic compounds. This task is done as part of an activity directed characterization. A separation scheme has been developed.
Keywords: carcinogens; mutagens; aquatic organisms; separation processes; invertebrates.

77555 Aquatic Species as Indicators of Carcinogens: Epizootiological Study of Tumors and Carcinogens in the Gulf of Mexico. Couch, J.A. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q775-Q067. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine fate and effects of carcinogens in natural coastal water and natural populations of fish and shellfish. This will be accomplished by: (1) sampling selecting coastal regions for fish and shellfish and sediments; (2) determining tumor and other disease frequencies in populations through pathology studies over several seasonal periods; (3) determining through chemical analyses prevalence of known and suspected chemical carcinogens in tissues and sediments of field samples; (4) correlating disease frequencies, residue prevalence, and human activity (pollution) in coastal region; and (5) testing suspect pollutants in carcinogen assay system described under ERL, GB project Q068. Several tumor types and related lesions have been found in fish and shellfish from five estuaries along the northern Gulf of Mexico. Diseased specimens appear to be more frequent in the heavier polluted estuary that is being sampled. Sediment and tissue samples from all stations are being prepared from chemical analyses.
Keywords: aquatic organisms; biological indicators; carcinogens; gulf of mexico; tumor cells; fishes; molluscs; coastal regions; bioassay; water pollution; biological models.

77556 Oxidation and Conduction of Carcinogenic Hydrocarbons in Marine Animals. Strength, D.R. (Auburn University, Dept. of Animal and Dairy Science, Auburn, AL, 36830). **Project number:** Q787-Q031. **Contract:** R806368-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$56,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The oxidative metabolism of polycyclic hydrocarbons (PAH) results in products of high cellular toxicity or mutagenicity. The

types of compounds that undergo this oxidative metabolism include: steroids, drugs, insecticides, anesthetics, and polycyclic hydrocarbons. The primary purpose of this proposed project is the study of types of oxidation products produced by the metabolism of selected fish and shellfish and the extent and types of conjugated products formed by these selected marine organisms. The enzyme systems involved in the production and activation of glucuronic acid and sulfate will be ascertained in tissues of marine organisms. Since oxidation of PAH produces more polar compounds that may be conjugated with several known compounds, the conjugation and consequent increase in solubility may be a highly important part of the process that protects all organisms from short-term toxicity and long-term carcinogens.
Keywords: carcinogens; polycyclic aromatic hydrocarbons; toxicity; aquatic ecosystems; fishes; molluscs; glucuronic acid; sulfates; tissues; physiology.

77557 Negative Screening for Marine Xenobiotic Chemicals. Dougherty, R.C. (Florida State University, Dept. of Chemistry, 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** Q787-Q032. **Contract:** R806334-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$35,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will develop chemical screening methods for the detection and molecular identification of mutagenic, carcinogenic, and teratogenic substances in marine organisms. We also investigate the metabolic fate of toxic substances and the generation of proximal carcinogens in marine organisms. Sources of xenobiotic chemicals in the natural environment will be identified by screening for the origins of contamination. The analytical methodology used in this study will be primarily centered on negative chemical ionization (NCI) mass spectrometry and mass-analyzed ion kinetic energy spectrometry (MIKES) of negative ion beams. Extracts of marine organisms that have been examined for mutagenic activity in biological assays will be directly examined by both NCI and MIKES techniques. If it is necessary, these extracts will be further fractionated by acid-base and solvent paratition of chromatographic means which do not involve adsorption. In addition to the identification of mutagenic compounds in marine organisms from contaminated natural environments, we will attempt to identify both false positives and false negatives in the biological screening procedures for xenobiotic chemicals, particularly the Ames Test. The collection of marine organisms and the biological screening of their extracts for xenobiotic chemicals will be conducted by the U.S. EPA Environmental Research Laboratory at Gulf Breeze, Florida.
Keywords: mutagen screening; water pollution; mutagenesis; carcinogenesis; teratogenesis; chemical effluents; biological models.

77558 Investigation of Chemical Mutagen Accumulation in the Tissues of Marine Organisms. Baylis, J.R. (University of West Florida, Dept. of Biology, Pensacola, FL, 32504). **Project number:** Q787-Q033. **Contract:** R806339-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$36,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will attempt to identify marine organisms which accumulate detectable levels of mutagenic or promutagenic compounds in their tissues as a result of experimental or natural exposure to pollution. Marine organisms consumed by man will be emphasized in the investigation. Such organisms would be useful as indicators of low level pollution of the marine environment. The organisms tested will be from experimentally polluted laboratory tanks, from selected natural sites both polluted and nonpolluted, and from unexposed controls. Tissue extracts will be screened for the presence of mutagenic compounds by means of the Ames Test and/or the fluctuation test. At the present time the principal investigator's laboratory has capability with the Ames Test and is developing capability with the fluctuation test. Experimental exposure and collection of feral organisms will be coordinated with investigations at the EPA Gulf Breeze Environmental Laboratory.
Keywords: chemical effluents; mutagens; biological accumulation; tissues; aquatic organisms; biological indicators; mutagen screening; water pollution; optimization.

77559 Metabolism of Polyaromatic Hydrocarbons by Mixed Function Oxidases in Marine Organisms. Melius, P. (Auburn University, Dept. of Chemistry, Auburn, AL, 36830). **Project number:** Q787-Q034. **Contract:** R806213-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Mixed function oxidases will be induced in certain marine organisms and the resulting enzymes will be evaluated for mutagenicity. Attempts will be made to determine which component of the overall enzyme system is affected by the xenobiotic inducing substances. Separation of the metabolites will be carried out by chromatographic procedures and these components will be tested for mutagenicity.
Keywords: polycyclic aromatic hydrocarbons; metabolism; toxicity; aquatic organisms; oxidases; mutagenesis; biochemical reaction kinetics.

77560 Development of a Carcinogen Assay System Utilizing Estuarine Fishes. Martin, B.J. (University of Southern Mississippi, Dept. of Biology, Hattiesburg, MS, 39401). **Project number:** Q787-Q035. **Contract:** R806212-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$70,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this proposal is the procurement of funds needed to develop a carcinogen assay system that employs estuarine fish maintained in a controlled environment. Fish will be exposed to three different environmental pollutants known to be human carcinogens. The total effect of the carcinogens will be studied. Effects on gross morphology will be observed and histological, cytochemical, biochemical, immunologic, and tissue culture techniques will be employed. An important goal will be the detection of preneoplastic lesions that might be used as an early warning detection system for carcinogens in the aquatic environment.
Keywords: carcinogens; bioassay; fishes; metabolism; biological indicators; neoplasms; aquatic ecosystems; pathological changes.

77561 Compounds Produced from Petroleum Utilization on Selected Marine Invertebrates. Mix, M.C. (Oregon State University, Dept. of General Science, 126 Agricultural Hall, Corvallis, OR, 97331). **Project number:** Q787--Q036. **Contract:** R804427-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$20,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) to determine the concentration (body burdens) of selected environmental chemical carcinogens in economically-important mollusks and crustaceans from Oregon bays, estuaries and inshore areas; (2) to determine if there is a potential public health hazard to man from consuming shellfish harvested from Oregon bays, estuaries, and inshore areas; (3) to survey populations of bivalve mollusks, determine the incidence of neoplastic diseases in these populations, and ascertain if there is any correlation between carcinogenic body burdens and the incidences of such diseases; (4) to identify point sources of chemical carcinogens that are present in Oregon bays and estuaries utilized in this study; and (5) to determine rates of carcinogenic polycyclic aromatic hydrocarbon uptake and elimination in bivalve mollusks. Extensive preliminary investigations have been conducted to determine which Oregon bays will be utilized in the study, ascertain which shellfish species will be used, and locate sites at which shellfish can be continuously sampled. Bivalve mollusks from different habitats in the various bays are analyzed for the presence and amount of benzo(a)pyrene (BaP) monthly or bimonthly. Histological sections are prepared so that diagnoses can be made and neoplastic diseases, if present, can be identified.
Keywords: petroleum; invertebrates; aquatic organisms; body burden; carcinogens; by-products; crustaceans; neoplasms; polycyclic aromatic hydrocarbons; benzopyrene; sampling; oregon; health hazards.

77562 Utilization of Mollusks for Monitoring, Surveillance, and Assessing the Public Health Significance of Polycyclic Aromatics. Mix, M.C. (Oregon State University, Dept. of General Science, 126 Agricultural Hall, Corvallis, OR, 97331). **Project number:** Q787-Q037. **Contract:** R806224-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objectives are: to measure baseline levels of PAH in indigenous bivalve mollusks; to demonstrate the practicality of monitoring and surveillance studies utilizing bivalve mollusks as monitors of environmental PAH; to determine the prevalence of cellular proliferative disorders in shellfish that inhabit pristine waters and those from environments contaminated with PAH; to measure baseline levels of aryl hydrocarbon hydroxylase (AHH) in M. edulis and M. arenaria; to evaluate the feasibility of using AHH assays of bivalve mollusks as monitors for environmental contamination; to evaluate the effects of low levels of PAH on the Pollicipes polymerus bioassay system; and to measure baseline levels of PAH in a variety of marine species from different Oregon bays.
Keywords: molluscs; biological indicators; public health; polycyclic aromatic hydrocarbons; health hazards; metabolism.

77563 Marine Protozoan Microsomal Activation of Oil Pollutants to Mutagens. Lindmark, D.G. (Rockefeller University, Biochemical Cytology Lab., 66th and York Avenue, New York, NY, 10021). **Project number:** Q787-Q038. **Contract:** R805364-02. **Support-**

ed by: Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The project consists of the isolation and characterization of microsomes from various marine protozoa. Work will be done on a small scale under laboratory conditions. The research will be done in collaboration with Dr. Josef Schmidt-Collerus at the Denver Research Institute (Grant No. R805671) who will study biphenyl hydroxylase activity. The second phase of the project will consist of parallel studies on the microsomes of marine algae. The purpose of the research is to predict the fate of selected compounds with mutagenic and pre-mutagenic activities.
Keywords: protozoa; aquatic organisms; petroleum; mutagens; biological effects; bench-scale experiments; biphenyl; hydroxylase; physiology; water pollution; oil spills; environmental impacts.

77564 Investigation of Enzymatic Screening Tests for Mutagens in Environmental Pollutants. Schmidtcollerus, J. (University of Denver, School of Arts and Sciences, Department of Chemistry, 2115 S. University Blvd., Denver, CO, 80210). **Project number:** Q787-Q039. **Contract:** R805671-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$20,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to study the feasibility of the in vitro activation of microsomal drug-metabolizing enzyme systems for the development of a rapid and senstive prescreening test for mutagenicity of synfuel-related environmental pollutants, their derivatives and their metabolic products as they may occur on land and in aquatic and marine environments.
Keywords: mutagen screening; enzymes; in vitro; feasibility studies; drugs; metabolism; chemical effluents; water pollution; land pollution; air pollution; carcinogens; synthetic fuels; mutagenesis.

77565 Development of Water Quality Criteria for Protection of Aquatic Life. Hansen, D.J. (EPA, Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q819-Q062. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This cooperative project between ORD laboratories at Duluth, Corvallis, Narragansett, and Gulf Breeze and OWP personnel seeks to develop defensible water quality criteria for consent decree chemicals that will protect aquatic life. Establishement of water quality criteria requires that consistent defensible guidelines be developed, that literature be reviewed, that additional data be produced, and that criteria and a suitable narrative be written. Public comments on this process are being used to insure that significant information is not overlooked. Initial guidelines for developing water quality criteria have been written, published in the Federal Register, and comments received. Criteria have been written for consent decree chemicals where data allow. These criteria are being published for comment.
Keywords: water quality; standards; aquatic organisms; biological models; chemical effluents.

77566 Water Quality and Mangrove Ecosystem Dynamics. Snedaker, S.C. (Univ. of Miami, 4600 Rickenbacker Cswy., Miami, FL, 33149). **Project number:** Q819-Q084. **Contract:** R803340. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to define the empirical relationship that exists between water quality and mangrove ecosystem dynamics and to evaluate that relationship as a two-way interaction. How do mangroves, through their normal functioning, influence the quality of water. In this field study, the literature was reviewed and used to develop a hypothetical relationship between water quality and mangrove dynamics. Pollutants such as heavy metals and pesticides were considered as were freshwater and tidal inflow and outflow. Uptake of pollutants was measured as were total leaf fall, seed fall, wood fall, and litter production. The first draft of the final report has been received and edited. A systems model based on field data was included. Mangroves do not accumulate appreciable amounts of heavy metals, DDT, DDE, DDD, PCB, Diedren, or Mirex.
Keywords: water quality; terrestrial ecosystems; trees; nutrients; root absorption; pesticides; metals; uptake; biological models.

77567 Analysis of Haloform Compounds and Precursors from Seawater Chlorination. Crane, A. (EPA, Bears Bluff Field Station, P.O. Box 368, Johns Island, SC, 29455). **Project number:** Q819-Q150. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to determine identification, rates of formation, and tissue levels of haloform compounds resulting from chlorination of natural estuarine and marine waters. Interactions of natural organic constituents and the conditions of compound formation are considered as well. The approach will be to: chlorinate natural and prepared samples of marine waters, manipulating the known and unidentified organic constituents; and determine microorganism levels of haloform by-products by liquid extraction and gas chromatography. Influence upon rates of three haloform by-products by presence of marine algae, or metabolic algal by-products, has been analyzed and target algal metabolites have been selected for testing to determine proportion of haloform that these products influence. One manuscript is in review.
Keywords: chlorination; seawater; halogen compounds; organic compounds; microorganisms; extraction; gas chromatography; algae; environmental effects; ecological concentration; aquatic ecosystems; water quality.

77568 Effects of Drilling Mud on Marine Organisms. Glassen, R.C. (Florida State Univ., Tallahassee, FL, 32306). **Project number:** Q831-Q026. **Contract:** R806130-01. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objectives are to develop and apply methods to determine environmental effects of offshore oil and gas exploration on marine organisms. This is done by determining effects that result from exposure of marine organisms to drilling muds and their components. Preliminary research has been completed on methods development to assess the impact of offshore oil and gas exploration on marine organisms.
Keywords: drilling fluids; toxicity; aquatic ecosystems; petroleum industry; natural gas industry; hydrocarbons; exploration; offshore sites; marine surveys.

77569 Effects of Drilling Fluids and Oil in Corals Occupying Hard-Bank Communities. Bright, T.J. (Texas A and M Research Foundation, College Station, TX, 77843). **Project number:** Q831-Q028. **Contract:** R805441. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$2,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

An experimental design is proposed in which the behavioral and physiological reactions of scleractinian corals indigenous to hard bank communities in the Gulf of Mexico are determined in response to chronic low levels of drilling fluid components, shale oil products, and carcinogens. The design incorporates time-lapse-macrophotographic and respirometric techniques to measure the response parameters. The corals shall be exposed to the contaminants in flow-through aquaria on board a platform twelve miles offshore of Panama City. Controls will include parallel observations of corals exposed to uncontaminated sea water in identical flow-through aquaria, and of corals transplanted to the side of the platform at a depth similar to that from which they were collected.
Keywords: corals; tolerance; drilling fluids; biological effects; toxicity; physiology; gulf of mexico; shale oil fractions; shale oil; environmental transport; risk assessment.

79000 Methods Development for Assessing Economic Benefits of Water Pollution Control. Kneese, A.V. (Resources for the Future, Inc., 1755 Massachusetts Ave. NW, Washington, DC, 20036). **Project number:** X775A-001. **Contract:** R806906-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Methodology will be developed for assessing the economic benefits of water pollution control and providing estimates of these benefits on a national basis. Specific objectives are to: (1) review and evaluate existing methods for, and applications of methods for, valuing water quality improvements; (2) develop improved models for benefits estimation and to improve the methods and techniques for implementing them; and (3) exploit existing data sets and, where appropriate, collect new data for empirical testing and estimation using the new methods. The research will concentrate primarily on benefits of national significance.
Keywords: water pollution control; economic impact; technology assessment; recreational areas; aesthetics; cost benefit analysis.

79001 Methods Development for Assessing Air Pollution Control Benefits. Adams, R.M. (Univ. of Wyoming, P.O. Box 3435, University Station, Laramie, WY, 82070). **Project number:** X775A-002. **Contract:** R806972-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Assessment methodology of the economic benefits of air pollution will be improved with the following specific objectives: (1) the valuation of atmospheric visibility in the national parklands of the Rocky Mountain region; (2) the design of economic methodologies for assessing the benefits of controlling acid precipitation and the provision of preliminary indications of the benefits of control; (3) an assessment of the benefits of air pollution control in the San Francisco Bay area; and (4) the design of economic methodologies for assessing the benefits of reducing soiling and materials decay from particulate air pollution.
Keywords: air pollution control; rocky mountain region; air quality; visibility; acid rain; control; economic impact.

79002 Laboratory and Field Trial Evaluation of the Cost Effectiveness of Two Types of Personal Ultraviolet B Dosimeters. Sober, A.J.; Fitzpatrick, J.B.; Anderson, R.R. (Massachusetts General Hospital, 32 Fruit Street, Boston, MA, 02114). **Project number:** X787-004. **Contract:** R807222-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: solar(100) **R and D categories:** Pollutant monitoring.

The objectives are to: (1) determine the fraction of incident uv-B received during normal lifestyle activities; (2) determine the optimum type of personal exposure device; (3) develop a film type exposure meter; and (4) calibrate an electronic dosimeter. The electronic and film type exposure meters will be compared in the laboratory for response characteristics and on volunteers for effectiveness in field use. The relative precision, accuracy, and cost of the two types of exposure meters will be considered in arriving at a choice for large field surveys.
Keywords: cost; efficiency; ultraviolet radiation; measuring instruments; comparative evaluations; calibration; design; photographic film dosemeters; dosemeters.

79003 Symposium on Health Aspects of Nonionizing Radiation. Shils, M.E. (New York Academy of Sciences, 2 E. 63rd St., New York, NY, 10021). **Project number:** X817A-001. **Contract:** R806710-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

Physical aspects of microwave radiation in relation to man, biomedical aspects of microwave radiation, public issues, epidemiology, and clinical applications will be explored through a symposium.
Keywords: health hazards; microwave radiation; epidemiology.

79004 Impact of Stratospheric Ozone Depletion upon Tropospheric Ultraviolet, Photochemistry and Smog. Green, A.E. (Univ. of Florida, Gainesville, FL, 32601). **Project number:** X861A-001. **Contract:** R806373-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to attempt to determine if depletion of stratospheric ozone (03) increases ultraviolet radiation at the earth's surface and to then examine possible impacts on skin cancer, plant yields, and photochemical smog. This will be done by undertaking radiative transfer calculations and modeling studies of 03 depletion impact on tropospheric uv radiation and photolysis rates and calculating photochemical models of the effect of enhanced uv radiation and photolysis rates on tropospheric photochemistry and smog formation. The investigators and others have previously done preliminary calculations leading to the hypothesis that there will be impact of 03 depletion on uv, photolysis, and smog formation.
Keywords: ozone; stratosphere; troposphere; ultraviolet radiation; photochemistry; atmospheric chemistry; smog; skin; carcinomas; plants; productivity; mathematical models; environmental impacts; biological radiation effects.

79005 Integrated Assessment of Stratospheric Ozone Protection. Ruff, R. (SRI International, 300 Ravenswood Ave., Menlo Park, CA, 94025). **Project number:** X861A-002. **Contract:** 68-02-3939. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Regulatory decision-making models to protect stratospheric ozone will be optimized to better identify research priorities where there are many data gaps and uncertainties. A first generation model has been developed and tests have indicated areas for improvement.
Keywords: stratosphere; ozone; ecological concentration; control; research programs; planning; decision making.

79006 State of Knowledge Report on Stratospheric Ozone. Tukey, A. (National Academy of Sciences, 2101 Constitution Ave. NW, Washington, DC, 20037). **Project number:** X861A-003. **Contract:** 68-01-4607. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to identify causes, effects, and possible methods of controlling human causes of stratospheric ozone depletion. The approach is to: review existing reports and data; evaluate uncertainties; provide estimates of both benefits and costs of options for controlling stratospheric ozone depletion; and indicate expected results of additional research. Results to date include collecting of reports and data, hearing reports from selected investigators, and partial drafting of materials for the required report.
Keywords: ozone; stratosphere; pollution sources; man; reviews; air pollution; cost.

79007 Benefit-Cost Analysis for Regulation of Damage to the Ozone Shield. Cumberland, J.H. (Univ. of Maryland, College Park, MD, 20742). **Project number:** X861A-004. **Contract:** R80697301. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Benefit-cost analyses models will be optimized for stratospheric ozone depletion by considering health effects on future generations, potenital irreversible effects, varying economic growth rates in different areas, and time.
Keywords: cost benefit analysis; ozone; stratosphere; ecological concentration; control.

79008 Assessment of the Impact of Increased Solar Ultraviolet Radiation upon Primary Producers. Worrest, R.C. (Oregon State Univ., 126 Agricultural Hall, Corvallis, OR, 97331). **Project number:** X864A-001. **Contract:** R806490-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Data will be obtained under natural light conditions which will permit assessment of the potential impact upon the phytoplankton component of a marine ecosystems due to increased levels of uv-b radiation. Seminatural ecosystems will be established within a greenhouse and supplied with a common, continuous flow of seawater. Daily exposure to natural long wavelength ultraviolet and visible radiation will be supplemented by a controllable exposure to uv-b radiation emitted by a fluorescent sunlamp/filter system. The daily exposure to sunlight will provide natural levels of photoreactivating radiation. Community productivity, biomass, concentrations of photosynthetic pigments and community composition will be analyzed. This project should provide some of the first data on the impact of increased levels of uv-b on aquatic ecosystems under seminatural conditions.
Keywords: solar flux; ultraviolet radiation; photosynthesis; seawater; visible radiation; aquatic ecosystems; environmental effects.

79009 Effects of a 50% Increase Above Ambient of uv-b Radiation Viability, Growth, and Productivity of Field Grown Soybeans and Barley. Karlander, E.P. (Univ. of Maryland, College Park, MD, 20742). **Project number:** X864A-002. **Contract:** R806312-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: solar(50); conservation(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Effects of enhanced uv-b radiation on the growth, productivity and viability of field-grown, double-cropped soybeans and barley will be measured. A uv-b irradiation system will be constructed that: (a) simulates natural uv-b radiation more closely than any in use to date; (b) includes a continuous monitoring of uv-b radiation intensity; and (c) controls the added uv-b radiation at a specific percentage above ambient at all times. Three plots will be used: a plot irradiated with uv-b enhanced; a plot not irradiated with enhanced uv-b but with all the experimental structures; and a neutral control plot. These plots will be observed weekly. Measurements will include stand counts branching, internode length and diameter, tillering, leaf area and color, flower initiation and maturation, seed yield and viability, straw yield, and nitrogen fixing capacity of soybean-rhizobium root nodules.
Keywords: ultraviolet radiation; biological effects; crops; soybeans; barley; plant growth.

79010 Calibration and Measurement Technique Development for uv-Radiometry. Kostkowski, H.J. (National Bureau of Standards, Washington, DC, 20228). **Project number:** X864A-004. **Contract:** X864A-004. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: solar(100) **R and D categories:** Pollutant measurements technology.

Improved techniques are described for determining the responsivity function for double monochromators in the 290 to 320 nanometer (nm) range for measuring terrestrial irradiance from direct sunlight, with estimated uncertainty not exceeding 5%. High wavelength accuracy spectroradiometer and laser systems, including a tunable ring dye laser for maximizing the cw power available in the 290 to 320 nm region of the uv spectral irradiation measurements, will be designed and procured. A high-precision and accuracy uv radiometry center will be set up and operated.
Keywords: sun; measuring methods; measuring instruments; visible radiation; ultraviolet radiation; monochromators; design; fabrication; accuracy.

85000 Boiler Stoker Field Test Program. Harvey, W. (Department of Energy, Germantown, MD, 20767). **Project number:** V829-02. **Contract:** D9-E681-F2. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Environmental Engineering and Technology. **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to design, build, and operate a 100,000-lb/hr coal-fired fluidized bed boiler. Focus is on locating 6 candidate units for performing detailed tests to determine the effect on performance and emissions of changes in coal analysis and sizing, degree of fly ash re-injection, overfire air admission, and ash handling.
Keywords: boilers; stokers; field tests; fluidized-bed combustors; coal; fly ash; waste management; air; pilot plants; construction; operation; combustion; sulfur compounds; nitrogen compounds; air pollution control; air quality; reinjection.

85001 Integrated Assessment: Economic and Social Consequences of Coal and Oil Shale Development. Barse, J.; Bender, L. (Montana State Univ., 14th and Independence Avenue SW, Washington, DC, 20460). **Project number:** V624C-058. **Contract:** D9-E766-EG. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Environmental Engineering and Technology. **Funding:** EPA.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant measurements technology.

Related capabilities were developed: (1) to analyze the effects of public policy decisions on the regional distribution of coal mining, transportation, and utilization; and (2) to protect local socioeconomic impacts of energy developments in the rural west. The approach is to: (1) construct and operate an interregional coal analysis model (linear program) to assess the effects on agriculture and resources of all alternative policies toward coal mining and coal use; and (2) develop economic modeling capabilities to analyze the socioeconomic and fiscal effects of rapid, coal-related growth on sparsely settled rural communities in the west.
Keywords: coal mining; rural areas; socio-economic factors; regional analysis; mathematical models; agriculture; oil shale industry; energy source development.

DEPARTMENT OF ENERGY

100000 Filter Fire Research. Alvares, N.J. (Lawrence Livermore Laboratory, Box 808, Livermore, CA, 94550). **Project number:** 600007. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

This project is directed towards devising efficient means for protecting HEPA (high-efficiency particulate air) filters and associated ductwork systems from the effects of heat and smoke particulates from fires. Excess heat will cause the filter to leak; smoke particles will plug the filter. Either can cause the release of toxic or radioactive materials into the atmosphere since the filters are used to trap particulate matter which may escape from the work areas. Employing a full scale fire test compartment, fires are set using various furnishings simulating actual fuel- and smoke-generating loadings, and their effects on heat damage and filter plugging determined. Heat abatement and smoke-scrubbing techniques are studied and evaluated for their technical and cost effectiveness. Included in the studies is work aimed at mitigating the effects of a fire in one work area as related to a common exhaust plenum system serving several work areas.
Keywords: air filters; smokes; fires; efficiency; performance testing; damage; plugging; leaks.

100001 Natural Phenomena Hazards. Murray, R. (Lawrence Livermore Laboratory, P.O. Box 808, L-90, Livermore, CA, 94550). **Project number:** 600022. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$100,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

Design guidelines are needed to provide safe design of DOE facilities against potential seismic and tornado/extreme wind hazards. This study will assist DOE to develop these design guidelines appropriate for both existing and new facilities being evaluated. The approach is to: (1) obtain and review all available seismic/tornado related information for each DOE site included in the project; (2) determine where potential problems exist; (3) develop seismic, tornado/extreme wind hazard models for each site and guidelines for their use; and (4) use these hazard models to uniformly assess current criteria at each site. A draft report covering the Phase I portion of the project has been submitted to DOE headquarters for comment. A seismic and tornado/extreme wind hazard model report will eventually be produced for each DOE site included in the project.
Keywords: energy facilities; design; seismic effects; tornadoes; safety; wind; damage; safety; risk assessment; mathematical models.

100002 Respirator Studies. Douglas, D. (Los Alamos Scientific Laboratory, Industrial Hygiene Group, Group H-5, MS-986, Los Alamos, NM, 87545). **Project number:** 600014. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$120,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Health protection, safety, and industrial hygiene.

At the request of DOE-DOES, respiratory protective equipment will be evaluated, its efficiency will be determined, and the continued use or suspension of the equipment will be recommended. The effects of respirators on human physiology during respirator use will be determined. DOE-contractor equipment will be reviewed and tested and persons wearing respirators will be physiologically monitored.
Keywords: respirators; protective clothing; air; inhalation; respiratory system; efficiency; physiology; personnel; biological effects; lungs.

100003 Air Sampling Program. Tillery, M.I. (Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 600015. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$115,000.
Related energy source: Coal(75); oil shale(25) **R and D categories:** Pollutant monitoring.

The objectives are: to evaluate air sampling procedures utilized to measure airborne concentrations in work areas; to develop air sampling strategies that provide the best estimate of worker exposure at a reasonable cost; to develop sampling procedures for plutonium that provide estimates of particle size; and to develop a course in air sampling methods for persons responsible for ensuring healthful work environments in DOE facilities. The approach will be to: determine correlations between air sampling data and bioassy data; evaluate current air sampling procedures; determine validity of current procedures for determination of inhalation hazards; and develop and evaluate air sampling instruments for determination of particle size and solubility. Air sampling strategies for energy conversion and processing pilot plants will also be determined.
Keywords: aerosols; sampling; health hazards; plutonium; bioassay; correlations; particle size; samplers; design; safety; gaseous wastes.

100004 Ventilation Systems Analysis. Gregory, W.S. (Los Alamos Scientific Laboratory, Group WX-8, MS-928, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 600019. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$140,000.
Related energy source: Coal(20); nuclear fission(20); nuclear fusion(60) **R and D categories:** Pollutant monitoring.

The objective of this program is to develop the capability to predict airflows and pressures within facilities subjected to internal explosions. This program will have particular applicability to nuclear fuel cycle facilities but can also be applied to other facilities such as synthetic fuel plants. The program will place emphasis on facility ventilation systems but will also be applicable to other airflow pathways within structures. Explosion flow regimes have a wide range of characteristics. Explosion processes can vary from slow combustion (deflagration) to extremely fast energy releases (detonation). The flow regimes range from low-pressure, low-velocity impulses similar to those caused by tornadoes to high-pressure shock waves. This program will be capable of handling all slow conditions associated with explosions. The program will capitalize upon the capabilities of the digital computer program TVENT developed to predict airflows and pressures within facilities during tornado conditions. The input and output routines that were structured to be familiar to heating and ventilating engineers, designers, and analysts will be retained. The program will be highly portable (that is, it will fit on many types of computers). TVENT has already been implemented on 15 different computers. The change in the basic program TVENT will involve reformulation of the fluid dynamic equations to accommodate flow regimes associated with explosions.

Keywords: nuclear facilities; nuclear power plants; air cleaning systems; ventilation systems; performance; tornadoes.

100005 Contamination Limits for Property. Healy, J.W. (Los Alamos Scientific Laboratory, Los Alamos, NM, 87545). **Project number:** 600088. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$75,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective is to derive methods for obtaining rational limits for radioactive contamination on or in property to be disposed of to the public. Information available in literature is used to study individual problems and, where feasible, propose criteria. Current studies are aimed at producing limits for uranium and thorium in soils.
Keywords: soils; uranium; thorium; contamination; maximum permissible activity.

100006 Handbook on Effluent Monitoring. Corley, J.P. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 600029. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective is to provide recommended methods and procedures for greater comparability among DOE contractor environmental and effluent radiological surveillance programs and reporting systems. Based on studies of current practices at DOE facilities and published standards, Battelle-Northwest will delineate areas where additional technical guidance for environmental and effluent monitoring should be developed. Recommended standard methodology for routine surveillance requirements will be selected, with expected performance criteria, relative advantages and limitations, and acceptable alternatives where applicable, on the basis of literature surveys, internal experience, workshops, and reviews by knowledgeable technical specialists. Draft versions of the resulting handbooks will be circulated under DOE-DOES auspices for comments and revised as agreed upon with DOES staff. Professional staff will be made available as may be agreed to assist with interpretation and implementation at DOE facilities.
Keywords: radiation monitoring; manuals; radioactivity; nuclear facilities.

100007 Assessment of Criticality Safety. Clayton. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 600021. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$45,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective is to develop and apply a systematic method to analyze the criticality safety programs in DOE facilities. All of the DOE contractors who maintain a criticality safety program will be surveyed. The survey will be conducted through site visits in which the individual characteristics of the different criticality safety programs will be determined and a compilation of their operating experience made. A preliminary fault tree will be developed and utilized to prepare questions for the criicality safety survey.
Keywords: criticality; safety standards; nuclear facilities; systems analysis; technology assessment.

100008 EH and S Standard for Geothermal Energy. Martin, J.B. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 600075. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$125,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant monitoring.

Geothermal energy development for electric power may be divided into four phases: geophysical exploration, drilling exploration, testing and development of the geothermal field, and power plant construction and operation. Direct utilization of geothermal resources are also being developed. The geophysical exploration phase involves a variety of site evaluation studies in which the environmental health and safety impacts are relatively small or nil. The drilling exploration and field testing and development areas have many safety and environmental health aspects. The developmental stages have created some new technology and required modification of existing technology, especially in well drilling operations. The power plant construction and operation phase is covered largely by existing standards that have been developed for nuclear and fossil fueled power plants. This proposed research will identify existing problems and make recommendations for new standards to be applied to geothermal energy development. While many of the major problem areas have been recognized, a risk tree type analysis, such as MORT (Management Oversight Risk Tree), will be utilized to assure the identification of all significant problems which may be associated with the geothermal program. A literature review will be accomplished to compile the existing standards, guidelines, or regulations that may be applicable to geothermal energy.
Keywords: geothermal exploration; geothermal resources; resource development; well drilling; safety standards; environmental impacts; health hazards; site selection.

100009 Energy Quality and Reliability Assurance Program Development. Witt, J. (Arinc Research Corp., Annapolis, MD). **Project number:** 600236. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.
Keywords: technology assessment; quality assurance.

100011 Environmental Monitoring Data Systems. Duffey, L. (EG and G Idaho, Inc., Idaho Falls, ID). **Project number:** 600234. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The environmental monitoring data system task involves the use of computerized data base systems to compile and present data on effluent releases and environmental monitoring at major DOE contractor sites. The Effluent Information System (EIS) and Onsite Discharge Information System (ODIS) collect, tabulate, and summarize air and liquid radioactive effluent releases. Sites currently report on an annual basis. The Nonradiological Effluent Information System (NREIS) and Environmental Data System (EDS) are currently under development. These systems will be used to assist DOE, site, and safety groups in determining compliance with local, state, and federal regulatory requirements.
Keywords: environment; monitoring; data acquisition systems; radioactive effluents; air pollution; radiation monitoring; chemical effluents.

100012 Quality and Reliability Assurance Program Plan. Trauth, C.A. (Sandia Labs., Albuquerque, NM, 87115). **Project number:** 600149. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: Coal(40); oil and gas(10); oil shale(10); solar(10); geothermal(10); hydroelectric(10); conservation(10) **R and D categories:** Pollutant monitoring.

Sandia Laboratories will provide study and engineering support in developing a comprehensive, cohesive program plan which will afford policy direction, from headquarters level, in the fields of quality assurance, reliability, and human factors relative to nonnuclear programs under cognizance of DOE. The program will place emphasis on assuring the health and safety of DOE contractor personnel and the general public, and on protection of property, faciliites, equipment, and environment.
Keywords: safety engineering; quality assurance; reliability; energy facilities; us doe; equipment protection devices; human populations; health hazards; sandia laboratories.

100014 Nuclear Safety Standards Project. Brynda, W. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 600026. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective of this project is to provide guidance in the design of new reactors or modifications of existing reactors by identifying the applicability of existing reactor standards, codes, and guides for DOE reactor facilities. In recognition of the diversity of the type and purpose of the DOE-owned reactors, they have been grouped into six categories; each category having generally similar design and operating characteristics. A design guide is developed for each reactor category that identifies and provides guidance in the application of standards and codes to the major areas of reactor safety and design. The major areas of reactor safety addressed by the design guide includes: siting, design, construction, decommissioning, modification, operation, maintenance, and quality assurance.
Keywords: reactors; modifications; standards; reactor safety; design.

100015 Emergency Technology. Chester, C.V. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 600097. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene

The overall effort of this program is directed toward protecting the population from the whole spectrum of potentially harmful manifestations of nuclear energy. Emphasis is on anticipation of need by cognizant governmental agencies for information on potential

threats years before the problem becomes a public issue, thus providing timely and reliable information to the user agencies and the public. Past efforts have anticipated the need for and supplied timely data on Soviet civil defense, feasibility and blast resistance of expedient shelters, effects of nuclear weapons on nuclear reactors, and comparison of terrorist use of chemical, biological, and radiological agents. Most important developments include development of a field-tested technology by which average Americans, in two or three days, can protect themselves and their families from nuclear war by using their own resources of material, tools, and labor.
Keywords: nuclear weapons; nuclear explosions; blast effects; civil defense; human populations; fallout shelters; nuclear power plants; safety.

100016 ARAC Operations. Dickerson. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 600031. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

ARAC is a computerized data communication and calculational system for rapidly estimating movement and concentration of toxic materials released into the atmosphere. The system was developed by Lawrence Livermore Laboratory for DOE primarily to assess the consequences of an accidental release of radioactive or other toxic materials that may occur at DOE testing, research or production facilities. In addition, this service is available for assessments pertaining to nuclear weapon accidents, threats of radioactive material dispersal, and foreign nuclear weapons tests. The basis for the ARAC advisories are numerical models (MATHEW and ADPIC) that calculate transport, diffusion and deposition of pollutants based on the nature of the released material, the topography of the local site, and local and regional meteorological conditions related to the site. Other models vary in complexity from the simple Gaussian diffusion approximation to a trajectory diffusion model. A data communication and acquisition network provides the numerical models with meteorological input data from the site and from the surrounding region. The regional data are received from the Air Force Global Weather Central (AFGWC), Offutt Air Force Base, Nebraska, via a computer to compute data link. Advisories are transmitted back to the site and displayed locally for use by personnel involved in the total assessment process.
Keywords: toxic materials; air pollution; radioactive aerosols; radiation accidents; data acquisition systems; radionuclide migration; radionuclide kinetics.

100019 Technical Safety Assessments. Stratton. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 600148. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The Los Alamos Scientific Laboratory proposes that it provide a continuing technical safety service for DOE headquarters and field organizations by performing technical safety assessments of selected environmental, safety, and health aspects of various programs and projects. These tasks would involve travel to the facility in question, inspection of the facility or portion thereof, discussions with appropriate personnel, study of reference documents and finally, preparation of reports. Completion of reports might require discussion, study and computer computations within LASL subsequent to inspection of the facility.
Keywords: reactor safety; research reactors; modifications; reactor components; reactor operation; risk assessment.

100020 Fusion Fire Protection Research. Alvarez, N. (Lawrence Livermore Lab., Livermore, CA). **Project number:** 600082. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The main goal of this program is to insure that fire protection measures for fusion energy experiments (FEE) evolve concurrently with the complexity of FEE. The requirement for fire protection for FEE and thermonuclear power reactors (TPR) assumes adequate knowledge of the normal operation of the FEE so that the fault modes introduced by unwanted fire can be effectively prevented or protected against. For this reason, the first year's programmatic effort is designed to qualitatively study the operation of selected FEE, to identify current experimental procedures, and to identify potential fire-related faults. In subsequent years, confirmed fire hazards and resultant fault modes will be separated so that rational fire protection and fire protection strategies can be identified and tested and so that research into unique modes of materials control, detection, and suppression can be conducted. Formulation of flexible guidelines for materials control and integrated detector/suppression systems for generic FEE and TPR, along with the development of unique concepts of detection and suppression will constitute the major product of this program.
Keywords: thermonuclear reactors; fire hazards; tritium; safety; failures; accidents.

100021 Technical Guidelines/Personnel Dosimetry Calibration. Bartlett. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** 600134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

A technical document will be developed to provide guidance in establishing personnel-dosimetry calibration procedures for DOE and DOE contractors. A data base for evaluating the calibration, design, and performance of dosimeters used at DOE facilities will be developed and dosimeter performance criteria will be recommended. The Health Physics Society Standards Committee's proposed standard on personnel-dosimetry performance criteria will be used in establishing techniques, but the scope of the project will not be limited by these recommendations. The project as contemplated will be carried out in three phases. In the first phase optimum calibration techniques will be developed. In the second phase a data base concerning dosimeter performance at various DOE facilities will be established. In the third phase a manual of calibration techniques will be written. The purpose of the study will be to evaluate the suggested protocol in the HPSSC standard to augment these recommendations as necessary, and to develop procedures for which there is no guidance.
Keywords: personnel dosimetry; calibration; manuals; us doe; dosemeters; performance; design.

100023 DOE High Explosive Safety Manual. (Department of Energy, Forrestal Building, Washington, DC). **Project number:** 600178. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: chemical explosives; safety; manuals; information.

100027 Management Systems. Nertney, R. (EG and G Idaho, Inc., Idaho Falls, ID). **Project number:** 600205. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

A comprehensive central environmental and safety data program for all DOE operations is being established at EG and G Idaho. It will provide a central automated information system for receiving, cataloging, and assembling data into output reports on DOE activities. These activities include: the radioactive effluent (gaseous and liquid) task which is now in operation and existing data program for tracking fire protection recommendations. OSHA identified deficiencies and emergency resources which are being transferred to EG and G Idaho and identified two new safety (SPDS) and environmental data (EMDS) programs which are being implemented during FY 1978. Also development of a non-radioactive solid waste data program is expected to be initiated in FY 1979 which was not included in the FY 1979 congressional budget submittal.
Keywords: safety engineering; data acquisition systems; radioactive wastes; information centers; solid wastes; fire prevention; environmental impacts.

100028 Fusion Safety Symposium. Miller. (Argonne National Lab., Argonne, IL). **Project number:** 600027. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Health protection, safety, and industrial hygiene.

To meet a need identified within ERDA and at the request of the ERDA Division of Safety, Standards, and Compliance, the Argonne Center for Educational Affairs has prepared a five-day overview course on fusion energy research and technology development. It is designed for personnel whose background is not in fusion. The lecturers will be well qualified persons from DOE, Argonne and other DOE contractors, and univerisities. The first presentation is scheduled for May 1977 in the Germantown area. One or more updated annual offerings are anticipated for future fiscal years.
Keywords: thermonuclear reactors; safety; education.

100030 Industrial Hygiene Task Force. Ettinger, H. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 600240. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Health protection, safety, and industrial hygiene.

An industrial hygiene task force will be established to assist in the definition of potential health problems associated with experi-

mental and developing energy technologies. Efficient utilization of these new energy technologies requires evaluation of sampling procedures, control practices, and respiratory protective equipment to provide an acceptable work environment within a cost effective framework during the development phase, and to assure that final development of the technology will not be delayed due to health concerns. Specific tasks and priorities will be established and recommendations will undergo formal review. Initial efforts will be directed at correlating the release of coal tar pitch volatiles with indicator gases or vapors that can be readily monitored.
Keywords: health hazards; occupational safety; energy source development; coal industry; coal tar.

100031 Health Physics Support and Assistance: DOE Division of Operational and Environmental Safety. Selby, J. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** 600242. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

Battelle Pacific Northwest Laboratories will function as a lead laboratory to provide health physics support and assistance to the Division of Operational and Environmental Safety, Department of Energy, on special studies principally associated with the analysis of impact of standards, regulations and engineering and administrative actions on occupational and environmental exposure. Support and assistance will also be provided for other specific subtasks or special studies identified and scoped by DOE as a priority item after review by PNL and DOE-RL. The designation of a lead laboratory in health physics, with an agreement and budget in place, will provide the Division with the additional expertise necessary to respond in an acceptable and timely manner to the myriad of questions and situations that arise during the operation of vast and numerous nuclear energy research, development and demonstration facilities. This response may be provided totally by PNL or may result from PNL coordination of responses from recognized health physics groups.
Keywords: safety; health hazards; us doe; research programs; financing.

100032 Criteria Development for DOE Decontamination and Decommissioning Operations. Nelson, I.C. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** 600239. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The primary objective of this project is to prepare a guide for use by DOE and its contractors in conducting decommissioning operations. This guide will provide a uniform basis for assessing hazard inventories, developing cost/benefit ratios and risk analyses, decision making, monitoring for compliance, and certification of decommissioning activities. While initially addressed to radioactive contaminants, this work will, in all likelihood, be expanded to address other contaminants. The initial version of the guide will be in the form of a handbook containing the following: (1) basic standards and criteria for both protective storage and unconditional release conditions, as agreed upon with the sponsor; (2) recommendations for establishing or confirming radioactivity levels, including statistical design, sampling techniques, and instrumentation performance criteria and samples; (3) methodology for estimating occupational radiation exposures during decommissioning operations; (4) methodology for estimating environmental exposures prior to, during, and subsequent to decommissioning operations, including unplanned releases; (5) simplified methods for determining specific numerical guidance for decontamination and/or release, for both exterior and interior surfaces and for bulk materials; and (6) recommendations for appropriate records generation and maintenance.
Keywords: decontamination; decommissioning; standards; nuclear fuels; nuclear facilities; fuel cycle.

100033 Toxic Material Advisory Program. White, O. Jr. (Brookhaven National Lab., Upton, NY). **Project number:** 600245. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The requirements to provide safe and healthy workplaces and to minimize the environmental consequences of doing business dictate that toxic materials associated with the Department of Energy's efforts be identified and that policy be established in the use of these materials. Several avenues, NIOSH's criteria documents, AIHA's hygienic guides, MCA's chemical safety data sheets, etc., provide information on toxic hazardous properties of many materials, generally those with high consumption rates, high exposure potentials, unrestricted consumer use, etc. Toxic materials particular to the Department of Energy needs may not be recognized to facilitate timely and authoritative guidance. Brookhaven National Laboratory proposes to expand its own efforts in this area by establishing the Center for Assessment of Chemical Hazards within the Safety and Environmental Protection Division to provide the expertise and structure for DOE to meet its changing problems and priorities with the necessary flexibility and speed. Specifically, BNL will: (1) conduct critical literature reviews using secondary and primary references; (2) obtain appropriate input from non-referenced sources such as users, manufacturers, researchers, other agencies, etc.; (3) compile a toxic material summary report (TMSR) for review by an appropriately assembled advisory panel; (4) prepare draft toxic material advisory reports (TMAR) if the panel ascertains that sufficient data exist; (5) submit draft TMAR's for peer review; and (6) upon addressing and documenting comments from the review, prepare pre-final TMAR's for submission to OES committee.
Keywords: toxic materials; personnel; health hazards; occupational safety.

100034 Energy Standards Coordination and Development. Snell, J. (National Bureau of Standards, Washington, DC). **Project number:** 600152. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); solar(25) **R and D categories:** Health protection, safety, and industrial hygiene.

Sanida Laboratories will provide study and engineering support in developing a comprehensive, cohesive program plan which will afford policy direction, from headquarters level, in the fields of quality assurance (QA), reliability (R), and human factors (HF) relative to non-nuclear programs under cognizance of DOE. The program will place emphasis on assuring the health and safety of DOE contractor personnel and the general public, and on protection of property, facilities, equipment, and environment.
Keywords: safety engineering; energy facilities; health hazards; public policy; quality assurance; reliability; us doe; personnel.

100035 SPRO Accident Investigation Support. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 600235. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: strategic petroleum reserve; energy supplies; accidents.

100040 Applications Development. Nertney, R. (EG and G Idaho, Inc., Idaho Falls, ID). **Project number:** 600206. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Health protection, safety, and industrial hygiene.

This 189 includes continuing operation of the System Safety Development Center (SSDC) within EG and G, Idaho. The purpose of this office is to provide continuing system safety development and application services for the Department of Energy (DOE), Division of Operational and Environmental Safety (OES). This development work will be generally based on the existing Management Oversight and Risk Tree (MORT) system safety model completed and reported in SAN 821-2. The continuing function of this office will be to: (1) assess DOE in-house and contractor system safety programmatic needs; (2) assess system safety state-of-the-art methodology, technology, and philosophy; (3) continue state-of-the-art modeling of MORT basic elements to meet current DOE needs; (4) design and develop functional methodology for practical implementation of program elements; (5) develop safety performance criteria and appraisal methods; (6) test effectiveness of developed methodologies; (7) evaluate/report results of development, testing, and application program to DES; (8) communicate system safety information to DOE and DOE contractors; and (9) train DOE and DOE contractor personnel in practical application of concepts, with emphasis on incident investigation and safety program appraisal.
Keywords: safety standards; us doe; idaho; education; technology assessment.

100042 Screening of Coal/Shale Conversion. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800387. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives of this work are to: (1) identify procedures to attenuate the release to surface or ground water hazardous components of coal conversion wastes; (2) define environmental chemistry which exert the strongest control on the mobility of the hazardous components following disposal and speciations; and (3) evaluate the possiblity of using surface land disposal of such wastes as an alternate and/or emergency waste management practice. These objectives will be accomplished by determining the removal rates of heavy from mildly oxidizing conditions typical of many inland shallow streams to highly reducing conditions typical of waterlogged soils and many sanitary landfills. Loss to the aqueous phase will be attenuated by supplementing the hazardous components with

various amounts and types of geologic media. These geologic media include limestones, sandstones, shales, as well as surface and subsurface soils varying in clay content, mineral composition, and pH. **Keywords:** coal gasification plants; coal liquefaction plants; waste water; waste management; ground water; surface waters; contamination; environmental impacts; limestone; sandstones; shales; soils; clays; minerals; ph value; waste disposal.

100044 Control Technology for In-Situ Oil shale Retorts. Fox, J.P. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 800353. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The purpose of this program is to develop control technology to protect the groundwater system when modified in-situ retorts are placed in the mahagony zone of the Piceance Basin. The program will address the problems of gas migration during retorting and water migration after retorting. Control technologies to be evaluated will include formation plugging and modification of local hydraulics and hydrology. The proposed work includes a literature survey, kinetic leaching experiments, laboratory and computer evaluation of existing control methods, and the development of new control methods. Emphasis is given to the utilization of process waste products, such as mine water and spent shale, in the development of new control technology.
Keywords: in-situ retorting; oil shales; ground water; water pollution abatement; leaching; hydrology; waste product utilization.

100045 Spent Shale as a Control Technology for Oil Shale Retort Water. Fox, J.P. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 800354. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The goal of this program is to determine how spent shale can be used to remove the organics present in oil shale retort waters and to determine if spent shale can be upgraded for use in conventional water treatment applications or as a filter medium for solvent refined coal (SRC). The removal of organics from retort water by conventional columns packed with surface spent shale and by abandoned in-situ retorts will be studied experimentally, and design parameters determined for a large-scale system. The feasibility of using packed beds of spent shale in series with an activated sludge unit will be evaluated. The proposed experimental program consists of four phases: batch studies, column studies, system studies, and upgrading studies.
Keywords: spent shales; retorts; waste water; water treatment; organic compounds; removal; filtration; pollution control; src process; waste product utilization.

100046 H-Coal Field Evaluation of ECT. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800361. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

An environmental and health monitoring and testing plan to study the H-coal-liquefaction installation at Catlettsburg, Kentucky, is being developed for the Assistant Secretary for Environment, Department of Energy. Data and information obtained from this and related projects will permit judgments to be made of the environmental acceptability of processes converting coal to liquids, in addition to their technical and economic suitability. The H-coal project is expected to operate for a period of three years and will use several different types of coal. State-of-the-art methods are to be emphasized in monitoring and testing, and the interests and needs of other government agencies, such as EPA and NIOSH, are to be integrated into the program. Process streams and plant effluents will be characterized chemically and physically by on-line and in-plant sample collections, measurements, and monitoring. Data developed will be used to determine the efficiency, reliability, and maintenance requirements of environmental control equipment, and to assess and document the adequacy of health and environmental controls incorporated into the process system.
Keywords: h-coal process; environmental impacts; data analysis; on-line measurement systems; sampling; liquid wastes; data compilation; pollution control; efficiency; pollution abatement.

100047 Gasifiers in Industry. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800403. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: coal gasification; technology assessment; industry; hydrocarbons; air pollution; land pollution.

100048 Assessment of Environmental Control Technologies for KGRAs. Phelps, P. (Lawrence Livermore Lab., Livermore, CA). **Project number:** 800198. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives of this project are to identify and to assess the engineering efficacy and the practicability of environmental control technologies to be used in government-sponsored geothermal programs in the Raft River area. Results are intended for use (1) by DOE Division of Environmental Control Technology (DOE/ECT) in performing the duty of independent overview of the environmental acceptability of these programs, and (2) by DOE in the preparation of DOE environmental assessments (EA) and impact statements (EIS) for the Raft River area. The principal concerns regard liquid wastes, subsidence/seismicity, and gaseous wastes. Emphasis is to shift in FY 1978 to conducting the necessary surveillance for confirming performance criteria for these technologies.
Keywords: raft river valley; environmental impacts; kgra; ground subsidence; seismicity; gaseous wastes; liquid wastes; geothermal resources; control.

100049 Radiological Assessment of Abandoned Nuclear Facilities. (Mound Lab., Miamisburg, OH). **Project number:** 800391. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

A program was initiated in 1974 by the Atomic Energy Commission (AEC), now DOE, to determine the condition of sites formerly used by the Manhatten Engineering District (MED) and the AEC for work involving the handling of radioactive materials. Phase I of the program consists of performing radiological surveys at the sites. Phase II consists of engineering evaluations of remedial actions at sites identified in Phase I as requiring such action. Phase III consists of performing the remedial actions. Radiological surveys have been completed at several sites. These results indicate that at some sites there is a need for further monitoring and evaluation of radon and its short-lived decay products. To provide this additional radon monitoring and hazards evaluation, Mound is proposing to establish an eight-to-ten man effort, including a four-to-six man survey team and the supporting technical and administrative personnel. The initial task in this program would be to develop a detailed work plan for this program based on information gathered through literature review, site visits, and discussions with personnel from Environmental Monitoring Laboratory (EML), Oak Ridge National Laboratory (ORNL), and Argonne National Laboratory (ANL), and also DOE/ECT staff. Concurrent with the development of this work plan will be an R and D task to evaluate the adequacy of existing instrumentation and techniques that are utilized for radon measurements. This work plan will also include the acquisition of the necessary equipment for measuring radon and its short-lived decay products. This will probably involve both borrowing a large number of items from EML as well as purchase and/or fabrication of additional systems. A maintenance and calibration facility will also be established.
Keywords: abandoned sites; radioactivity; radiation monitoring; radon; daughter products; technology assessment; decommissioning; nuclear facilities.

100050 Development of Material Constitutive Descriptions for ECT Assessments of Energy Materials Shipping Systems. Valentin, R.A. (Argonne National Laboratory, Building 335, Argonne, IL, 60558). **Project number:** 800193. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$60,000.
Related energy source: Coal(25); nuclear fission(50); nuclear fusion(25) **R and D categories:** Health protection, safety, and industrial hygiene.

This program encompasses a number of objectives that, while interrelated in their ultimate application to energy system shipping container design and evaluation, are best pursued as separate technical tasks. The overall objective is the development of constitutive descriptions for the materials used in shipping container systems with particular emphasis on the modeling of rapid transient loading. These descriptions and the related containment failure analyses and experiments will provide the basis for developing a rational margin of confidence in such container systems. To achieve this overall objective, the scope of effort has been divided as follows: Task A--Assessment and Application of Endochronic Plasticity Theory for the Dynamic Analysis of Energy Materials Shipping Containers; Task B--Failure Analysis of Energy Materials Shipping Containers, Analytic Representation of Dynamic Failure Modes and Effects; Task C--Constitutive Representation of Thermal/Structural Interactions; Task D--Analytical Methods Development for Estimating and Bounding Structural Damage to Energy Materials Shipping Containers; Task E--Development of Analysis Support Experiments; and

Task F--Design Optimization of Energy Materials Shipping Containers Subjected to Extreme Loading Conditions.
Keywords: containers; design; evaluation; materials; failures; testing; transport; damage; packaging; safety; energy sources.

100051 ECT for Electric Power Reduction from Coal. Sather, N.F. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 800057. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$1,100,000.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective of the program is to provide current in-depth evaluations of technical, environmental and economic aspects of coal-based electricity systems and comparative evaluations of alternative systems under specified conditions. Systems being evaluated include: conventional combustion with flue gas cleanup, coal cleaning/combustion, fluidized-bed combustion, production/combustion of coal-derived fuels, and gasification/combined-cycle power generation. The technologies are characterized as completely as available information permits and correlations are developed for computing inputs, residuals and costs in successive unit operations of a coal-to-electricity sequence as a function of coal properties, regulatory requirements and site-specific factors. Subcontractors and consultants with pertinent expertise are employed to a considerable extent. Reports providing initial assessments of the technologies listed above have been issued. A computerized data bank integrating data on coal washabilities and reserves has been established. Optional strategies in conventional combustion have been compared. The development and refinement of process simulation models is continuing.
Keywords: environmental effects; coal; combustion; fossil-fuel power plants; flue gas; cleaning; coal preparation; washing; fluidized-bed combustion; fuel gas; coal liquids; production; combined-cycle power plants; regulations; coal reserves; information systems; simulation; emission; fly ash; desulfurization; scrubbers; nitrogen oxides; sulfur oxides; particles; pollution control; power generation.

100052 Environmental Control Technology Survey of U.S. Strip Mining Sites. Johnson, D.O. (Argonne National Laboratory, Building 8, Argonne, IL, 60439). **Project number:** 800109. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$430,000.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives of this project are to identify sites where surface mining is likely to increase over the next 20 years; to study these sites to obtain a data base from which to assess potential health and environmental impacts from their being mined; to assess the effectiveness of the control technology utilized and examine the alternatives; to recommend control technologies for new or expanding mines to allow those mines to operate in an environmentally safe manner; and to recommend future R and D needs and priorities in environmental control technology. These objectives will be attained by: survey of future coal production areas and selection of case study sites; bi-weekly sampling and analysis of site effluents; collection and analysis of climatic, hydrologic, and geologic data; projection of site impacts and extrapolation for coal regions; and examination of control technology economics and efficiency. Waste product disposal/reclamation, interrelations with site characteristics, control technology practices, and effectiveness of treatment will be analyzed and recommendations made for alternatives to existing technologies and for future R and D needs.
Keywords: usa; coal mining; surface mining; site selection; forecasting; health hazards; environmental impacts; monitoring; pollution control; recommendations; sampling; hydrology; economics; efficiency; mineral wastes; waste disposal; land reclamation; acid mine drainage; dusts; ground water; surface waters.

100053 Evaluation of Pollutants from Flash-Hydro Gasifier. Albananese, A.S. (Brookhaven National Lab., Building 526, Upton, NY, 11973). **Project number:** 800264. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$65,000.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The environmental factors and the control technologies involved in the Flash Hydropyrolysis of coal (FHP) will be assessed by: (1) conducting laboratory analyses on samples obtained from BNL's experimental FHP unit and, based on the experimental data, preparing conceptual flow diagrams, including mass and energy balances, of full-scale FHP-chemical and FHP-refinery complexes; and (2) surveying the literature to determine available ECT's, assess available technology and identify the areas in which new technology is required. The results of this study will (1) provide an indication of the possible effluents from an integrated FHP complex; (2) provide a basis for establishing environmental guidelines for FHP and related processes; and (3) identify areas in which new control technologies would be required for commercialization of the process. To date, the product streams of the FHP unit have been analyzed for sulfur, nitrogen, ammonia phenol, HCN and thiocyanate. An environmental assessment of a conceptual industrial scale FHP-chemical complex has also been made. Means of controlling the level of atmospheric CO2 will be assessed by surveying the literature and consolidating findings on CO2 emissions and atmospheric concentration levels and preparing conceptual processing schemes for CO2 recovery and recycle. The results of this study will identify some of the options which are available for controlling the level of CO2 in the atmosphere. To date, background information on sources of CO2 and atmospheric CO2 levels has been gathered and analyzed. Process options for CO2 capture, reuse and disposal have also been identified and compiled.
Keywords: chemical effluents; emission; hydrocarbons; synthetic fuels; carbon dioxide; coal liquefaction; flash hydropyrolysis process; environmental impacts; air pollution abatement; water pollution abatement; land pollution abatement; control; technology assessment; pollution control; earth atmosphere.

100054 Control Technology for In-Situ Oil Shale Retorts. Fox, J.P. (Lawrence Berkeley Lab., Bldg. 70, Berkeley, CA, 94720). **Project number:** 800353. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$25,000.
Related energy source: oil shale(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The purpose of this program is to develop control technology to protect the groundwater system when modified in situ retorts are placed in the Mahogany Zone of the Piceance Basin. The program will address the problems of gas migration during retorting and water migration after retorting. This program will be implemented through literature surveys, laboratory studies and computer modeling of a series of control options. The following options will be evaluated: (1) making the retort largely impermeable to groundwater flow by partial or complete filling with a cementitious material; (2) making the retort largely impermeable by using polymers or other agents to plug fissures in retort walls and to form localized plugs; (3) chemically immobilizing the leachables without hydraulically sealing off the retort; (4) deliberate leaching with groundwater or an organic solvent which would be captured, treated and reused; and (5) using a cap rock which would significantly retard the movement of groundwater through the retort. This program will identify and evaluate technically and economically feasible options for stabilizing spent in-situ retorts, and recommend those methods suitable for use in a commercial plant. The successful completion of this program will alleviate a significant environmental barrier for in-situ oil shale development. This program was initiated in July 1978. During this quarter, a literature survey of control options used in related industries and leaching studies was initiated.
Keywords: ground water; computer calculations; mathematical models; hydraulics; oil shales; oil shale industry; environmental effects; water pollution; economics; .

100055 Spent Shale as a Control Technology for Oil Shale Retort Water. Fox, J.P. (Lawrence Berkeley Lab., Bldg. 70, Berkeley, CA, 94720). **Project number:** 800354. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000.
Related energy source: oil shale(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The goal of this program is to determine how spent shale can be used to remove the organics present in oil shale retort waters and to determine if spent shale can be upgraded for use in conventional water treatment applications or as a filter medium for solvent refined coal. Batch experiments will be conducted to determine adsorption isotherms for several spent shale/retort water combinations and to evaluate the effect of pH, temperature, and particle size on adsorption. Column studies will be conducted using optimum conditions identified during the batch work and design parameters for a large-scale operation will be determined. Effluent from the column studies will be treated in an activated sludge unit and overall system performance will be evaluated. This program will develop a new technology to remove organics from oil shale retort waters. The resulting technology will improve environmental control technology economics for the oil shale industry. The program was initiated during July 1978. The work completed during this quarter included the resolution of a number of analytical problems associated with the handling and analysis of oil shale retort water and the completion of batch isotherm studies.
Keywords: spent shales; waste water; uses; adsorption; particle size; ph value; temperature effects; oil shale processing plants; isotherm; sorptive properties; waste processing; organic compounds.

100056 Fate of Mercury at Paraho Demo Site. Fox, J.P. (Lawrence Berkeley Laboratory, East End of Hearst, Bldg. 70, Berkeley, CA, 94720). **Project number:** 800363. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA).

Office of Environmental Compliance and Overview. **Funding:** DOE-$30,000.
Related energy source: oil shale(100) **R and D categories:** Health protection, safety, and industrial hygiene.

A program is reported to measure the concentration of mercury in offgas from oil shale processes, to identify its chemical form, and to assess the ability of existing air pollution control technology to reduce the mercury to acceptable levels. An existing technique, Zeeman Atomic Absorption spectroscopy, will be refined to make continuous in-place measurements of mercury in oil shale offgases. The resulting instrument will be used at several field sites to make in-place continuous measurements of mercury in the gas stream. In parallel with this measurement activity, published literature and patents will be reviewed to identify techniques suitable for mercury reduction from gas streams containing high levels of organics and CO/sub 2/. Suitable technologies will be tested in the laboratory using gases generated by a laboratory-scale retort. The program was initiated in July 1978. During this quarter, an existing ZAA spectrometer was redesigned and fabrication of a field instrument initiated. Joint experiments with Laramie Energy Technology Center (LETC) were completed that verified that mercury is nonuniformally emitted from simulated in-situ retorts due to volatilization and condensation along the packed bed. A literature survey was initiated on existing control technology for the removal of mercury from gaseous streams.
Keywords: oil shale processing plants; mercury; emission; monitoring; air pollution control; absorption spectroscopy; organic compounds; carbon dioxide; gaseous wastes; pollution control equipment; chemical state.

100057 ECT Aspects of In-Situ Coal Gasification Groundwater Quality Changes and Subsidence Effects. Mead, S.W. (Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA, 94550). **Project number:** 800155. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$185,000; EPA-$250,000.
Related energy source: Coal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

Part of this project is aimed at measuring and assessing the effects on ground-water quality that may be caused by the underground reaction products of in situ coal gasification. Additional objectives include the development of predictive capabilities--for large scale in situ coal gasification--and the identification of appropriate control technologies. Another part of this project is aimed at developing predictive capabilities and identifying control technologies appropriate for the ground movement and subsidence effects that will accompany large scale in situ coal gasification. The groundwater quality studies include water sampling and analysis (including GS-mass spec studies) before, during, and after in situ coal gasification experiments. Also included are laboratory ash-leaching and coal-sorption studies of reaction product contaminants. Computer modeling is used to predict the evolution of the contaminated plume of ground water. The subsidence studies involve the application and validation of a finite element computer code for subsidence prediction. The modeling studies will be enhanced by strength measurements of overburden cores, and by surface and subsurface geotechnical measurements in conjunction with in situ coal gasification experiments.
Keywords: in-situ gasification; coal gasification; ground water; water quality; environmental effects; ground subsidence.

100058 Geothermal Loan Guaranty Program: Assessment of Environmental Control. Moody. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** 800180. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$40,000.
Related energy source: geothermal(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives are to identify environmental control technologies to be used in activities for which application is made for a geothermal loan guarantee, and to assess these and other environment and safety concerns. The methods employed are to review applications and environmental impact assessments and statements; as needed request supplemental information and site visits, and to draw on appraisals of state-of-the-art of control technology and field experience in assessing effectiveness and practicability.
Keywords: financing; geothermal energy; energy source development; environmental impacts; safety.

100059 LNG Spill Program. Hogan, W.J. (Lawrence Livermore Laboratory, Box 808 L-49, Livermore, CA, 94550). **Project number:** 800230. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$1,156,000.
Related energy source: oil and gas(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives are to develop and verify an ensemble of analytical models which can describe the phenomena occurring in LNG releases to the environment. The verification of the models will involve an extensive experimental program. The verification steps are: (1) obtain or develop models for vapor generation, dispersion, combustion and rapid deflagration/detonation; (2) establish test site criteria, evaluate and select site, design test facility, and supervise construction; and (3) develop experimental program, develop instrumentation, conduct tests, analyze data and report data and comparisons with models. The product will be a set of verified models which can be used to predict LNG spill effects for large scale releases (10,000 to 100,000 m/sup 3/) based upon data collected at smaller scale (10 to 1000 m/sup 3/). Preliminary versions of most models are now running and experimentation at 5 m/sup 3/ is about to begin.
Keywords: liquefied natural gas; gas spills; vapors; safety; mathematical models; combustion; site selection.

100060 Inhalation Tox Shale Dust. Holland, L.M. (Los Alamos Scientific Laboratory, Health Division, Mammalian Biology Group, Box 1663, Los Alamos, NM, 87545). **Project number:** 002525. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$180,000.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The long-term goals of this relatively new program may be summarized as follows: (1) obtain samples of the potentially hazardous materials associated with oil shale mining and various processing stages and prepare them in a form suitable for exposure of small laboratory animals; (2) expose the animals by the relevant routes and study both nonlethal and lethal toxic effects; (3) determine by chemical analysis the tissue distribution of the applied substances, possibly including their metabolic products; (4) observe tissues microscopically and biochemically to determine the site and mode of toxic action, including tumor formation; and (5) assess the results in terms of existing or proposed acceptable exposure limits for the workers and the population. The description of the detailed program will follow this order of scientific progression. Short term inhalation exposures of Syrian hamsters to both raw and spent shale were begun in mid-1976. Longer term inhalation studies (up to 60 weeks) were initiated in 1977 with raw shale and two kinds of spent shale. Aerosols were generated from a Wright dust feed after material obtained from the Laramie Energy Research Center (LERC) was reduced to a fine dust by ball-milling. In an effort to deliver more precise doses and to enhance the response, several groups of animals were also exposed to suspensions of the same aerosolized shale material by intratracheal instillation. Long-term dermal carcinogenicity studies which compare crude shale oils with standard petroleum crude oils are in progress. Experiments involving intestinal tract exposure have also been initiated. Fibrogenesis and carcinogenesis are the biomedical end points of primary interest in this program and will be studied by standard methods (e.g., histopathology, histochemistry, hematology, and blood chemistry). Immunological competence will also be tested.
Keywords: oil shales; oil shale mining; oil shale industry; laboratory animals; health hazards; toxicity; chemical analysis; tissue distribution; neoplasms; personnel; human populations; dose limits; hamsters; inhalation; aerosols; dusts; gastrointestinal tract; skin; eyes; carcinogenesis; immunity; hydrocarbons; in vivo; synthetic fuels; biological effects; spent shales; immune reactions; pathological changes; blood.

100061 Assessment of Environmental and Safety Controls for Hydrogen. Edeskuty, F.J. (Los Alamos Scientific Laboratory, MS-764, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 800128. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$156,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

There are significant advantages to many of the proposed uses of hydrogen in energy systems. This project is designed to assist in evaluating the possibility of such uses of hydrogen by performing a detailed review and study of all factors leading to safety problems or environmental impacts. Thus the overall objective of the project is to define these problems and impacts and to recommend satisfactory solutions. Working relationships have been established with organizations having experience in producing, handling, and transporting hydrogen. We have examined rules and regulations controlling the transportation of hydrogen, the transmission of hydrogen gas through pipelines, the shipment of liquid hydrogen, and the problem of hydrogen embrittlement. We are assesing the findings to date which are primarily addressed to safety problems. We will next address the consideration of environmental impacts.
Keywords: hydrogen; safety; environmental impacts; transport; metallurgical effects; embrittlement; pipelines.

100062 Full-Scale Impact Testing for Environmental and Safety Control Assessments of Energy Material Shipping Container Systems. Seagren, R.D. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800046. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA).

Office of Environmental Compliance and Overview. **Funding:** DOE-$220,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Heavily-shielded energy material shipping systems, similar in size and weight to those presently employed to transport irradiated reactor fuel elements, are being destructively tested under dynamic conditions. In these tests, the outer and inner steel shells interact in a complex manner with the massive biological shielding in the system. Results obtained from these tests supply needed information for new design concepts. Containment failure (and the resulting release of radioactive material to the environment which might occur in an extremely severe accident) is most likely through the seals and other ancillary features of the shipping systems. Analyses and experiments provide engineering data on the behavior of these shipping systems under severe accident conditions and information for predicting potential survivability and environmental control with a rational margin of safety.
Keywords: accidents; spent fuel casks; casks; biological shielding; steels; failures; destructive testing; transport.

100063 Assessment of Environmental Control Technology for Coal Conversion Wastewater Systems. Klein, J.A. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 800060. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$200,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this program is to investigate the amenability of aqueous coal conversion wastes to various state-of-the-art and developing environmental control technologies. The approach is to study the fate of the various compounds of interest, especially PNA's and refractory, highly substituted phenolics during treatment. Screening tests are being performed on the ability of biological degradation, ozonation, wet oxidation and adsorption to clean up aqueous effluents. Results to date indicate that an ORNL-developed, tapered, fluidized-bed bioreactor can achieve phenol reductions of up to 99.9%, but that refractory organics are often present. Ozone treatment has degraded 99% of the residual phenol and 22 to 97% of any PNA present. Several lignite coals have removed phenol and PNA from actual wastewater with loadings of up to 2 mg organic material per gram of coal.
Keywords: coal gasification plants; coal liquefaction plants; waste water; hydrocarbons; metals; organic compounds; polycyclic aromatic hydrocarbons; phenols; biodegradation; ozone; lignite; sorptive properties; oxidation; standards; pollution regulations; pollution control; environmental effects; health hazards; chemical effluents.

100064 Control of Hydrocarbon Emissions from First Generation Gasifiers. McWherter, J.R. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800158. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$57,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this investigation is to determine the feasibility of using catalytic incineration and coal-fired incineration as methods of controlling hydrocarbons and carbon monoxide emissions from coal conversion processes. Questionnaires have been sent to manufacturers of catalysts and catalytic incineration systems requesting information on the availability and recommended operating conditions of catalysts for tail-gas cleanup service. A flowsheet has been developed and the design, fabrication and installation initiated, of a system that integrates a catalytic reactor and the tail gas from an existing coal carbonization experiment. Arranagements for a subcontract to determine the feasibility of using coal-fired incineration to remove HCs and CO from tail gas have been initiated. This subcontract will be let to a commercial manufacturer of small-scale incinerators and/or boilers. Areas of anticipated concern in the screening of catalytic systems include the effect of tars, entrained particulates, halogens, trace metals, etc. on catalyst activity; the production of SO3 from sulfur compounds such as COS, H2S, and mercaptans; and the determination of any required operating conditions compatible with gaseous waste streams from coal conversion plants.
Keywords: coal gasification plants; gaseous wastes; hydrocarbons; carbon monoxide; combustion; catalytic combustors; incinerators; catalysts; deactivation; sulfur trioxide; feasibility studies; coal liquefaction plants; chemical effluents; emission; air pollution control; recommendations.

100065 Environmental Control Assessment of Cogeneration as a District Heating Source. Stockdale, W.G. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800306. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this study is to examine the environmental aspects of cogeneration as applied to district heating systems for a large metropolitan and urban area; particularly as it relates to the use of cogeneration as an air pollution control technique for reduction of pollutant types and quantity and the reduction in fuel required for heating. A typical cogeneration system design will be selected and the source terms for emissions calculated. The facility will be considered for coal and oil operation and pollutants will include NO-X, SO-X, particulates, hydrocarbons and others related to fuel usage. Also, an economic evaluation of cogeneration will be made and compared to the more energy intensive control technologies employed in the smaller units to be replaced.
Keywords: co-generation; environmental impacts; district heating; air pollution control; coal; petroleum; nitrogen oxides; sulfur oxides; particles; hydrocarbons; comparative evaluations; energy conservation; urban areas; economics.

100066 Assessment of Environmental Control Options for Global CO2 Control. Fulkerson, W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800310. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$40,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The Oak Ridge National Laboratory has begun to study a number of CO2 removal and sequestering possibilities. Possible removal methods include absorption from stacks, removal from the atmosphere, and stripping from ocean water. We are examining stack removal first because it may be less expensive than the other options. The physical form of the CO2 whether compressed gas, aqueous solution, liquid CO2, solid CO2, or CO2--H2O clathrate and the location of the storage area are the important factors in choosing a means of transportation. Sequestering possibilities include storage in abandoned wells, or other earth cavities, reacting with calcium carbonate deposits in the oceans, and cold storage at the poles. Recycling the CO2 as hydrocarbons is being examined also. Some of the advantages and problems related to several transportation-storage possibilities will be discussed. All of the removal and permanent storage methods examined so far appear to be expensive in energy and money terms. Since emissions are world wide, any scheme for controlling atmosphere concentrations will probably involve many nations. The institutional and international aspects of the problems will be studied if we find reasonable solutions to the economic and engineering problems.
Keywords: earth atmosphere; air pollution; carbon dioxide; air pollution control; economics; energy consumption; waste disposal; transport; recycling; engineering; international cooperation.

100067 Analysis of Nuclear Fuel Cycles. Fleischman, R.M. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800001. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$500,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this program is to identify areas in developing nuclear fuel cycles where inadequate consideration is being given to environmental controls, where inconsistencies and conflicts exist in environmental policy, and where environmental control improvements can be justified on a cost/risk/benefit basis to ensure that funds are not expended for control in instances where neither the potential effects nor public concerns warrant such expenditures. Environmental control systems and technology in use and under development for controlling radiological and chemical effluents from nuclear energy systems will be described. Physical and chemical forms of the input feed and required process materials will be defined to the extent known. Treatment and confinement processes to eliminate or control the release of residual radiologically and chemically toxic materials to the biosphere will be described for adequacy.
Keywords: power reactors; fuel cycle; environmental effects; radioactive waste processing; radioactive effluents; radioactive waste management; fission product release.

100068 Assessment of Environmental Control for Wastewater in In-Situ Oil Shale Retorting. Mercer, B.W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800061. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$150,000.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A study is reported that is designed to assess the capabilities of current technology for the treatment and disposal of wastewaters generated by shale oil recovery and refining operations. Benchscale technology studies are being conducted to evaluate conventional

biological and physical-chemical treatment processes for mine waters, retort waters, and refinery foul waters. The treatment processes being studied include activated sludge, trickling filters, gravity sedimentation, dissolved air flotation, chemical coagulation, steam stripping, solvent extraction, carbon adsorption, ion exchange, filteration, and reverse osmosis. The recovery of useful byproducts, such as ammonia, is also being investigated. Disposal methods such as land disposal and underground injection are being evaluated. Process wastewater samples, such as retort water, used for the treatability studies are being obtained from both government and private sponsored operations involving field tests and pilot or demonstration plants. The adequacy of conventional treatment and disposal methods for shale oil wastewaters will be assessed with respect to the impact on the environment and in relation to state, regional, and federal standards.
Keywords: waste water; waste processing; waste disposal; activated sludge process; filtration; sedimentation; flotation; flocculation; solvent extraction; adsorption; ion exchange; osmosis; research programs; oil shale processing plants.

100069 Assessment of ECT for Selected First Generation Coal Gasifiers. Mudge, L.K. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800065. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$10,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the study are: (1) to determine if environmental control technologies in commercial use with Koppers--Totzek (K--T) and Winkler gasifiers are adequate relative to emission standards; (2) to identify areas where improved control technologies are needed; and (3) to rank research and development programs in terms of their potential benefits. Efforts for FY 1978 are directed toward revision of the draft report to include discussion about the applicability of control technologies to the Texaco and pressurized Koppers--Totzek processses.
Keywords: pollution control; technology assessment; air pollution; coal gasification; koppers-totzek process; winkler process; sng processes; sulfur oxides; removal; desulfurization; waste management; nitrogen oxides; sulfates; nitrates; hydrocarbons; aerosols; waste water; air quality; water quality.

100070 Compressed Air Energy Storage Environmental Control Technology Concerns. Craig. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800246. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$25,000.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Compressed air energy storage systems (CAES) include large underground caverns that are subjected to pressure, temperature and humidity fluctuations and result in a number of environmental concerns. The technical aspects of these concerns range from effects on geology and ecology during the development state, to leakage and cavern collapse during operation. Additional concerns include effects on water bearing formations, subsurface geology, irreversible commitment of resources, and effects of operation. Conceptual development of CAES technology and initial studies of environmental concerns have now progressed to a stage where feasibility for technology application appears quite favorable. DOE and EPRI are currently evaluating proposals for demonstrating CAES systems. Consequently, it is now important that a formal program plan for assessment of environmental issues be developed. The progam plan is needed to identify and set forth the slope of the environmental issues of concern and to initiate a definitive plan for meeting DOE protocol and directives. The program will provide assurance that environmental problems associated with CAES have been addressed, discussed, and can be solved.
Keywords: compressed air energy storage; pollution control equipment; compressed air energy storage equipment; technology assessment; compressed gases; underground storage; geology; ecology; environmental impacts; cavities.

100071 Integrated LNG Safety and Control Program. Hall, R.J. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 800156. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$300,000.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this program is to develop in a timely manner the liquefied natural gas (LNG) safety and control information needed by industry, regulatory agencies and the general public in making LNG decisions. The work will involve both experimental and analytical studies directed at development of a sound information base germane to LNG release prevention, and understanding and control of vapor generation and dispersion, fire and explosion phenomena.
Keywords: liquefied natural gas; safety; information needs; materials handling; lng industry.

100072 Decommissioning of Retired Hanford Facilities. King, R.R. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 800271. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$245,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Technology applicable to the Hanford decommissioning effort is being developed. Concrete surface removal techniques are being evaluated. Water cannon and rock splitter techniques are shown to be effective and potentially useful concrete decontamination methods. A program is underway to investigate the properties of concrete which are important to understanding contamination mechanisms and to design high integrity containment structures. A biobarrier (rock, gravel, sand, topsoil) technique is being evaluated as a potentially useful method of preventing plant and animal penetration of contaminated burial grounds. A prototype field instrument is being developed for measuring low levels of residual transuranic activity in structural materials and soils.
Keywords: nuclear facilities; decommissioning; concretes; decontamination; hapo.

100073 Environmental and Fire Hazards of Materials Used in Solar Heating and Cooling Systems. Searcy, J.Q. (Sandia Labs., Albuquerque, NM). **Project number:** 800171. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$118,000.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary purpose of this project is to compile a list of solar heating and cooling (SHAC) materials (working fluids, storage media, insulations, and other materials) and to examine them from the viewpoints of toxicity, fire safety, economics, and engineering properties. Included in the list will be commonly used materials with similar properties for comparison. This list is to be suitable for distribution to the public and is envisioned to be used by the homeowner as a guide for selecting, using, and disposing of SHAC materials. A complete literature and manufacturer survey or a preliminary chemical analysis as last resort will be made to determine the composition of the working fluids, storage media, and solid materials. Discretion will be exercised in selecting the detail of the analysis for each candidate materials. Those not immediately found to be of minimal environmental consequence will be investigated further in Phase II. The data compiled in FY 77 will be presented in a written report to DOE for issue to the general public. The language used in the report will be understandable to the average homeowner. Those materials for which insufficient composition and toxicity data is available will be studied further by experimental means.
Keywords: solar heating systems; solar cooling systems; working fluids; thermal energy storage equipment; thermal insulation; toxicity; fire hazards; economics; environmental impacts; safety.

100074 Assessment of the Radiological Impact of Western Coal Utilization. (Mound Laboratory, Miamisburg, OH). **Project number:** 800118. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$59,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Administration's desire to reduce our dependency upon imported fossil fuels, as well as other factors, is moving the United States toward an economy based on coal as the primary fossil fuel. Government agencies, environmentalists, and scientists have become increasingly concerned with potential problems associated with large additions of trace elements to the environment from utilization of fossil fuels. In particular, the particles released to the atmosphere have relatively greater concentrations of certain trace elements than the feed coal or the collected fly ash. Western coal is also known to contain uranium and its decay products at much greater concentrations than most eastern coals. Uranium is found chiefly in low-rank and impure coal, including lignite, subbituminous coal and carbonaceous shale of the Northern Great Plains and Rocky Mountain regions.
Keywords: coal; radioactive effluents; coal industry; western region; environmental impacts; decision making; environmental policy; energy policy; fossil-fuel power plants; flue gas; combustion products; chemical composition; radioactivity; radiation monitoring; air quality.

100075 Scale Model Experiments for Environmental and Safety Control Assessments of Energy Material Shipping Container Systems. Robins, R.A. (Battelle Columbus Labs., 505 King Ave., Columbus, OH, 43201). **Project number:** 800045. **Supported by:** Department of

Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$386,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The scope of work covered in this program is the development of experimental data and analysis of the structural response of spent fuel and high-level waste transportation systems to assess the effects of accident environments on safety and potential environmental consequences. The approach used in this program is to conduct a few carefully selected experiments for specified container accident conditions, and simulated environments. The containers used in the current experiments are replica scale models of typical spent fuel and high-level waste shipping casks. These experiments are being closely coordinated with LASL to provide the most relevant baseline data for subsequent correlation of the computer codes being developed there.
Keywords: spent fuels; high-level radioactive wastes; transportation systems; accidents; safety; environmental impacts; casks.

100076 Environmental Control Technology Requirements in Solid Waste Processing. Young, J.C. (Ames Laboratory, Ames, IA). **Project number:** 800121. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$120,000.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this project is to identify obvious and potential water use and water pollution problems at facilities designed and operated to process municipal solid wastes for the purpose of energy or resource recovery, to characterize the treatability of these wastewaters, and to identify available methods and their adequacy for treating these wastewaters. The overall objective is to assess the adequacy of environmental controls for meeting existing and projected water pollution control requirements.
Keywords: municipal wastes; solid wastes; water requirements; water pollution; water treatment plants; environmental impacts; energy conservation; water pollution control; technology assessment.

100077 Improved Water Management of Coal Conversion Processes. Parsons, W.A. (Arthur G. McKee and Company, 6200 Oak Tree Blvd., Cleveland, OH, 44131). **Project number:** 800161. **Contract:** EE-77-C-02-4375. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$179,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the study is the evaluation of the technical and economic feasibility of controlled two-stage quenching of coal conversion retort gases as a means of enabling improved water management of coal conversion processes. The study compares the technical and economic practicality of two-stage gas quenching with single stage gas quenching for a fixed bed gasifier plant. Engineering concepts of water management systems for the alternatives are compared. Cost estimates enable the assessment of the practicality of the alternatives. The results indicate that strong electrolytes in the retort gases will be absorbed to a high degree in a controlled primary quench sufficient to condense 5 percent of the total gas moisture. The separation of strong electrolytes in such a low-volume purge will improve the quality of secondary condensates so as to facilitate their reuse in the process.
Keywords: coal gasification; lurgi process; water requirements; quenching; fuel gas; ammonium chlorides; removal; cleaning; purification; water pollution control; feasibility studies; water; recycling.

100078 LNG-Scale Effects in LNG Hazard Analysis and Testing. Fay, J.A. (Massachusetts Institute of Technology, Mechanical Engineering Department, Cambridge, MA, 02139). **Project number:** 800188. **Contract:** EE-77-S-02-4204. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$70,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A program is being conducted to develop an analytical framework for use in deciding what measurements ought to be made to answer key questions in LNG spill events with respect to various hazards. The spill volume is considered the major variable in defining the size of a spill. Other physical properties are considered parameters which affect the extent of the hazard but which need not necessarily be taken into account explicitly in determining the effects of scale. Preliminary results for unconfined water spills, unconfined land spills, and confined land spills of LNG show that thermal radiation intensity and vapor concentration vary nearly in proportion to the spill volume, but that the time scale on which the spill events proceed increases only slightly with spill size. It is recommended that a range of wind speeds and atmospheric stabilities be studied independently of spill volume in whatever field tests are undertaken.
Keywords: liquefied natural gas; gas spills; hazards; research programs; size; water; vapors; volume; wind; velocity.

100079 LPG (Liquefied Petroleum Gas) Boiling Rates on Water. Reid, R.C. (Massachusetts Institute of Technology, Chemical Engineering Department, Cambridge, MA; 02139). **Project number:** 800225. **Contract:** EE-77-S-02-4548. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A program is reported to measure liquified petroleum gases (LPG) boiling rates, measure vapor fractionation occurring, and compare the results with theory. Laboratory-scale experiments are conducted and analytical models are developed to compare with present theory. The experimental program is continuing.
Keywords: liquefied petroleum gases; boiling; vapors; fractionation; bench-scale experiments; water; time dependence.

100080 Oil Assessment of Environmental Control Technology Aspects of EOR Wastewater Cleanup. Thompson, R. (Tulsa University, Chemical Engineering Department, Tulsa, OK, 74104). **Project number:** 800229. **Contract:** EE-77-S-05-5596. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$35,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to assess the efficacy and practicability of membrane processes for treatment of wastewaters produced by tertiary oil recovery techniques. An experimental study will determine the effectiveness of membrane ultrafiltration process in the concentration and removal of sulfonates and crude oil from EOR wastewaters. Information will permit operating and capital costs for full-sized units to be estimated. Environmental effectiveness of these techniques will be assessed.
Keywords: waste water; membranes; water pollution; water; enhanced recovery; petroleum; ultrafiltration; purification; water treatment; sulfonates; removal.

100081 Evaluation of the Effect of Coal Cleaning on Fugitive Elements. Boyer, J.F. Jr. (Bituminous Coal Research, Inc., 350 Hochberg Road, Monroeville, PA, 15146). **Project number:** 800236. **Contract:** EE-77-S-02-4427. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$183,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to prepare a state-of-the-art report on the effects of coal mining, preparation, transportation, and utilization on trace elements found in coal; (2) to determine the effect of conventional and non-conventional coal cleaning on fugitive elements by cleaning twenty coals under controlled laboratory conditions, analyzing the fractions obtained thereby, and evaluating the effect of such cleaning on the distribution in various fractions of the fugitive elements and on the removal of these constituents from the coal; and (3) to provide a description of accurate analytical methods used and developed on this project for use by coal industry and commercial laboratories for determining the concentrations of selected trace elements in coal. As of this date, thirteen of the proposed twenty coals have been obtained. Cleaning of ten, analysis of seven, and evaluation of the data from cleaning four of them has been completed. Thus far, effective removal of many of those constituents of coal which might cause problems with their release to the environment has been demonstrated.
Keywords: coal; washing; elements; trace amounts; chemical analysis; quantity ratio; feasibility studies; coal preparation; chemical composition.

100082 Treatment of Coal Liquefaction Process Wastewater. Haynes, W.P. (Pittsburgh Energy Technology Center, 4800 Forbes Avenue, Pittsburgh, PA, 15213). **Project number:** 800238. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$200,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are: (1) to develop an integrated treatment process through bench scale treatability of PDU and pilot plant waters from coal gasification that could be used commercially to treat plant waters for reuse or discharge; (2) to test various wastewater treatment unit operations; and (3) to provide data that can be used for design of demonstration or commercial coal gasification wastewater treatment processes.
Keywords: coal gasification plants; waste water; water treatment; demonstration plants; water treatment plants; design; bench-scale experiments; synthane process; water pollution control; solvent extraction; adsorption; evaporation.

100083 LNG-Design for Medium Scale LNG Spill Tests. (Holmes and Narver, Orange, CA, 92666). **Project number:** 800265. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$153,000.

Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A program is described devoted to development of a conceptual design for medium-scale LNG spill tests to be conducted at either NWC, China Lake, or NRDS at NTS. Organizations at these sites will provide general plans, cost and time schedules. The availability of existing equipment, water, etc. are to be evaluated along with topography and meteorology aspects. Complete conceptual design is scheduled for October 1977. Final design is scheduled to begin in December 1977.

Keywords: liquefied natural gas; gas spills; demonstration programs; research programs; hazards; meteorology; topography; testing.

100084 Environmental Control Technology Requirements for Future AC, High-Voltage Overhead Facilities. Scott; Walton, B.L. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** 800189. **Contract:** EY-76-C-03-0115. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$66,000. **Related energy source:** general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The main objective of this program is to provide the Division of Environmental Control Technology of DOE with an overview of current understanding about environmental impacts of high-voltage transmission lines by assessing testimony recently submitted for licensing a 765-kV line in New York. A multidisciplinary team was employed to review the recent testimony and to recommend research on environmental impacts and environmental control technology where appropriate. The draft final report was completed in June 1978. The testimony indicates potential impacts from the audible noise and from the electrostatic shocks that people can receive when they touch a large vehicle parked under the lines. The testimony also indicates that certain cardiac pacemaker and lead combinations may under special circumstances undergo reversion to a fixed rate of pacing in the presence of the fields under the lines, but that little risk to cardiac patients results except possibly for those patients for whom competition between the heart's own rate and the pacemaker rate presents a health risk. The testimony fails to demonstrate biological hazard from the fields. Further research is necessary to understand the effects of the fields on biological systems. The testimony indicates that ozone produced by the lines will not significantly affect the environment.

Keywords: new york; ehv ac systems; power transmission lines; environmental effects; noise; electromagnetic fields; health hazards; ozone; cardiac pacemakers; overhead power transmission.

100085 Assessment of Environmental Control Technology for Solar-Derived Fuels. Austin, T.A. (Ames Laboratory, Ames, IA). **Project number:** 800200. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$87,000.

Related energy source: solar(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this project is to identify the obvious and potential environmental impacts associated with using solar derived materials for energy production (biomass conversion processes). Conversion of animal manure to methane gas; crop residues to gas, ammonia or liquid fuels; production of trees or marine crops for energy production; and processing of sawmill waste into fuels are examples of technologies now being developed for conversion of solar derived materials to fuels for energy. This project is designed to provide ECT of ERDA with sufficient background on the state-of-the-art of these new technologies, to document their obvious and potential environmental impacts and to assess environmental control technologies. The impacts include air pollution, water pollution and land impacts resulting from both the dispersal of residues remaining after processing and the utilization of the derived fuel. The conversion processes (anaerobic digestion, direct burning, fermentation, and pyrolysis), the disposal of any waste residuals, and environmental impact and required control technologies for the derived fuels will also be investigated. Phase 1 will assess the processes and their potential for immediate (within the next 5 years), intermediate (5 to 10 years) and long range (10 to 20 years) application. Phase 1 will provide the state-of-the-art of the technologies involved so that preliminary priorities can be established. A general planning document will be completed in phase 2. This document will identify those technologies that have immediate application and the associated known environmental impacts. A priority listing of study needs for assessing potential environmental impacts will be developed in the planning document. During phase 3 waste stream characterizations and assessments for the key biomass conversion processes will be conducted where data are inadequate. These data will permit a refinement of environmental impact assessment mode during phases 1 and 2 and will help establish more reasonable priority rankings.

Keywords: manures; crops; residues; biomass; environmental impacts; wood wastes; air pollution; water pollution; conversion; waste disposal; planning; information needs; synthetic fuels; trees; anaerobic digestion; combustion; fermentation; pyrolysis.

100086 Assessment of Environmental Control Industry: Waste Treatment Technology. Gasperino. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800247. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$30,000. **Related energy source:** conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Water Pollution Control Act Amendments (PL92-500) require substantial treatment of industrial wastes. Most waste treatment processes to date have been developed with little regard to energy usage. PNL proposes to develop a program to assess the possibilities of energy conserving industrial waste treatment processes and to look at environmental control from a total energy utilization systems concept. This program would provide an overview of DOE work in this area and develop a center of excellence available to DOE for such matters as pollution abatement, regulation interpretation, and appraisal of other government agency's programs. Additionally, the program will analyze what is currently happening in industrial pollution control and pinpoint key problem areas for detailed study.

Keywords: water pollution control; water treatment; waste water; pollution control equipment; energy consumption; waste management; information centers; pollution abatement; technology assessment; industrial wastes; energy conservation.

100087 LNG-Medium-Scale LNG Spill Tests. Lind, C.D. (U.S. Naval Weapons Center, China Lake, CA, 93555). **Project number:** 800220. **Supported by:** Fish and Wildlife Service, Kearneysville, WV (USA). **Funding:** DOE-$135,000.

Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A program is described devoted to determining the extent of hazard for 50 cubic m LNG released on water or land. Predictive models are utilized to determine extent of vapor cloud travel and radiation from fire, then tests are conducted and experimental results are compared with predictive models. Plans for instrumented field tests and medium-scale LNG tests are summarized.

Keywords: liquefied natural gas; gas spills; vapors; diffusion; transport; testing; motion; water; fire hazards.

100088 LPG Hazard Assessment. Welker, J.R. (Applied Technology Corp., P.O. Box FF, Norman, OK). **Project number:** 800224. **Contract:** EP-78-C-05-6020. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$10,000.

Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A program is reported to conduct a systematic examination of potential hazards in the production, storage, and distribution of LPG. For those hazards identified and analyzed, basic engineering data are to be developed for designing or evaluating existing hazard control systems for LPG.

Keywords: liquefied petroleum gases; production; storage; transport; safety engineering; research programs.

100089 Environmental Assessment for Gasifiers in Industry. (Oak Ridge National Laboratory, Central Management Office, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800300. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$250,000.

Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this program is to implement an environmental and health, monitoring and testing program at the University of Minnesota at Duluth Gasifier Project. Process streams and plant effluents will be characterized chemically and physically by on-line and in-plant sample collections, measurements, and monitoring. Data developed will be used to determine the efficiency, reliability, and maintenance requirements of environmental control equipment, and to assess and document the adequacy of health and safety controls incorporated into the process system.

Keywords: coal gasification; gaseous wastes; liquid wastes; solid wastes; chemical analysis; environmental effects; health hazards; air pollution control; water pollution control; sampling; monitoring; hydrocarbons; particles; emission.

100090 Evaluate Feasibility of Methods and Systems for Reducing LNG Tanker Fire Hazards. Allan, D.L. (Arhur D. Little, Inc., Cambridge, MA, 02403). **Project number:** 800228. **Contract:** EP-78-C-02-4734. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000; DOC-$63,000.

Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Details are given concerning a program to identify and evaluate methods and naval concepts for reducing LNG tanker fire hazards. The program includes analysis of the feasibility of methods for significantly reducing fire hazards caused by major LNG tanker

accidents. A literature search was completed and initial contacts were made with shipbuilders and government agencies. Analytical methods were developed to estimate changes in thermal hazards. **Keywords:** tanker ships; liquefied natural gas; accidents; gas spills; fire hazards; fire prevention.

100091 State-of-the-Art Review of State/Federal Environmental Requirements Concerning Electrical Effects of Overhead Transmission Lines. Shah, K.R. (Shah and Associates Incorporated, 467 N. Frederick Avenue, Gaithersburg, MD, 20760). **Project number:** 800296. **Contract:** EV-78-X-01-1802-0. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$10,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The subject program is comprised of two parts, a large effort pertaining to the assessment and control of potential pollutants from Brookhaven National Laboratory's (BNL) flash hydropyrolysis of coal process (FHP), and a smaller effort dealing with an analysis of means of controlling the concentration of atmospheric CO2. Emphasis is placed on the FHP because of its potential for producing liquid and gaseous fuels from coal. The portion of the program pertaining to CO2 will draw on information from other organizations concerning global CO2 concentrations and efforts while studies at BNL will concentrate on an assessment of the technology of environmental control of CO2 from the atmosphere and from energy-related industrial emissions.
Keywords: power systems; power transmission lines; environmental effects; reviews; regulations; overhead power transmission; air quality; noise pollution; safety.

100092 Study of Gelled LNG. Rudnicki, M.I. (Aerojet Energy Conversion Company, P.O. Box 13222, Sacramento, CA, 95813). **Project number:** 800311. **Contract:** EP-78-C-03-2057. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Details are given concerning a program to assess the technical and economic feasibility of decreasing the hazard of transporting, storing, and handling LNG to gelling it. The program includes preparation of LNG fuels; physical properties measurements; conducting preliminary safety tests; preparation of preliminary design of industrial scale gelation processes; and preparation of preliminary economic assessment of proposed industrial process. A final report is due April 1979.
Keywords: liquefied natural gas; transport; storage; gelation; safety; pollution control.

100093 Technical and Economic Assessment of Environmental Advantages Associated with Use of Battelle Treated Coal in Gasifiers. Feldmann, H.F. (Battelle-Columbus Laboratories, 505 King Avenue, Columbus, OH, 43201). **Project number:** 800312. **Contract:** W-7405-ENG-92. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$78,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this study is to evaluate the environmental and economic advantages of using coal treated by a proprietary process developed by Battelle as an environmentally acceptable feedstock for commercially available industrial gasification systems. This process involves chemically incorporating Ca++ ions into the coal by contact with a CaO slurry in an autoclave. The use of Battelle Treated Coal (BTC) as a gasification feedstock is intended to capture sulfur in the feed coal with the chemically incorporated calcium to produce a low-sulfur fuel gas. The energy market of primary interest to BTC application is the industrial market. It is assumed that this user is currently using natural gas which will be curtailed. The economic evaluation will show which of the following alternatives available to industrial users of natural gas are most viable: (1) coal-fired boiler with particulate removal and flue-gas desulfurization; (2) coal gasifier and gas-fired boiler with particulate removal and flue-gas desulfurization; (3) coal gasifier with hydrogen sulfide and particulate removal and gas-fired boiler; and (4) coal gasifier using BTC with particulate removal and gas-fired boiler. The technical and environmental evaluation of BTC utilization will be carried out through an experimental program designed to compare the performance of BTC and untreated coal with respect to sulfur content of product gas and environmental effect of sulfur captured in the ash. The scope of the planned technical effort covers preparation of BTC's under various treatment conditions and laboratory-scale gasification studies to simulate a fixed-bed gasifier, a fluidized-bed gasifier, and an entrained-bed gasifier operation. Thus, the technical effort is being directed to demonstrate the usefulness of BTC for wide industrial applications.
Keywords: coal gasification plants; air pollution control; coal preparation; battelle hydrothermal coal process; fossil-fuel power plants; flue gas; desulfurization; particles; removal; fuel gas; hydrogen sulfides; environmental effects; economics; comparative evaluations.

100094 Feasibility Analysis and Testing of Chemical Recovery from Coal Conversion Plant Waste Streams. Heist, J.A. (Concentration Specialists, Inc., 204 Andover Street, Andover, MA, 01810). **Project number:** 800349. **Contract:** EP-78-C-02-4943. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$35,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The first (funded) phase of this program will investigate the economics of several advanced waste treatment concepts to the conventional precipitation and biological oxidation techniques. The latter will be considered a base case. The alternative methods being considered are reverse osmosis, ultrafiltration, and freeze crystallization. These processes will be evaluated for concentrating liquid wastes into a minimal volume (for injection back into the coal conversion reaction train, etc.) or for by-product recovery by direct fractionation of the wastes into the components. The method used to compare the advanced concepts consists of sequentially performing the individual tasks: characterization, process performance prediction, treatment system preliminary designs, and economic evaluation of alternatives.
Keywords: coal liquefaction plants; coal gasification plants; waste water; waste processing; economics; ultrafiltration; osmosis; crystallization; feasibility studies; performance testing.

100095 LPG (Liquefied Petroleum Gas) Research Assessment. Patrick, M. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 800350. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$40,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

DOE has requested this as one part of an overall DOE program on safety and environmental control aspects of liquefied fuels. DOE's purpose for this program is to examine the safety and environmental control issues relating to the use of liquefied fuels such as LNG, LPG, H2, NH3 and alcohol. An assessment is needed which identifies current status of, and needed additional research, development and demonstration (RD and D) work (if any) for, safety and environmental control in processing, storing, transferring and transporting liquefied petroleum gas (LPG) in the United States. Concerns have been expressed by DOE and a part of the Congress on the adequacy of safety and environmental control provisions and regulations applicable to LPG. One need in responding to this concern is to examine the technological bases for such provisions and regulations and determine what, if anything, should be done to assure industry, government and public of the soundness and adequacy of these bases. This work will include identifying the overall scope of the LPG industry, both existing and anticipated, from production to utilization. Past and current RD and D work on LPG properties, release prevention and control, vapor generation and dispersion, fires and explosions will be identified and assessed. The process of assessing the RD and D and identifying any needed additional work is expected to involve the participation of national level experts from academia, R and D organizations, industry and government.
Keywords: liquefied natural gas; liquefied petroleum gases; ammonia; alcohols; transport; safety; environmental policy; chemical properties; physical properties; technology assessment.

100096 Burning of Oil Spills. Thompson, J.F. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 800351. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Studies involve the technical feasibility and state-of-the-art of using combustion as a countermeasure to minimize oil pollution from vessels in situ, on the water surface, and from oil soaked debris.
Keywords: oil spills; water pollution; combustion; feasibility studies; water pollution abatement.

100097 Assessment and Control of Water Contamination: Oil Shale Extraction and Processing. Wewerka, E.M. (Los Alamos Scientific Laboratory, MS 734, Los Alamos, NM, 87545). **Project number:** 800356. **Supported by:** Forest Service, Portland, OR (USA). Pacific Northwest Forest and Range Experiment Station. **Funding:** DOE-$70,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

A research program is announced to assess the nature and magnitude of water contamination resulting from the major surface and in situ shale oil extraction methods, and to identify technology suitable for controlling water pollution from these sources. Full use will be made of existing knowledge and information concerning

contamination of waters associated with oil shales, shale oil and wastes. Experimental work will be conducted where necessary to generate additional information to support a thorough assessment of control technology needs and options.
Keywords: oil shales; in-situ processing; water pollution control; evaluation; technology assessment; water pollution.

100098 Assessment of the Radiological Impact of Coal Utilization. Wewerka, E.M. (Los Alamos Scientific Laboratory, CMB8, MS 734, Los Alamos, NM, 87545). **Project number:** 800360. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$35,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The purposes of this work are to identify potential environmental and health hazards that may result from low-level releases of radioactive substances during the mining, processing, and combustion of coal and to define environmental control technologies where appropriate. Three main tasks comprise the experimental parts of this program. The first task includes measurements of the radionuclide concentrations in various coals, coal wastes and ashes and the determination of the distribution of radionuclides in the various sectors of the coal utilization cycle. High sulfur coals and areas where little information about radionuclide composition or releases now exists (such as coal refuse dumps, coal storage areas and ash dumps) are being emphasized. The second task involves the use of laboratory and field experiments to define the nature and magnitude of the radionuclide releases from coal mines, storage areas, refuse dumps and ash disposal sites. This will be done by means of laboratory leaching experiments involving various coal and waste samples collected from the field and by conducting radon release measurements at various disposal sites. The third part of the program, that of the environmental controls development, will be done in tandem with the first two tasks. As soon as environmentally troublesome areas appear as a result of the distribution and release studies, assessment studies of appropriate environmental control technologies will be started.
Keywords: coal industry; low-level radioactive wastes; health hazards; environmental impacts; radiation monitoring; wastes; leaching; leachates; chemical composition; pollution control.

100099 Dry/Wet Cooling Towers. Johnson. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800232. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of DOE's dry cooling tower (DCT) program is to develop (in conjunction with utilities and the cooling tower industry) dry cooling tower systems and dry/wet systems that can be applied to conserve water resources, increase power plant siting flexibility, and give efficient power plant performance over a year's cycle. At costs (capital and operating) substantially below system presently available from manufacturers. The focus of PNL's task within the DOE program is to move forward the development and demonstration of heat rejection technology. The aim is that tested technology will be gathered and disseminated to potential users with the end result that waste heat rejection methods will be adopted that: (1) are low in consumptive use of waters; (2) do not thermally burden the aquatic biosphere; (3) are lower in initial and operating costs than present systems; (4) have low maintenance and operating costs; (5) are societally acceptable; and (6) can be integrated into an energy conservative (efficient) generating system.
Keywords: thermal power plants; cooling towers; performance; cost; technology assessment; socio-economic factors.

100100 Removal of NOx and SO2 from Flue Gas Through Electron Beam Irradiation. DeHaas, E. (Research-Cottrell Co., Inc., Bound Brook, NJ). **Project number:** 800239. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$20,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this study is to assess the technical, economical, and environmental aspects of a novel concept for controlling NOx and SO2 emissions from flue gases via electron beam irradiation. The candidate process possesses several potential advantages over conventional flue gas scrubbing operations: (1) NOx and SO2 emission are reduced simultaneously; (2) the process is dry which enhances reliability and facilitates disposal of solid wastes, which for process, possesses some fertilizer value; and (3) the process configuration lends itself to retrofit application. The project is divided into five subtasks: (1) literature review of irradiation of SO2 and NOx system; (2) development of reaction model for process to include effects of irradiation, operation conditions, and flue gas composition; (3) bench scale experiments with dc electron beam; (4) bench scale experiments with pulsed electron beam; and (5) engineering evaluation of process for development. Subtasks 1 and 2 are required to establish a reliable model to be used for detailed evaluation of experimental results and to establish a means for scaling process to layer sizes. Subtasks 3 and 4 involve experimental evaluation of the process using two types of electron beams. Each task evaluation will include effects of temperature, gas composition, dosage and dose rate, and reaction products.
Keywords: nitrogen oxides; sulfur dioxide; flue gas; denitrification; desulfurization; irradiation; electron beams; air pollution control; pollution control equipment; thermal power plants; feasibility studies.

100101 Environmental Control Technology in In Situ Oil Shale. Moody, M. (Lawrence Livermore Laboratory, Livermore, CA, 94550). **Project number:** 800316. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE-$40,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

Retort integrity is critical for worker safety during the retorting operation and for long term subsidence control of abandoned retort areas. The short term problem of roof collapse during underground retorting will be studied with a subsidence computer model and field instrumentation at the Colorado Lease Tract CA during the modular development phase. The long term solution to retort integrity and subsidence is to develop some method of grouting to reduce the void volume of the old retorts and increase the strength of the residual spent shale. Methods of grouting with optimum slurries made from surface spent shale will be examined in the laboratory and the field to determine the effectiveness of grouting to increase strength and reduce void volume.
Keywords: oil shales; in-situ retorting; ground subsidence; strata control; computer calculations; mathematical models; grouting; rio blanco oil shale project; spent shales; slurries.

100102 Aerial Measuring System (AMS). Doyle, J.F. (EG and G Idaho, Inc., Idaho Falls, ID). **Project number:** 600001. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The AMS operation provides both an airborne radiological monitoring system capability for emergency response to a nuclear accident and an aerial remote sensing and ground correlation program. The 24-hour-a-day nuclear emergency capability is operational out of both a western and eastern base, using two fixed wing survey aircraft continuously and partial annual use of helicopters. The aerial remote sensing/ground correlation provides data on: (1) naturally occurring radiation in the environment; (2) radiation contamination whose type and amount are influenced by man-made activities; and (3) measurements of geological, hydrological, and ecological features. The Aerial Measurement System (AMS) Program is divided into two segments. The operations activity includes the actual carrying out of the aerial monitoring mission. The technical support segment provides the technical and scientific backup, including instrumentation and data analysis.
Keywords: radiation monitors; radiation monitoring; aerial monitoring.

100103 Three Mile Island Accident. Williams, R. (Washington Univ., St. Louis, MO). **Project number:** 600257. **Supported by:** Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective of the program is to prepare documentation on the DOE participation in the Three Mile Island accident.
Keywords: three mile island-2 reactor; reactor accidents; reactor safety; us doe; documentation.

104000 Water Resources Council. Project number: 006931. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$848,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

Three regional water assessments for coal and oil shale technologies are being conducted in the Upper Colorado, the Missouri River and the Ohio River Basins. Draft reports are due in the Fall of 1978. Additional water assessments will be initiated in 1978 for priority regions in the country to examine all energy technology types and resource development. A site-specific water assessment for the proposed low Btu coal gasification plant in Georgetown, Kentucky, is expected to be completed by mid 1978. Additional site-specific studies in Illinois and Ohio may also be undertaken in 1978. Draft Technical Guidelines for conducting Sections 13(a), (b), and (c) water assessments were developed and are expected to undergo interagency-WRC review by September 1978. A trial application of these guidelines to selected parts of Appalachia was completed in 1978. Methodology for determining in-stream flow requirements was completed in 1978. Application of this methodology to assessments

of water availability in various regions is in progress in, for example, Upper Colorado River Basin. This methodology may be broadened to apply to lakes and reservoirs. Feasibility of using UPGRADE system for water quality assessments for regional and site-specific situations was examined in 1978. During 1978, additional capabilities will be added to UPGRADE for assessing water quality by incorporating information on groundwater and energy-specific pollutant data. Studies (by Interstate Conference on Water Problems) were initiated to define water issues requiring assessments, as perceived by 13 representative western and eastern states, taking into account institutional, legal, and other factors.
Keywords: energy source development; water requirements; coal industry; oil shale industry; coal gasification plants; water quality; water resources; surface waters; ground water; sewage; fresh water; liquid wastes.

104001 Regional Assessments Activity. Ballou, S. (Argonne National Laboratory, 9700 South Cass Avenue (EIS-T-11 No. 5), Argonne, IL, 60439). **Project number:** 001345. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$100,000. **Related energy source:** Coal(50); oil and gas(25); nuclear fission(25) **R and D categories:** Pollutant measurements technology.

The Great Lakes Regional Comparative Assessment focuses on the evaluation of existing and future environmental impacts associated with the present mix of power generating facilities and alternatives for future power production within the Great Lakes Drainage Basin (GLDB). Current efforts are aimed at the identification and assessment of the major biological and physical resources within the Lake Michigan watershed. Results of this pilot study provide a necessary information base for the GLDB assessment. In addition to identifying and assessing cumulative impacts of power production, the proposed study will address the compatibility of future power production with resource availability. Identification and evaluations of resource management and/or alternative technology options that mitigate undesirable consequences of power development will be accompanied by recommendations for priority research.
Keywords: great lakes; regional analysis; power plants; environmental impacts; decision making; resource conservation.

104002 Environmental Policy Analysis: Air Quality Issues That Affect DOE Programs. Goldsmith, B.J. (Environmental Research and Technology, Inc., 696 Virginia Road, Concord, MA, 01742). **Project number:** 007414. **Contract:** EE-77-C-01-6036. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$200,000.
Related energy source: Coal(90); conservation(10) **R and D categories:** Environmental effects assessment.

The Subcommittee on the Geochemical Environment in Relation to Health and Disease itself held no meetings during this period, but it sponsored a meeting on 16 January 1979. At that meeting, invited representatives from government agencies and industry-related associations met with subcommittee and staff members to discuss and determine whether a study on this subject would be appropriate and needed. There was a consensus that a panel study is needed to define these hazardous materials and to identify and differentiate those aspects, such as size of fibers, that will help set up standards of risk. Proposals were prepared and sent to USBM, USGS, DOE, NSF, and the Navy Department. Proposals to EPA and the health agencies are contemplated.
Keywords: environmental policy; air quality; experiment planning; health hazards; chemical effluents; biological effects; hazardous materials; coal.

104003 Policy Analysis: Air Quality. Leppert, G. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002962. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$210,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to provide DOE with analysis of the relationship among technical, environmental, health, economic and societal factors as they affect environmental regulations, energy and environmental policy and commercialization of developing energy systems. Specific studies on the implications of the Clean Air Act Amendments and subsequent regulations on energy production and development and conservaion technologies will be conducted, empasizing the areas of prevention of significant deterioration, nonattainment and new source performance standards, surface mining issues affecting coal utilization, and implications of atmospheric carbon dioxide accumulation.
Keywords: pollution regulations; energy policy; environmental policy; commercialization; technology utilization; socio-economic factors; clean air act; energy conservation; power generation; standards; surface mining; carbon dioxide; health hazards; coal; fossil-fuel power plants.

104004 Policy Studies: Radiation. Hessel, D.L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA; 99352). **Project number:** 002228. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$200,000.
Related energy source: Coal(25); nuclear fission(75) **R and D categories:** Environmental effects assessment.

The objective of this project is to analyze priority environmental policy issues relevant to development of energy technologies. Analysis will be conducted on brush-fire issues, as well as on issues of less immediacy. Specific studies will be conducted on transuranics in the environment, impact of regulations on DOE operations and the nuclear option, comparative risks of energy production technologies, and impacts of water pollution control laws and programs on energy development.
Keywords: energy source development; environmental impacts; environmental policy; economic impact; decision making; transuranium elements; environmental effects; pollution regulations; energy sources; risk assessment; water pollution control; nuclear energy; us doe.

104005 Studies and Environmental Policy Analysis: Water Quality and Quantity Issues that Affect DOE Programs. Fry, A. (Energy Resources Company, Cambridge, MA). **Project number:** 007435. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$260,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The policy analysis includes technical, economic, social, legal, and institutional analysis of environmental policy issues and standards for water quality.
Keywords: energy policy; environmental policy; technology assessment; economic impact; social impact; legal aspects; water quality; standards; water resources; water requirements; energy source development.

104006 Policy Studies: Wastes. Jacobs, D.G. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 002975. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$155,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The Policy Analysis Division assists the Assistant Secretary for Environment of DOE in evaluations of the environmental consequences of emerging policy decisions influencing national environmental and energy development goals. The Office of Environmental Policy Analysis was established at ORNL to coordinate the participation of staff members from programmatic research divisions and consultants from outside the laboratory in the analysis of environmental policy issues. Thus far, ORNL's policy analysis program has centered around hazardous waste and water availability policy issues. The objectives are: (1) to conduct or participate in environmental and energy related policy analysis studies; and (2) to assess the policy and institutional constraints of (a) the Resource Conservation and Recovery Act, with particular emphasis on energy and resource recovery and facility siting, (b) water availability, water quality, and other energy and natural resources, and (c) nuclear radiation issues, including radioactive waste. The approach taken will be: (1) to develop and apply national and regional analysis methodologies and techniques to assess the potential environmental, social, and economic effects of alternative energy technologies; (2) to collect data to assess the enery-related constraints to waste disposal, resource recovery, water use, and use of other energy and natural resources, and (3) to develop, maintain, and apply county-level data bases and analysis techniques to conduct scenario siting, and water analysis and related national assessments.
Keywords: government policies; environmental impacts; hazardous materials; waste management; water resources; socio-economic factors; energy source development; regional analysis; evaluation.

104007 Analysis of Critical Issues in the Siting of Coal-Fired Generating Facilities. Schroeder. (Armour, Schroeder, St. John and Wilcox, 440 Pacific Avenue, San Francisco, CA, 94133). **Project number:** 007788. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$74,000. **Related energy source:** general science(100) **R and D categories:** Environmental effects assessment.

The project is structured to address the policy implications of three broad developing trends in the energy facility siting process: (1) consolidation of government decisionmaking authority; (2) expanded opportunities for citizen participation; and (3) a more open planning process. Project structure is provided by a conceptual framework developed and presented in the interim publication identified below. The approach includes investigation of the influence of alternative regulatory institutional arrangements on siting decisions particularly in relation to the three trends. A detailed exploration of the obstacles implicit in administrative agencies' efforts to include energy considerations in their deliberations will also be performed.

Keywords: fossil-fuel power plants; site selection; government policies; environmental policy; public opinion; planning; decision making.

104008 Policy Studies: Toxics (2980). Zak, B.D. (Sandia Labs., Albuquerque, NM). **Project number:** 002980. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$100,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: government policies; environmental policy; toxic materials; health hazards.

104009 Regional Assessment Activities and Ecological Effects. Davis, D. (C615-574-5926, Oak Ridge, TN, 37830). **Project number:** 001684. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$782,000.
Related energy source: Coal(30); oil and gas(10); nuclear fission(30); solar(10); geothermal(10); conservation(10) **R and D categories:** Environmental effects assessment.

The principal objective of the regional studies program is to conduct regional integrated assessments designed to help balance social, economic, and environmental goals with energy development goals on a regional basis. ORNL focuses its activities on the southern region of the United States. A regional energy siting and assessment theme provides much of the integrated assessment program at ORNL. During FY77 substantial effort was directed to initiate the interlaboratory National Coal Utilization Assessment (NCUA). The NCUA will continue in FY78 and be completed in FY79. Related assessments for nuclear and other fuel technologies will be initiated. An outreach program has been initiated in the RSP aimed at increasing collaborative efforts with state and regional agencies, universities, and industry.
Keywords: environmental impacts; social impact; economic impact; regional analysis; site selection; energy source development.

104010 Regional Assessment Activities (1304). Meier, P. (Brookhaven National Laboratory, Upton, NY). **Project number:** 002967. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$411,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This project is in support of the EV/OTI Regional Assessment Division and provides detailed assessments and analyses of regional impacts of individual, and aggregations of, energy technologies and activities to determine land use, water use, socioeconomic, and residual management impacts of departmental policies and programs. The project pays particular attention to interrelationships between the natural and developed attributes of the northeast, examining physical, environmental, and human resource constraints to technology assimilation. The project has the following three major activities: (1) Regional Characterization Subtask; (2) Issue Identification Subtask; and (3) Mitigation Strategies Subtask. Subtask I provides the basic data and information upon which all other activities are based. It gathers, in a format consistent among laboratories, the geophysical, social, economic, ecologic, and cultural characteristics of the northeast as they currently exist. Subtask II is based upon the characterization of the northeast and the various future energy scenarios developed by the department and identifies, quantifies, and prioritizes the potential environmental and socioeconomic conflicts which may evolve if the energy strategies are implemented as planned. Subtask III develops and adapts various environmental planning techniques, such as facility siting procedures, which can aid in mitigating the conflicts identified by the foregoing subprogram. Results are published as guidelines which are distributed to regional decisionmakers.
Keywords: energy source development; environmental impacts; land use; water; socio-economic factors; management; government policies; decision making; regional analysis.

104011 National Environmental Assessments. Hamilton, L.D. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 002223. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$170,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This program will provide the Department of Energy (DOE) with dissections of relationships among technical, environmental, health, economic, and societal factors as they affect environmental regulation, energy, and environmental R and D policy, or the commercialization of developed energy systems. The program entails longer-term policy analyses to diagnose incipient energy/environmental problems and short-term studies to meet policy-making needs in DOE. The DOE/Assistant Secretary for Environment (ASEV) environmental policy analysis program has identified two major tasks: Task 1 is a review and evaluation for identification of potential conflicts between energy development and environmental/use policies; Task 2 is the analysis of critical issues identified in Task 1 as assigned by ASEV/Office of Environmental Policy (OEP). This Schedule 189 covers Task 1. Revisions will be prepared as required to cover activities under Task 2.
Keywords: energy policy; environmental policy; decision making; technology assessment; environmental impacts; pollution regulations; energy; environment; energy source development; us doe; risk assessment.

104012 National Environmental Assessments. Lohrding, R. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** 002971. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$105,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Two tools have been developed for analyzing the environmental effects of the siting and operation of coal-fired electric power plants. These tools consist of computer codes which require development and application to policy issues. One code is a national linear programming model of coal supply and electricity generation; the other code is a model for simulating the plume from emissions of a coal-fired power plant. The visibility code requires development in the areas of color rendition, treatment of light scattering and the size distribution input. The coal model requires development in the areas of environmental constraints (visibility), electricity generation technologies, data base verification and development, and aggregation of the regional basis of the model. This policy model should be used to examine some of the many ramifications of government policies. Part of this examination is validation of the model as a descriptive device. Of particular interest to western states is the effect that energy facility siting will have on rural economies, particularly as regards agriculture and the use of water in that industry. Current approaches to water use in agriculture and the question of energy development need to be reviewed and critiqued so that the appropriate policy questions can be raised. New computerized graphic displays will be developed to present the results of this and other policy models.
Keywords: fossil-fuel power plants; coal; site selection; operation; environmental impacts; plumes; simulation; government policies; air pollution; energy policy; environmental policy; rural areas; land use; industry; agriculture.

104013 Cooperative Program Between WRC and DOE to Initiate Achievement of the Objectives of Section 13. Fairchild, W.D. (Water Resources Council, U.S., Washington, DC). **Project number:** 007141. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$182,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The University National Oceanographic Laboratory System (UNOLS) office objectives are to create a mechanism for coordinated utilization and planning for oceanographic facilities through an association of academic institutions in a national system whereby institutions can work together and with funding agencies to assist in the effective use, assessment and planning for oceanographic facilities and to improve the level and stability of federal support for academic oceanography, thereby continuing and enhancing the excellance of this nation's oceanographic programs.
Keywords: us doe; oceanography; coordinated research programs; experiment planning.

104014 Regional Assessment Activities (1348). Hessel, D.L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002978. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$274,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Assessment activities under regional assessment are designed to identify and assess regionally-derived health, environmental, safety, and social issues related to national energy plans and to assist in the use of this information in helping establish DOE policies and programs. The program is designed to evaluate the potential consequences of application of a portfolio of energy technologies in a region. This portfolio and the conditions under which it is to operate are specified by DOE in a scenario as a representation of a national policy option. The intent is to examine a series of policies in sequence or in tandem. The results will be used as input to energy policy makers. Conduct of the program in the PNL is dependent upon the maintenance of a highly qualified staff of regional and technical experts and a detailed, up-to-date information bank. The information required includes environmental data, descriptions of actual and proposed developments, institutional structure, laws, and relevant public and private officials.
Keywords: regional analysis; health hazards; environmental impacts; safety; social impact; national energy plan; energy policy.

104015 Policy Studies: Uranium. (Sandia Labs., P.O. Box 5800, Albuquerque, NM, 89115). **Project number:** 002229. **Contract:** EY-76-

C-04-0789. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$100,000. **Related energy source:** nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to analyze the relationships among technical, environmental, health, economic, and societal factors and regulations as they affect energy research, development, and demonstration policy decisions or affect commercialization of developed energy systems. Specific studies on the environmental constraints to uranium supply and the impact of regulation of toxic substances on DOE programs and operations will be conducted.
Keywords: energy sources; decision making; uranium; environmental effects; nuclear fuels; toxicity; legal aspects; pollution laws; regulations; environment; socio-economic factors; research programs.

104016 Regional Assessment Activities. Lohrding, R. (Los Alamos Scientific Lab., S-2, MS 606, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 002227. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$362,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Specific studies on the availability of western water for energy, legal, and institutional barriers to water use for energy, consumptive use of water in energy production processes, and potential tradeoffs for water use between agriculture and energy are conducted.
Keywords: usa; water resources; availability; legal aspects; energy source development; agriculture; government policies; evaluation.

104017 Alternative Urban Strategies. Berman, S. (Lawrence Berkeley Laboratory, Berkeley, CA). **Project number:** 003211. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$25,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Small rural communities face distinctive problems in upgrading their municipal utility systems. There is a growing awareness that the scaling down of utility technologies developed for larger urban areas is not always an optimal solution for small communities. In this research project, we are examining the feasibility of using nonconventional technologies to provide small communities with potable water, hot water, space heating and cooling, electricity, and solid and liquid waste disposal. The nonconventional technologies range from conservation measures to decrease the demand or growth in demand for a service to appropriate/alternative technologies. Both the technical and the economic feasibility potential of these nonconventional technologies as a mitigation strategy for the specific utility problems of energy-impacted boom towns is also being examined. Specific areas of research include: development of criteria on which to base the selection of technologies; cataloging of those technologies which show the most technical potential; assessment of the socio-economic and environmental impacts associated with a particular technology; comparison with more conventional technologies; analysis of policy, administrative, and managerial implications of using a specific technology; development of an implementation plan for the most promising technologies; and development of criteria for evaluating a technology in place. In addition, coordination with other Federal agencies (EPA and Farmers Home Administration) whose responsibilities overlap with this research, as well as with a number of small communities, will be maintained.
Keywords: technology assessment; socio-economic factors; environmental impacts; management; communities; municipal wastes; waste disposal; hot water; electric power; drinking water; public utilities; urban areas.

104018 Regional Assessment Activities. Siri, W. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 001535. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$285,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to assess the economic, social, institutional, and environmental impacts on air, water and land resources of future energy development and use in California, Hawaii and Nevada. Each of three states are characterized for their current economic and environmental conditions as regards energy supply and use. Based on this characterization and the anticipated level of energy supply and use, regional energy issues are identified. Mitigating strategies to minimize the impact of these issues are then proposed.
Keywords: california; hawaii; nevada; energy source development; economics; socio-economic factors; environmental impacts; air quality; water quality; land pollution; monitoring.

104019 National Environmental Assessments. Leppert, G.; Hoover, L.J. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002230. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$80,000. **Related energy source:** Coal(90); conservation(10) **R and D categories:** Environmental effects assessment.

The objective is to provide DOE with identification and analysis of the impacts of environmental laws and regulations on energy systems and policies. Studies will be conducted on the impacts of the Clean Air Act Amendments and subsequent regulations on energy production, conversion, and conservation technologies, emphasizing regulations requiring prevention of significant deterioration of ambient air quality, new source performance standards and nonattainment of air quality standards.
Keywords: energy policy; regulations; clean air act; energy source development; energy conversion; energy conservation; air quality; standards; implementation; socio-economic factors.

104020 Integrated Assessment of Environmental Impacts. Holdren, J.P. (Lawrence Berkeley Laboratory, 100 T-4, Berkeley, CA, 94720). **Project number:** 003212. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$50,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives are to: (1) illuminate the problem of integrated assessment of environmental impacts by reviewing recent and ongoing work that bears on it in three areas of endeavor--environmental science, environmental economics, and impact assessment models and vehicles now in use by decision makers; (2) draw insights from this review that can advance the search for comparability among measures of impacts of different character; and (3) address the problem of appropriate regulatory strategy in the absence of comparability. The methods employed includes: (1) critical analysis of tools relevant to integrated assessment, and (2) critical analysis of ways available tools are being used by institutions engaged in environmental decision-making, specifically standard setting at the national level. Inputs include reports of the Risk/Impact Panel of CONAES, recent studies by the present investigators for CEQ and RFF, and the AEAR of ERDA/DOE. Four case studies in the role of integrated assessment in standard setting are underway--stationary-source air pollution, mobile-source air pollution, water pollution, and reclamation of strip-mined land. Early products will include summary papers on all issues and case studies listed above. Subsequent products (FY 1979) will include paper discussing ways to improve integrated assessment, with emphasis on incorporating trade-offs in environmental standards.
Keywords: environmental impacts; decision making; standards; mathematical models; air pollution; water pollution; land reclamation; surface mining; social impact; economic impact.

104021 Applications and Maintenance of Environmental Analysis System. Pikul, R. (Mitre Corp., McLean, VA). **Project number:** 007602. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$819,000. **Related energy source:** general science(100) **R and D categories:** Environmental effects assessment.
Keywords: environmental impacts; data compilation; data analysis; information systems; energy; environment.

104022 National Environmental Assessments. Parzyck, D. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002224. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$355,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The Office of Environmental Policy (OEP) has been established to maintain a continuous review of issues related to the health and environmental aspects of the nuclear fuel cycle and coal conversion technology, to perform brushfire analyses of specific topics upon request, and to undertake, through the use of best available personnel, analyses of critical environmental policy issues related to energy options. The staff, and consultants as required, articulates the health and environmental objectives to be obtained by policy decisions, collects and reviews pertinent regulations and policy statements, reviews alternatives, enumerates current legal and technical constraints, reviews pertinent analyses that have been completed or are underway by other groups, and prepares issue statements. The issue statements and subsequent analysis of these issues focus on further information that needs to be developed, resolutions and decisions that need to be made, and alternative strategies that might be followed by ERDA in the continuing development of sound policy. Critical issue areas include: (1) the criteria for management of residual radioactive wastes from inactive uranium milling sites and for decommissioning of other sites that have been used for nuclear activities; (2) health, safety, environmental, and institutional aspects of high-level and low-level radioactive wastes; (3) impact of water resources in the eastern United States on energy development; and (4) standards for carcinogens. The OEP is also charged with identification of environmental policy questions relating primarily to the

nuclear fuel cycle or to coal conversion technology, but also including other areas which appear to have national, regional, state, and local implications.
Keywords: environmental policy; national government; government policies; technology assessment; health hazards; fuel cycle; nuclear fuels; energy conversion; coal; energy policy; radioactive wastes; carcinogens; energy source development.

104023 Technology Assessments and EDP's. Hessel, D.L. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 001348. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$725,000.
Related energy source: Coal(80); oil and gas(10); oil shale(10) **R and D categories:** Environmental effects assessment.

The purpose of this program is to provide a multi-technology integrated assessment of the long-term environmental, socioeconomic and health implications of future energy-related developments in the region. PNL's region has been defined as the states of Alaska, Idaho, Oregon, and Washington. The impacts of one multi-technology scenario will be analyzed over the time horizon 1975 to 2020. To supplement the generalized multi-technology analysis there will be further analyses of specific import to the region.
Keywords: energy source development; risk assessment; environmental impacts; health hazards; social impact; economic impact; alaska; idaho; oregon; washington; regional analysis; oil shale industry; coal industry; technology assessment.

104024 Technology Assessments and EDP's. Lohrding, R. (Los Alamos Scientific Laboratory, Los Alamos, NM, 87545). **Project number:** 001536. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$498,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The Rocky Mountain regional studies program participates in assessments and analyses of the regional impacts of energy technologies. These studies consider the water use, land use, air quality, health, residual management, and socio-environmental impacts of energy development. Emphasis is on technology assessment and identification of major regional issues. The program results are intended to be useful to the DOE in fulfilling its NEP-related responsibilities to state and local institutions and to other federal agencies. LASL has been assigned several lead-laboratory responsibilities; these are the national assessment of solar energy, the regional energy/environment data source book, and the regional assessment of the NEP. Presently LASL also has responsibilities for completion of the Rocky Mountain region's national coal utilization assessment, an environmental assessment of the NEP, and input to environmental development plans.
Keywords: technology assessment; particles; aerosols; land use; air quality; health hazards; socio-economic factors; environmental impacts; energy source development; rocky mountain region; regional analysis; environment; water resources.

104025 Technology Assessments and EDP's. Anspaugh, L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** 002626. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$607,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The project objective is to provide assessments of environmental, economic, social, and health impacts of geothermal energy facilities. Methods are to accumulate data pertaining to high-priority sites and establish data base; conduct initial assessment to characterize potential problems; formulate development scenario as basis for specific assessments; examine regional-scale issues; determine options for resource development and effluent control; and disseminate results.
Keywords: geothermal energy; energy source development; environmental impacts; social impact; economic impact; health hazards; regional analysis.

104026 Technology Assessments and EDP's. Meier, P. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001304. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$844,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective of this program is the development, testing and application of data, models and assessment tools for regional energy planning. It is part of an integrated multi-laboratory effort aimed at critical energy planning problems requiring analysis at the regional (multi-state) scale. The primary outputs of the program are a series of policy analyses and set of evaluation tools that can be used by state, local and regional agencies as well as utilities and industrial groups with interests in energy-related planning. The Brookhaven National Laboratory (BNL) program is structured into three main components: (1) a program of regional liaison, emphasizing the establishment of an energy planning and analysis partnership with each of the states in the northeast; (2) a program of integrated regional assessments, addressing key regional energy issues with particular concern for environmental and health impacts and the analysis of complex trade-offs between environmental quality, economics, national security, social impacts, institutional questions and technical considerations; and (3) a program of special studies, addressing methodological and policy questions, and including technical support to other regional studies programs.
Keywords: regional analysis; energy models; data analysis; technology assessment; decision making; social impact; economic impact; energy policy; energy conservation; information systems.

104027 Technology Assessments and EDP's. Davis, R.M. (Oak Ridge National Laboratory, Building 4500-N, MS G-22, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002976. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$360,000.
Related energy source: Coal(30); oil and gas(10); nuclear fission(30); solar(10); geothermal(10); conservation(10) **R and D categories:** Environmental effects assessment.

The objectives are: (1) to conduct national and regional technology assessments of alternative energy technologies and energy fuel cycles; and (2) to perform lead laboratory assessment responsibilities for scenario disaggregation, siting, and water availability analysis. The methods used are to: (1) develop and apply national and regional analysis methodologies and techniques to assess the potential environmental, social, and economic effects of alternative energy technologies; (2) conduct assessments in concert with other participating national laboratories; and (3) develop, maintain, and apply county-level data bases and analysis techniques to conduct scenario, siting, and water analysis and assessments.
Keywords: technology assessment; regional analysis; usa; fuel cycle; water resources; availability; water requirements; national energy plan; energy; environmental impacts; social impact; economic impact; data.

104028 Technology Assessments and EDP's. Siri, W. (Lawrence Berkeley Lab., Bldg. 90, Rm. 3120, Berkeley, CA, 94720). **Project number:** 002691. **Contract:** W-4705-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$215,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to assess the economic, social and institutional impacts on water, land and air resources of coal supply and use in California, and to estimate economic impacts of coal supply rationally. The national energy supply scenario was disaggregated to California. Based on supply scenarios to the year 1990 we reviewed the impacts on regional resources. We are also estimating the capital and manpower requirements and secondary economic impacts of national energy supply to the year 2000.
Keywords: economic impact; social impact; california; water resources; coal; land requirements; air quality; manpower; coal industry.

104029 Technology Assessments and EDP's. Hoover, J. (Argonne National Laboratory, EES Division, Bldg. 12, 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 001351. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$865,000.
Related energy source: Coal(25); oil and gas(25); nuclear fission(15); nuclear fusion(10); solar(10); conservation(15) **R and D categories:** Environmental effects assessment.

The Integrated Technology Assessment program is to provide an identification and analysis of alternative energy options. Energy options under consideration include coal, oil and gas, nuclear, conservation, and solar. In analyzing these options, consideration is given to the possible health, environmental, social, and economic implications of meeting energy requirements by these options. The program will integrate impact information to assist in energy R and D planning, assessment, and policymaking. Program thrust can be divided into two areas: (1) evaluation of technologies and policies, and (2) support activities that lead to the identification of further issues to be considered in these evaluations or enhance the capability to conduct them. During FY 77 and FY 78, major accomplishments of the program were in three areas: (1) Regional Technology Impact Assessments--an assessment of impacts from increased coal use in the Midwest was completed, issues of interest to state and regional officials identified, and technical assistance provided; (2) R and D Planning and Decisionmaking--a major comparative assessment of fluidized-bed combustion versus burning low sulfur coal and use of scrubbers with high sulfur coal was conducted; and (3) Energy and Environmental Policymaking--an environmental analysis of the National Energy Plan and an evaluation of the implications of the BACT Policy effects on regional coal production and transportation patterns were conducted. A series of papers were written for Con-

gressional Hearings identifying the potential constraints to increased coal utilization.
Keywords: coal; petroleum; natural gas; nuclear power; solar energy; energy conservation; environmental impacts; socio-economic factors; health hazards; technology assessment; energy policy; site selection; energy source development; regional analysis.

104030 Studies and Analyses of Environmental Management Systems for Use in Assessing and Implementing DOE's Environmental Mission. (GCA Corp., Bedford, MA). **Project number:** 008050. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The contractor is expected to handle large amounts of computerized data and to be able to pull such information together from many varied sources and to utilize it in effective and efficient modes in order to develop summations, graphics, print-outs, and other perspectives which will be required. The data to be handled may include meteorological data, in connection with air diffusion studies; chemical and toxicological data, in connection with the responsibilities of the DOE under the Toxic Substances Control Act; and data on air quality and other topics as needs require. The emphasis will be on machine-processing and presentations, but based upon sound, up-front analytical work. The contractor will be expected, in addition, to maintain a familiarity with a variety of computerized models which will be invoked in the course of these analyses. In particular, the air dispersion models used by EPA are likely to be of special usefulness.
Keywords: environment; information systems; data analysis; data acquisition; toxicity; water pollution; air pollution; land pollution; meteorology; mathematical models; computers; data base management.

104031 Social and Economic Impact Studies. (Massachusetts Inst. of Technology, Cambridge, MA). **Project number:** 7258. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: energy; social impact; economic impact; socio-economic factors; environmental impacts.

104032 Analysis of Human Health Effects. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 0899. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: human populations; health hazards; government policies; energy source development; technology assessment.

104033 Preparation of FY 1977 Environmental Development Plans. Parker, A.J. (Mueller Associates, Inc., Baltimore, MD). **Project number:** 007473. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: environment; us doe; research programs; technology assessment; pollution abatement; planning.

104034 Technology Assessment Report. Gordon, T. (Futures Group, Glastonbury, CT). **Project number:** 008269. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: technology assessment; data analysis; planning; reviews.

104035 Fossil Energy Technical Support. Pikul. (Flow Resources Corp., San Rafael, CA). **Project number:** 008272. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental effects assessment.
Keywords: coal; petroleum; natural gas; oil shales; sulfur compounds; nitrogen compounds; carbon oxides; hydrocarbons; photochemical oxidants; particles; elements; trace amounts; pollution; technology assessment; fossil fuels.

104036 Fossil Energy Technical Support. Bierman. (Science Applications, Inc., La Jolla, CA). **Project number:** 008270. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental effects assessment.
Keywords: fossil fuels; technology assessment; coal; petroleum; natural gas; oil shales; sulfur compounds; nitrogen compounds; carbon oxides; hydrocarbons; photochemical oxidants; particles; elements; trace amounts; thermal effluents; solid wastes; pollution.

104037 Annual Update of EV Portion of the MHD-EDP. (Montana Energy and MHD R and D Inst., Inc., Butte, MT). **Project number:** 007701. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The work will result in the preparation of an environmental readiness document (ERD) for magnetohydrodynamic (MHD) technology. This document will be used as an assessment of the environmental readiness of the technology in the next phase of the acquisition process. The MHD ERD will evaluate the commercial readiness of the technology with respect to environmental issues. This effort will be made to identify potential environmental problems that may be encountered based upon current knowledge, proposed and possible new environmental regulations, and the uncertainties inherent in planned environmental research. The MHD ERD will assess: (1) the current state of knowledge about environmental concerns associated with the technology; (2) available control technology capability and costs; (3) current and proposed regulations which will effect commercialization of the technology; (4) areas of environmental concern for which available information is inadequate and further environmental research is necessary; and (5) any potential showstoppers, that is, detrimental impacts so severe and unavoidable as to halt development. The emphasis is on identification of areas of uncertainty or possible risk.
Keywords: mhd generators; mhd power plants; environmental impacts; commercialization; regulations; evaluation.

104038 Studies, Analyses, and Technical Support to EV Offices. Pikul, R. (Mitre Corp., McLean, VA). **Project number:** 007712. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: data analysis; risk assessment; technology assessment; environmental impacts; energy source development.

104039 Support for Producing Coal Extraction, Beneficiation, and Transportation EDP and Associated EDP Related Activities. (Hoffman-Muntner Corp., Silver Spring, MD). **Project number:** 007699. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.
Keywords: coal mining; coal preparation; coal; transport; data analysis; environmental effects.

104040 Studies and Reports in Support of EV Offices-NEPA (7384). Iura, T. (Aerospace Corp., McLean, VA). **Project number:** 007743. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: national environmental policy act; implementation; data acquisition; data base management; pollution control.

104041 Studies and Reports in Support of EV Offices (7693). Iura, T. (Aerospace Corp., Germantown, MD). **Project number:** 007771. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: environmental impacts; evaluation; environment; pollution.

104042 Nuclear Energy Technology Support. Thadani. (Teknekron, Inc., Berkeley, CA). **Project number:** 008271. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.
Keywords: reactor technology; nuclear energy; nuclear engineering.

104043 Environmental Impacts Analysis and Methodology Development Through Seas. (Mitre Corp., McLean, VA). **Project number:** 008099. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: medical applications(100) **R and D categories:** Environmental effects assessment.
Keywords: data analysis; technology assessment; data acquisition; seas; mathematical models; water pollution.

104044 Non-Federal Institutional Constraints. (Univ. of Tennessee, Knoxville, TN). **Project number:** 007891. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives are to construct a map of global temperature patterns during the period 6000 to 7000 B.P. from pollen data on

land and from marine plankton data in the oceans, and then, to calculate a globally-averaged estimate of the atmospheric temperature during this period. This information will supply a data base for checking model-simulations of future climates and will complement the work of the Climate Research Unit at Norwich, England, in time periods within the past 3000 years.
Keywords: earth atmosphere; ambient temperature; global aspects; paleontology; pollen; plankton; climates; mathematical models; forecasting; computerized simulation.

104045 Subjective Probabilities Development for Oil Shale Production and Environmental Control Processes. (Woodward-Clyde Consultants, Denver, CO). **Project number:** 008058. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental effects assessment.

The general purpose of this work is to assist Denver Research Institute and the U.S. Department of Energy in the development of subjective probability estimates on (1) levels of potential effluent discharges from oil shale production processes; and (2) efficiencies of pollution control equipment that may be used in various oil shale processes. These estimates may later be incorporated by DOE in a more comprehensive development of policy tools used in assessing impacts of environmental legislation upon energy and supply enhancement.
Keywords: oil shale industry; pollution; pollution control; environmental impacts; mathematical models.

104046 National Environmental Assessments. Siri, W. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 003241. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Damage to a living cell's genetic material invites several potentially harmful consequences including interruption of normal metabolic processes, induction of endogenous viruses, mutation, and cell death. To properly assess the biological consequences of environmental factors that promote lesions in DNA, it is essential to fully comprehend the interaction of DNA metabolic enzymes with damaged DNA templates. Our objective is to acquire an improved understanding of the biochemical events associated with DNA repair and other cellular responses to DNA damage. Part of our program takes advantage of the wealth of genetic information available with bacterial systems and focuses on in vivo studies of excision and postreplicational repair in strains deficient in various DNA metabolic enzymes. These experiments are complemented by in vitro studies in which a primarily biochemical approach is used as a monitor.
Keywords: environmental impacts; evaluation; genetic effects; viruses; mutations; dna; biological repair; biochemical reaction kinetics; enzymes; bacteria.

104047 NESS EIS/Environmental Assessment. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 003278. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

As requested by the Department of Energy, the work of the project consists of assessments of environmental and social impacts of energy policy initiatives during the development of National Energy Plan II and preparation for the production of a legislative environmental impact statement for NEP-II. This project is jointly supported by ASPE and ASEV.
Keywords: environmental impact statements; national energy plan; environmental policy; social impact; economic impact; environmental impacts; evaluation.

104048 National Environmental Assessment. Hessel, D. (Pacific Northwest Lab., Richland, WA, 99352). **Project number:** 003243. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The environmental impacts and information program element in DOE plans, manages, and participates in national environmental, safety, and health impacts assessments, integrated energy technology assessments, and maintenance and dissemination of information based on assessments. Activity at PNL is currently focused on the methods research and development subprogram. One current project concerns the development of a national interregional air residual transfer coefficient matrix. This is part of an effort in DOE to improve available environmental models. The second project addresses the development and application of methodologies for comparing risks to public safety from various energy technologies, both at the national and regional geographic levels.
Keywords: environmental impacts; safety; health hazards; energy source development; technology assessment; mathematical models; data acquisition.

104049 Studies and Reports in Support of EV Offices (7385). Iura, T. (Aerospace Corp., Germantown, MD). **Project number:** 007772. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: regional analysis; environment; energy source development; environmental impacts.

104050 Preliminary Research in Planning the Preparation of a Mitigation Fact Book. (Urban Systems Research and Engineering, Inc., Cambridge, MA). **Project number:** 008055. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: manuals; pollution abatement; pollution control; environment; us doe; planning; regional analysis.

104051 Support of Conference on Western Water Issues, 17--18 May 1979. (California Inst. of Technology, Pasadena, CA). **Project number:** 008118. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: water resources; meetings; western region; resource conservation.

104052 Policy Studies 2227. Lohrding, R. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 002972. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

There are seven principal sets of analyses included under this task; three are air-related issues and four are water-related issues. Under the category of air issues, three issue papers will be prepared: (1) discussion of the impacts and constraints associated with the emissions of oxides of nitrogen (NOx); (2) description of the influence of control devices on visibility impacts from coal burning power plants; and (3) discussion of the feasibility of conducting a cost-benefit study comparing alternative control strategies for protecting visual air quality due to impacts from coal fired power plants. Four principal sets of analyses are included under water-related issues: (1) evaluation of water use in the uranium mining and milling industry through a water management model used to estimate damages that may be associated with mine dewatering and to investigate probable effects of proposed legislation to limit dewatering; (2) identification and subsequent evaluation of water-related issues for emerging energy technologies including establishment of probable water demand and examination of possible impacts to the environment of potential waste streams; (3) assessment of long range transport problems in in-situ processing of both oil shale and coal with emphasis on developing measures of problem impacts for regions capable of supporting in-situ processing activities; and (4) assessment of inter-media environmental impacts to water supplies from increased energy development including air pollution and solid waste disposal impacts on watersheds and/or groundwater sources. Efforts will be directed to quantify these impacts and their subsequent damage, as well as to identify strategies available to control these impacts/damages.
Keywords: air pollution control; water pollution control; fossil-fuel power plants; feasibility studies; nitrogen oxides; coal industry; oil shale industry; environmental impacts.

104053 Studies, Analyses, and Technical Support to EV Offices. (Mitre Corp., McLean, VA). **Project number:** 008063. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(50); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: environmental policy; air pollution; land pollution; sulfur dioxide; nitrogen oxides; carbon dioxide; carbon monoxide; photochemical oxidants; aerosols; particles; radioisotopes.

104054 Studies and Reports in Support of EV Offices. Iura, T. (Aerospace Corp., Germantown, MD). **Project number:** 008223. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: socio-economic factors; energy source development; carbon dioxide.

104055 TSCA Issues Analysis and Report (Synfuels). (Human Resources Management Co., Washington, DC). **Project number:** 008260. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This is a DOE program for large scale development of liquid fuels from coal and shale. A report will be presented covering this analysis and recommendations provided.
Keywords: coal; oil shales; synthetic fuels; synthesis; energy source development; data analysis; government policies.

104056 Analysis of Impacts of State Environmental Laws, Regulations, and Permitting Procedures on DOE Emerging Technologies. (Booz, Allen and Hamilton, Inc., Bethesda, MD). **Project number:** 008060. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: state government; laws; environmental impacts; pollution regulations; licensing; environmental policy; energy policy.

104057 Synfuels Assessments. (SRI International, Menlo Park, CA). **Project number:** 008268. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: synthetic fuels; solid wastes; sulfur compounds; nitrogen compounds; hydrocarbons; oxidizers; particles; aerosols; government policies; evaluation.

104058 Surveillance Program and Integrated Issue Analysis. Wright, S. (Fred C. Hart Associates, Inc., New York, NY). **Project number:** 008062. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Fred C. Hart Associates will prepare a series of issue papers which will review and assess developments and energy-related issues pertaining to the combined regulation of water quality, air quality, and solid waste disposal. These papers will provide updates on the progress of programs being developed by the US EPA to implement the Resource Conservation and Recovery Act, the Toxics Substances Control Act, the Safe Drinking Water Act, and the Clean Air and Water Acts, as they affect DOE energy development programs. In particular, the cumulative effects of EPA's regulatory programs will be assessed and programmatic overlaps will be identified and evaluated. This project will review and make recommendations concerning future policy considerations, the focus of research and development efforts and the enhancement of DOE/EPA interaction in addressing the energy aspects of pollution control.
Keywords: us doe; energy source development; research programs; air pollution control; water pollution control; us epa; implementation; resource recovery acts; resource conservation; toxic materials; drinking water; legislation; clean air act; clean water act; air quality; water quality; waste disposal; pollution regulations; environmental policy; recommendations.

104059 Environmental Control Cost Estimate for Oil Shale Technologies. (Univ. of Denver, Denver, CO). **Project number:** 008046. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This task will estimate the environmental control costs for the more significant oil shale production processes under several levels of plausible environmental pollution control regulations and standards. Available technology for production processes and control technologies will be screened and listed. A materials energy balance process model will be developed for the more viable alternatives to identify potential sources and magnitude of environmental exposure. The various control technologies will then be assessed in terms of efficiency and cost and a final scenario will be developed for estimation of the environmental control costs of production alternatives.
Keywords: pollution control; oil shale industry; cost; regulations; compliance; forecasting; mathematical models.

104060 Quick Reaction Issues Studies and Policy Analysis Relevant to DOE's Environmental Decisions. (American Management Systems, Rosslyn, VA). **Project number:** 008048. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The contractor will be assigned several tasks dealing with current policy issues and related technological options. The assignment will be to explore these issues and options; develop data bases on these subjects; and/or develop better presentations of the information in a format which is most useful to DOE managers. Another area of the work will deal with maintaining an awareness of certain programs in the national laboratories relative to particular issues. The emphasis will be on the ability to pull together the required information rather rapidly and organize it effectively in order that its meaning and significance can be most quickly comprehended and converted into useful management tools.
Keywords: us doe; environmental policy; pollution control; technology assessment; data acquisition; data base management.

104061 Economic and Environmental Policy Analysis of Hazardous Materials Associated with Energy Development Programs. (Resources for the Future, Inc., Washington, DC). **Project number:** 008100. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: economic policy; environmental policy; hazardous materials; energy source development; government policies; air; water; land use; pollution abatement.

104062 Develop Management Information System. (American Management Systems, Inc., Arlington, VA). **Project number:** 007983. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to construct a map of global temperature patterns during the period 6000 to 7000 B.P. from pollen data on land and from marine plankton data in the oceans. When this is complete, a globally-averaged estimate of the atmospheric temperature during this period will be calculated. This information will supply a data base for checking model-simulations of future climates.
Keywords: global aspects; temperature distribution; plankton; mapping; earth planet.

104063 Studies and Analysis of Toxic and Solid Waste Issues for Use in Assessing and Implementing DOE's Environmental Mission. (Radian Corp., Austin, TX). **Project number:** 008047. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: Coal(34); oil and gas(33); oil shale(33) **R and D categories:** Biological effects of pollutants in experimental systems.

During the third quarter of FY 79, the contractor will be required to carry out a set of task studies dealing with the interface between the Toxic Substances Control Act and DOE energy developing programs. This work will include gathering existing data and information on toxic substances produced in the course of manufacturing synthetic fuel liquids from coal, shale, and other substances. These data will be analyzed to determine the causative factors in the generation of the toxic materials and relate this back to parametric features of the chemical process utilized in the production of the synthetic fuels. Other tasks will be assigned relating to solid waste disposal and the Resource Conservation and Recovery Act to identify the impacts of that legislation and the related regulations upon current and future energy production in the United States. Specific concerns deal with the disposal of waste and byproducts resulting from the production and conversion of energy, e.g., synfuels. It is important that the extent of these interactions be thoroughly understood and alternative options identified to mitigate the problems which will arise.
Keywords: solid wastes; toxic materials; implementation; resource conservation; synthetic fuels; waste disposal; coal industry; oil shale industry; petroleum industry; natural gas industry; environmental impacts.

104064 Develop Alternative Forms for Presenting Environmental, Safety, and Health Impact Information. (TERA, Inc., Arlington, VA). **Project number:** 008102. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

During the first year, the contractor will examine the relationship between worker health and worker environment in six navy shipyards and one private yard. The study population is comprised of approximately 250,000 workers employed since the early 1950's. The actual study will consist of the construction of an automated data base of all relevant information on individual work histories of all workers employed since the early 1950's. Existing Federal and state information systems will be queried to identify separated employees that have died. Death certificates for these persons will be obtained. In the second year, research of vital records, social security, etc., and tracing occupational histories of each worker who died will continue. Each subject will be classified by job class, thereby developing an individual work history profile for each worker. Analysis of data will begin using a variety of life table.

Keywords: environment; safety; health hazards; data acquisition; information systems; data base management; technology assessment.

104065 Perform Diffusion Model Analyses Using Models Designed for Remote Access. Benoit, W.J. (Environmental Protection Agency, Washington, DC). **Project number:** 008090. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: air pollution; remote sensing; mathematical models; diffusion.

104066 Policy Studies. Jones, R. (Lovelace Foundation, Inhalation Toxicology Research Inst., Albuquerque, NM). **Project number:** 003276. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is directed to providing input for policy decisions concerning radiation exposure of human populations. Major attention has been directed to providing input on the movement of fission product and transuranic radionuclides through the environment and into man, the fate of the radionuclides in man, estimated radiation dose to critical tissues, and the projected health risks associated with various exposure scenarios. Analyses have been performed for site specific situations such as Rocky Flats and the northern Marshall Islands and for generic situations such as guidance for transuranics in the environment. The project draws heavily on the expertise developed by Institute scientists during the course of laboratory investigations of the toxicity of transuranic and fission product radionuclides and risk assessment modelling activities.
Keywords: human populations; radiation doses; decision making; fission products; radionuclide migration; radioecological concentration; tissues; mathematical models; risk assessment; health hazards.

106000 Effect of Petroleum-Related Pollutants on Aurelia Growth and Development. Spangenberg, D. (East Virginia Medical School, P.O. Box 1980, Norfolk, VA, 23501). **Project number:** 007615. **Contract:** AS05-77EV05593. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(60); oil shale(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The effects of petroleum-related pollutants (PRPs) on metamorphosis and budding of aurelia will be studied under controlled laboratory conditions. Jellyfish polyps induced to metamorphose will be exposed to a range of benz(a)pyrene, pyrene, naphthalene, biphenyl, anthracene, perylene, 2-3 benzanthracene, phenol, creosol, pristane, and benzene. The following developing structures will be closely observed: number and morphology of arms, lappets, mouths, rhopalia, gastric filaments, and muscles. Ephyrae will be observed under the light microscope (LM) to determine the numbers of statoliths and nematocysts present. The regularity and rate of pulsing will be recorded. Scanning electron microscopic (SEM) studies will be made of the surfaces to determine whether flagellum formation and surface morphology in general are normal. Organisms showing aberrant structure formation will be further studied with the transmission electron microscope (TEM) to determine the cellular changes associated with the abnormality (especially nerve and muscle changes associated with pulsing irregularity or inhibition). The effects of the PRPS on budding in the aurelia polyps will also be determined. The doubling times of chemically treated organisms will be compared with controls.
Keywords: petroleum; toxicity; benzopyrene; naphthalene; biphenyl; anthracene; benzanthracene; phenols; benzene; morphological changes; aquatic organisms; metabolism.

106001 Fish Eggs and Larval Fish. Walsh, J.J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001382. **Contract:** FY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The total finfish biomass of the Middle Atlantic Bight is now 25% of the estimated virgin stocks. Differences in recruitment and size of year classes of fish are believed to be a function of variable mortality rates during their larval phase. Thus, emphasis at Brookhaven National Laboratory (BNL) has been placed on predictive methods of determining the rate of survival of larval fish under varying environmental conditions and adult spawners. For survival of these larvae, food must fall within narrow particle size ranges, must be above a critical concentration, and must have nutritional value adequate for further growth and development. Fish larvae in the coastal ecosystem are also extremely vulnerable to damage by entrainment in heat exchangers, by oil pollution, and by chlorine and heavy metals. Recently acquired data on the mesoscale spatial and seasonal distributions of larval fish in the New York Bight are now sufficient to permit the location, tracking, and intensive sampling of cohorts of newly-spawned larvae. However, the additional determination of larval-fish growth and survival can be achieved only through a multidisciplinary approach encompassing laboratory and field measurements of all ecosystem processes impinging on the fish and their potential prey and predators. Only through such an approach can predictive models and adequate managment of eventually-harvestable fish stocks be developed to distinguish between natural fluctuations and environmetal deterioration.
Keywords: fishes; eggs; larvae; atlantic ocean; coastal regions; population dynamics; food; aquatic ecosystems; particle size; nutrition; water pollution; environmental effects; mathematical models; biological effects; mortality; forecasting; survival curves.

106002 Investigating the Impact of Drilling Mud and Its Major Components on Bivalve Species of Georges Bank. McLeod, G. (New England Aquarium Corp., Central Wharf, Boston, MA, 02110). **Project number:** 007662. **Contract:** EE-77-S-02-4580. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Exploratory drilling operations will probably result in the release of the equivalence of 10 to the fifth power tons of drilling mud into the Georges Bank area. Previous studies have shown that turbid suspensions of clay minerals, such as those used in drilling mud, can disrupt the metabolism of bivalve molluscs. Therefore, a research program is conducted in which populations of five commercially important bivalve species will be placed in closely controlled environments and exposed to various loadings of drilling mud or one of its principal components. The effect of this exposure on tissue weight and feeding rate will be measured, and histological analyses will evaluate the mobilization of the organisms' defense mechanisms against the unwanted particulate material. A second group of experiments will measure the tendency of these species to extract heavy metals from the drilling mud particles. Test populations will be exposed to suspensions of metal-enriched bentonite, attapulgite and plant starch. The organisms' repsonse to the additional insult posed by the above physiological evaluation and by the analysis of tissue samples for heavy metal content. The results of these analyses will be compared to those run on control populations and to the metal concentrations released by the extraction of the particulate suspensions using one of four chemical treatments. This comparison will indicate which, if any, of the four yields metal data closely resembling that part of the total metal load taken up by bivalve molluscs.
Keywords: drilling fluids; georges bank; environmental effects; aquatic ecosystems; biological models; clays; molluscs; particles; aerosols; metals; toxicity; metabolism.

106003 Sediment Trap Intercomparison Experiment in the Panama Basin. Weinberg, E.H. (Office of Naval Research, Arlington, VA, 22217). **Project number:** 008067. **Contract:** 79-EV10045. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Pollutant measurements technology.

It is proposed that a sediment trap and in situ pump field intercalibration experiment be held in the Panama Basin in the summer of 1979. Many investigators are currently making measurements of the vertical flux of particulate matter in the ocean, using moored or free-floating devices to intercept the particulate flux. These devices differ widely in their design characteristics, and it is not clear at this time how compatible the results from different experiments are. In order to resolve this problem, invitations to participate in an inter-calibration experiment were sent to all U.S. investigators known to be currently active in this field. At this time, 23 investigators, representing 11 different designs of moored sediment traps, 3 designs of free-floating sediment traps and 2 designs of in situ pumps, have agreed to participate. Samples from each trap will be split, weighed and sent to the investigators for measurement of basic properties (taxonomy, major elements, carbonate, organic C, N, P, and 230Th and 210Pb). The results of the experiment will be discussed at a symposium in the late spring of 1980. The costs of the analyses will be borne by the on-going grants of the participants. This proposal covers costs for shipping, travel, mooring deployment and recovery, and shipping time.
Keywords: sediments; oceanography; seas; thorium 230; lead 210; carbonates; carbon; nitrogen; potassium; panama canal zone.

106004 Coastal Shelf Transport and Diffusion. Csanady, G. (Woods Hole Oceanographic Inst., Woods Hole, MA, 02543). **Project number:** 007500. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); oil and gas(20); oil shale(20); nuclear fission(20) **R and D categories:** Environmental transport and conversion of pollutants.

The structure of flow and mixing processes in coastal boundary layer will be determined by data analysis, interpretation, and associated theoretical development, following data collection phase which ended 1978. Dynamics of shelf circulation, both mean and storm-driven transient, will be studied and related to simple conceptual models. Conceptual models will be developed for dynamics of flow and mixing processes in shelf-edge frontal zone. Parameterization schemes for vertical and horizontal turbulent transfer processes will be developed.
Keywords: coastal regions; boundary layers; data analysis; fluid flow; mixing; mathematical models; turbulence; environmental transport; continental shelf; seawater.

106005 Coordination of Oceanographic Programs in Pacific Northwest Coastal Waters. Anderson, G.C. (Washington Univ., Seattle, WA). **Project number:** 008094. **Contract:** 79-EV10047. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide coordination services for Department of Energy-supported oceanographic research in universities of the Pacific Northwest region. In addition, close liaison will be maintained with the Marine Science Programs at the Marine Research Laboratory, Battelle-Pacific Northwest Division, Sequim, Washington, and the DOE west coast coordinator, Dr. William Templeton.
Keywords: oceanography; coordinated research programs; us doe; washington.

106006 Symposium on Marine Benthic Dynamics: Georgetown, SC. (Skidaway Inst. of Oceanography, Savannah, GA). **Project number:** 008104. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

A conference on benthic processes in the marine environment is being held April 4--7, 1979, to assess benthic secondary production, trophic transfer between benthic and pelagic systems, and contribution of detritus to the nutrient pool from the viewpoint of vulnerability on the benthos to environmental disturbances.
Keywords: benthos; biological models; nutrients; population dynamics; environmental impacts; meetings.

106007 Food Chain Dynamics and Fish Mortality. Dagg, M.J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001303. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The goal of this program is an understanding of coastal trophic-dynamics as affected by natural stimuli and anthropogenic perturbations. This knowledge includes the differentiation of responses of heterotrophic planktonic populations to natural and man-caused events and a description of the ultimate affects of these events on the transfer of energy between trophic levels. Mesoscale seasonal and geographical variations in coastal ecosystems are now reasonably well described, but the small-scale and short-term processes which appear to immediately control zooplankton community structure and dynamics remain poorly understood. An understanding of these processes of secondary production requires an integrated field program encompassing physical parameters, phytoplankton production and physiology, zooplankton and ichthtoplankton behavior, growth and survival, and nutrient regeneration by bacteria, benthos, and the other higher trophic levels. Intensive ecosystem studies of a variety of coastal habitats coordinated with laboratory experimentation will provide the basis for predictive models and the evaluation of potential effects of human activities in the coastal environment.
Keywords: coastal waters; aquatic ecosystems; ecology; food chains; zooplankton; population dynamics; productivity.

106008 Toxicity of Pu-239 and Ra-226. Jee, W.S.S. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003115. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim of the project is to predict the risk from plutonium to a human population of all age groups. Juvenile beagles, age three months, and mature beagles, age five years, are injected once with a specific dose of Pu-239 or Ra-226, both in citrate buffer at pH 3.5. They are then observed throughout their post-injection lifespans for toxic effects of Pu-239 or Ra-226. At the time of death, a complete autopsy and histopathologic examination of tissues is conducted. Biopsy specimens of rib and liver are removed serially at specified times after nuclide injection from some lifespan animals of both the juvenile and mature animal studies in order to provide interim information on dosimetry and tissue response. Special studies of juvenile and mature beagles are done to characterize nuclide toxicity and the cellular mechanisms involved and to refine the prediction of risk to the general human population.
Keywords: dogs; plutonium 239; radium 226; toxicity; life span; metabolism; human populations; risk assessment; injection; radionuclide administration.

106009 Mechanisms of Internal Emitter. Jee, W.S.S. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003116. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the project is to improve the prediction of risk of skeletal tumors produced by exposure of a general population to radionuclides related to the nuclear fuel cycle. Quantitative models for risk prediction will be formulated by correlating the age dependent skeletal biology of beagles and humans with the dynamic microdistribution of the nuclides which have been injected into beagles. The skeletal studies center on quantitative histology of both the cells at risk and the anatomic structure of trabecular bone. The concentration and dynamic microdistribution of the nuclides are measured experimentally, and the dose rates and integral doses to the cells at risk are calculated.
Keywords: radioisotopes; radionuclide kinetics; skeleton; dogs; man; age dependence; risk assessment; tissue distribution.

106010 Radionuclides in Rodents. Taylor, G.N. (Univ. of Utah, Salt Lake City, Utah). **Project number:** 003118. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We are investigating the Pu/Ra toxicity ratio in mice, the effect of the sex organs on the susceptibility of radiation-induced osteosarcomas to chemo therapy, and tumor antigens in alpha-particle-incuded osteosarcomas.
Keywords: plutonium compounds; radium compounds; toxicity; comparative evaluations; gonads; response modifying factors; mice; osteosarcomas; chemotherapy; antigens.

106011 Research on the Marine Food Chain. Ebbley, R.W. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 006329. **Contract:** EY-76-03-0010. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(25); solar(75) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This is a multidisciplinary study of the relationships among planktonic organisms and their environment emphasizing the Southern California Bight. The Bight is an area of intensive human use. It is characterized by a narrow continental shelf, with deep basins and rises offshore. The purpose of the study is to evaluate effects of energy-related human activities in these waters against a background of rather high natural variability and changes resulting from other human activities. The study of this variability of plankton stocks and activities in relation to that of the physical and chemical environment is taking place on several time and space scales in order to use those natural fluctuations to reveal mechanisms of change. In particular we seek to understand the driving forces for plankton production, the fates of that production, including fluxes of organic matter to deep water and sediments, and the roles of dissolved and colloidal organic matter in the carbon budget. Studies will emphasize the role of bacteria in secondary production and the dynamics of the microplankton food webs in which they participate. In addition to providing information on the Southern California Bight as a habitat for plankton, much of the work has implications for human affairs such as ocean photosynthesis as a sink for carbon dioxide, effects of uv-B on ocean photosynthesis, the importance of plankton for fisheries, waste disposal in the deep ocean, and effects of power generation using ocean thermal energy gradients (OTEC) on plankton species assemblages and their activities.
Keywords: food chains; bacteria; plankton; habitat; photosynthesis; waste disposal; seas; ultraviolet radiation; ocean thermal energy conversion; carbon dioxide; baseline ecology; carbon cycle; mineral cycling.

106012 Toxicity of Pu-239 and Ra-226. Jee, W.S.S. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003114. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to assess the toxicity of plutonium in man. Beagles are injected intravenously at 17 months of age with Pu-239 or Ra-226, and observed throughout their lifespan for radiation-induced lesions, which occur primarily in the skeleton and liver. The major radiation induced endpoint encountered is

skeletal cancer, occurring from 2 to 13 years after injection. The lifespan of beagles in this laboratory averages approximately 13 years. Detailed retention studies are used to calculate radiation doses. Detailed quantitative histopathologic studies are performed so that beagle and human skeletons can be compared and tumor incidence in beagles can be used to improve risk estimates in man. **Keywords:** plutonium 239; radium 226; toxicity; biological radiation effects; dogs; osteosarcomas; injection; radionuclide administration; radiation doses; dose-response relationships.

106013 Environmental Effects of Offshore Energy Production in the Subtropics and Tropics. Thorhaug, A. (Florida International Univ., Miami, FL, 33199). **Project number:** 008086. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This study will concentrate on the effect of heat, salinity changes, heavy metals, and light changes on microcosms of subtropical and tropical organisms found attached to offshore structures and the concomitant invertebrates and fishes that associate with them. These microcosms will be taken from prior ecological studies and existing panels of construction materials placed at OTEC sites prior to these studies. The objective is to assess the effect of these factors on the animals and plants occurring, both for sublethal and lethal effects, as well as accumulation of toxic substances within the food chain. Field studies in cooperation with the OTEC program will be coupled with laboratory studies and models.
Keywords: ocean thermal energy conversion; aquatic organisms; environmental impacts; offshore operations; fishes; invertebrates; thermal pollution; waste heat; ph value; metals; ultraviolet radiation.

106014 Retention and Toxicity of Thorium in Dogs. Jee, W.S.S. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003245. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to compare the range of skeletal pathology (malignant and others) seen in Th-228 lifespan beagles to that seen in the more thoroughly studied Pu-239 lifespan beagles from the University of Utah. The effect of graded doses (0.0017 to 0.3 mu ci/kg injected intravenously) of Th-228 has been studied in 74 beagles over their lifespans during 1954--1978. The principal toxic effect at lower doses for long time periods was osteosarcoma. Detailed skeletal histopathologic studies are to be carried on two groups of bones, which are representative of the whole skeleton. The first, sites with a high incidence of osteosarcoma, include the trabecular bone of the proximal humerus, illium, proximal femur, thoracic vertebral body, and lumbar vertebral body. The second, sites with a low incidence of osteosarcoma, include the trabecular bone of the distal humerus, proximal ulna, and distal ulna. The findings in these sites will be compared to findings from the same sites in Pu-239 injected lifespan beagles. As a final product, we expect to be able to compare dose response of the skeleton to Th-228 and Pu-239 and to develop a toxicity ratio for the two nuclides.
Keywords: thorium 228; biological radiation effects; dogs; osteosarcomas; chronic exposure; plutonium 239; comparative evaluations; toxicity.

106015 Comparative Metabolism Actinide. Wrenn. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003270. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The time dependent retention (metabolism) of the actinides (principally U, Th, Pu, and Am) is being compared in several mammalian species including man (for skeleton, liver, and lung) by measurement of these actinides in beagles, primates, and man and by development of mathematical models to describe time dependent behavior for single or continuous intake. The result will be realistic dosimetric models for these actinides applicable to man and suitable for risk estimation and standards development.
Keywords: actinides; metabolism; radionuclide kinetics; skeleton; liver; lungs; mammals; mathematical models.

106016 Toxicity in Beagles. Mays, C.W. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003119. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A DOE-approved experiment was started in May 1977, involving 126 young adult beagles injected with Ra-224. These animals will be observed throughout their lifespans for radiation effects, especially bone sarcomas. The main purpose of this experiment is to establish the Pu-239/Ra-224 toxicity ratios in dogs which, when multiplied by the observed toxicity of Ra-224 in German patients, should indicate the approximate toxicity of Pu-239 in man.
Keywords: radium 224; dogs; toxicity; osteosarcomas; biological radiation effects; biological models; plutonium 239; man.

106017 Deposition, Retention and Toxicity. Stevens, W. (Univ. of Utah, Salt Lake City, UT). **Project number:** 003120. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this project is to assess the toxicity of Am-241, Cf-249, Cf-252, and other actinide (atomic number greater than 92) elements relative to Pu-239 in beagles. The primary goal will be to extrapolate the information obtained in dogs to man. Extensive studies are being performed to determine the toxicity of Pu to man using the Pu/Ra toxicity ratio in man and beagles. The similarity of chemical and physical properties of the trivalent actinides suggests that a comparison of initial deposition, distribution at the anatomical, cellular and subcellular level, retention as a function of time, and resulting toxic effects between these elements and Pu could serve as a basis for the assessment of their toxicity to man.
Keywords: actinides; toxicity; biological radiation effects; dogs; rbe; plutonium 239; radionuclide kinetics; comparative evaluations.

106018 Evaluation of Hazards from Tritium Dominant Lethal Mutations in Mice. Carsten, A. (Brookhaven National Lab., Medical Dept., Upton, NY, 11973). **Project number:** 000034. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fusion(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of these studies is to ascertain the concentration of tritium and deuterium in drinking water that does not produce detectable dominant lethal mutations or depress hemopoietic stem cells in mice, and then proceed to study comparable effects of non-nuclear pollutants on the same systems. It would be desirable to have some experimental data from which one could calculate the amount of tritium irreversibly incorporated into oocyte nuclei from tritiated water having such low specific activity that oogenesis is unimpared by radiation damage. It is predicted that such calculations could be accomplished more proficiently using the deuterium micromapping technique, to study the incorporation of deuterium into oocytes from deuterated water rather than by tritium autoradiography. This technique is being used for distribution studies and radiation dose measurements in conjunction with the tritium and deuterium biological effect studies. The relative genetic and somatic hazards from nuclear and fossil fuel energy production will be determined.
Keywords: tritium; deuterium; drinking water; threshold dose; quantity ratio; mice; blood formation; oogenesis.

106019 Detrimental Biological Effects of Magnetic Fields. Baum, J.W. (Brookhaven National Lab., Safety and Environmental Protection Division, Upton, NY, 11973). **Project number:** RPIS 1375. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Detrimental biological effects of magnetic fields have been reported by a number of authors, but confirmed by few. Since controlled thermonuclear reactors will require the use of large magnets, human exposure is anticipated near these plants. Long-term genetic and somatic effects are of special interest and will be evaluated both experimentally and theoretically in this work. Pollen abortion and stamen hair mutations are being studied in the sensitive Tradescantia test system. This system has been studied extensively by BNL and is known to be sensitive to chemical mutagens in the ppM range and to ionizing radiations at doses below one rad. It is useful in long-term chronic exposure studies which are of special interest here for detection of small effects. Drosophila are also being used in studies aimed at understanding mutation risk and mechanisms and exploring possible subtle effects which may be induced during sensitive developmental stages of the organisms. M-5 and ORE-R strain are initially being used to detect sex-linked mutations.
Keywords: magnetic fields; biological effects; tradescantia; chronic exposure; mutations; pollen; stamen; drosophila.

106020 Tumor Mechanisms. Lloyd, E.L. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 002563. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Firm predictions of the risk to man from low doses and low dose rates of alpha particle emitters probably depend on knowing the mechanism by which radiation induces tumors. Basic mecha-

nisms of bone tumor induction by alpha particles are, therefore, being studied by: (1) direct alpha irradiation of mammalian cells in culture; (2) light and electron microscropy of the cells at risk in normal human adult bone; (3) observation of changes in bones from radium patients at the sites where bone tumors most frequently develop; and (4) measurements of the immunocompetence of the radium patients.
Keywords: alpha particles; low dose irradiation; delayed radiation effects; cell cultures; man; oncogenic transformations; skeleton.

106021 Theory of Induction of Bone Cancer by Radiation. Marshall, J.H. (Argonne National Lab., Argonne, IL). **Project number:** 002490. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To determine the long-term risk to man from internal radioactivity, it is clear that we need a theory which predicts the number and time distribution of tumors as a function of dose, dose rate, and linear energy transfer. We propose to create a Theory of the Induction of Bone Cancer based upon physical and biological mechanisms which will fit the data for alpha, beta, x, and fission radiation in culture, mouse, dog, and man by about 1983, give or take a couple of years. The major postulates have been published: Alkaline Earth Metabolism in Adult Man (1973), Theory of Induction of Bone Cancer by Alpha Radiation (1977), and A Possible Low-Lying Linear Component in the Induction of Bone Cancer by Alpha Radiation (1979). Generalization to radiation of different LET, together with experiments here and elsewhere which test the postulates, are in progress.
Keywords: skeleton; neoplasms; radioinduction; carcinogenesis; alpha particles; beta particles.

106022 Nucleic Acids in Pathogenesis. Niyogi, S.K. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 000165. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Environmental agents, as by-products of energy production, have profound effects on biological processes. Such agents are known to affect, directly or indirectly, cellular control mechanisms, possibly in both normal and pathological states. Studies of replication, transcription and processing of nucleic acids would provide the baseline information of such interactions which lead to mutagenesis, teratogenesis and carcinogenesis. Environmental mutagens and teratogens may result in altered genotype in which carcinogens and mitogens could cause derangement of control mechanisms in both normal and virus-infected systems. Often, remarkable insights have been gained in the understanding of pathogenesis in man from studies of model systems. It is, therefore, our objective to study both eukaryotes and prokaryotes. We are working on both normal and virus-infected systems in close concert with one another and with others in the division. We are studying the structure and function of DNA replication intermediates of teratogenic Kilham rat virus and of murine leukemia virus. RNA transcription is being studied with M13 phage (resembles RNA tumor viruses) and SV40 (viral carcinogenesis). Various mitogens are being tested for induction of DNA replication in yeast. Modifications of E. coli RNA polymerase following T4 infection are being studied to understand the control of transcription in a viral-infected system. Control of RNA processing is being investigated in yeast.
Keywords: nucleic acids; chemical effluents; pathogenesis; by-products; dna replication; baseline ecology; viruses; mutagenesis; carcinogenesis; teratogenesis; leukemia viruses; yeasts; escherichia coli; biological effects; pathological changes.

106023 Theoretical and Applied Cryobiology. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 000167. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The program is devoted to low temperature biology, to the permeability and osmotic responses of cells, and to the effects of temperature and the state of the aqueous environment on the cell surface. Cells and tissues under study include mouse embryos, fetal pancreases, and mammalian erythrocytes and tissue culture cells. The assessment of mutagenic, carcinogenic, and physiological effects of effluents from the production of energy from nuclear and non-nuclear sources requires mammalian tissue culture systems and large animal colonies with known and unchanging characteristics. Storage in the frozen stage can prevent genetic drift and materially reduce the expense of maintaining breeding colonies. Freezing and low temperature storage are also relevant to: (1) preservation of mutations and germplasm variants; (2) the use of ova transfer techniques in developing more energy-efficient livestock; (3) the establishment of organ and tissue banks to facilitate immunologically matched transplants; (4) retrospective studies and studies on aging; and (5) electron microscopy (e.g., freeze-cleaving, electron probe analysis) and photobiology. Success in freezing complex cellular systems has required an understanding of fundamental cryobiology. Further understanding is essential to further progress.
Keywords: cryogenics; freezing; permeability; pancreas; erythrocytes; tissue cultures; mutations; biological effects; preservation; storage.

106024 Mechanisms of Damage and Repair. Masker. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 003236. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Damage to a living cell's genetic material invites several potentially harmful consequences including interruption of normal metabolic processes, induction of endogenous viruses, mutation, and cell death. To properly assess the biological consequences of environmental factors that promote lesions in DNA it is essential to fully comprehend the interaction of DNA metabolic enzymes with damaged DNA templates. Our objective is to acquire an improved understanding of the biochemical events associated with DNA repair and other cellular responses to DNA damage. Part of our program takes advantage of the wealth of genetic information available with bacterial systems and focuses on in vivo studies of excision and postreplicational repair in strains deficient in various DNA metabolic enzymes. These experiments are complemented by in vitro studies in which a primarily biochemical approach is used to monitor DNA repair as well as the replication and recombination of damaged DNA in a cell-free system capable of sufficient fidelity to efficiently produce biologically active virus particles. Insight gained from these studies should provide a more general appreciation of the consequences of DNA damage and permit extrapolation to more complex biological systems. Hopefully, this will allow a more enlightened approach to understanding health hazards imposed by DNA damage.
Keywords: metabolism; viruses; mutations; biological repair; genetics; bacteria; dna replication; biological models.

106025 Studies on Tumor Cell Immunology. Kennel, S.J. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002360. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Cancers produced or promoted by environmental chemicals, radiation, or viruses have all been shown to display unique molecules on their cell surfaces (tumor specific antigens). These antigens are the targets of an individual's immune response against tumor cells. In addition, tumor specific antigens can serve as tags which differentiate tumor cells from normal cells. This project utilizes antibody molecules which bind to tumor specific antigens to target cytotoxic agents directly to tumor cells. Three areas of study are necessary: (1) molecular identification of tumor specific antigens; (2) production of antibody to these antigens; and (3) coupling and delivery of drugs and other cytotoxic agents to the tumors. We have made antibody preparations to well define tumor specific antigens of virus induced leukemias and sarcomas of mice, and are studying the coupling and delivery of drugs to these tumors in vitro and in vivo. Two different lung tumors of mice (one spontaneous and one induced by methylcholanthrene) are being studied for tumor specific antigens. Antiserum to whole tumor cells is under study. Antisera to human leukemia/lymphoma cells are being used to detect specific molecules on the tumor cells. Other methods of targeting drugs to tumor cells are being explored.
Keywords: tumor cells; immunology; carcinogenesis; mice; sarcomas; 3-methylcholanthrene; chemical effluents; ionizing radiations; viruses; biological models.

106026 Metabolism of Aromatic Amino Acids. Gaertner, F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002371. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

3-hydroxyanthranilate is a normal intermediate in the metablism of L-tryptophan in mammals. In some individuals, an elevated level of 3-hydroxyanthranilate in the urine is believed to be the cause of bladder cancer. Normally the oxygenase which catabolizes 3-hydroxyanthranilate in the liver and kidney is extremely active and prevents such an accumulation. In order to study the toxicity of 3-hydroxyanthranilate in more detail we have begun to analyze in mice the factors (both genetic and environmental) which influence

the hepatic activity of this oxygenase. In addition, an enzyme involved in the synthesis of this carcinogen in mice, kynurenine formamidase, is under intensive study. Two previously unknown forms of this activity have been observed, and alleles for each form have been demonstrated. With the aid of GEMSAEC technology we are in the process of locating these alleles in the genome of the mouse. In addition to establishing valuable new genetic markers for the analysis of environmental mutagens, these studies should lead to a better understanding of the function of formamidase in the metabolism of L-tryptophan and in the synthesis of the neurotransmitter L-kynureninamine. We are also interested in the function and organization of enzymes which synthesize L-tryptophan in lower eucaryotes.
Keywords: amino acids; metabolism; aromatics; tryptophan; carcinogens; mutagenesis; mice.

106027 Regulation of Membrane Transport Systems. Cook, J.S. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002368. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

All mutagens, carcinogens, pollutants, and other toxic compounds, as well as all nutrients, have their first interaction with living cells at the cell surface. We are concerned with the regulation at the surface of uptake of nutrients, particularly sugars, amino acids, and essential minerals like potassium and sodium. The cells we use are human, normal and tumor derived, in tissue culture, or chemically transformed hamster cells that can be reversibly converted from normal to tumorigenic by growth at different temperatures. We have been conducting in-depth studies on how two classes of naturally occurring compounds interact with the cell surface and affect uptake of nutrients, and how cells respond. The classes of compounds are: (1) those that interact very specifically with certain transporters, i.e., membrane molecules responsible for uptake; and (2) certain diphenol compounds that dissolve in the matrix of the membrane and perturb uptake more generally. In the first case, the cells may detoxify themselves by internalizing the specific receptor and sequestering or degrading the toxic agent bound to it. In the second case the cells, starved for nutrients, are commonly induced to synthesize new transporters. Cancer cells constitutively synthesize more transporters than normal cells, and are thus not limited by nutrients for growth. We are studying the controls on the synthesis of transporters in chemical-treated and tumorigenic cells.
Keywords: membrane transport; tissue cultures; cell membranes; tumor cells; hamsters; mutagens; chemical effluents; carcinogens; metabolism.

106028 Gene Expression in Carcinogenesis. Kenney, F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001699. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Defective control of gene expression is characteristic of all cancers and may be central to malignant transformation. Our objective is to define the molecular mechanisms by which gene expression is regulated in mammalian cells and how this control is lost in cells transformed to malignancy. Cellular processes determining phenotype including transcription, translation and turnover of mRNA and proteins are analyzed in a model hepatoma cell system where these reactions are under hormonal control. Other hepatomas in which the normal control mechanisms are not operative are analyzed to determine the molecular basis for loss of control of gene expression in malignancy. Genes coding for leukemia virus are normally silent but can be activated by experimentally altering cellular DNA. Chromatin is being fractionated into active and inactive components to begin analysis of the molecular basis for activation of these genes known to be associated with carcinogenesis.
Keywords: carcinogenesis; genetic variability; mammals; proteins; rna; leukemia viruses; chromatin.

106029 Carcinogen-Cell Genome Interaction. Yang, W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001701. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project places emphasis on one aspect of cancer research, namely, carcinogen-cell genome interactions which ultimately determine the susceptibility or resistance of mammals and humans to induction of cancers. Specifically, the energy-related pollutants can be examined for cancer causing effects by employing pertinent systems and technology which have been developed in this laboratory for studying viral oncogenesis. We will study mouse FV-1 gene locus restriction of leukemia viruses; a model system for studying genetic factors in preventing cancers is useful for determining how regulation of this gene locus is affected. We have a sensitive method of DNA transfection for leukemia viruses and are employing it as a measure for determining the effects of carcinogens, mutagens, and radiation on the cell-genome integration of a foreign oncogenic DNA molecule. We will study enzymology of DNA synthesis during carcinogenesis with focus on the fidelity function of mammalian DNA polymerases and the primer molecules. We have characterized unique cellular tRNA species as primers for reverse transcription of onconovirus genomes. We will apply lectin-gel chromatography for isolation of specific membrane glycoprotein antigens from cancer cells and tumor viruses to be used as reagents for studying their expression and host immune response.
Keywords: carcinogenesis; cell membranes; mammals; human populations; dna-ase; mice; tumor cells; biological models.

106030 Bioorganic Chemistry and Enzyme Catalysis. Dogherty, D. (Oak Ridge National Lab., P.O. Box X; Oak Ridge, TN, 37830). **Project number:** 001558. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The programs in this proposal are related to both coal conversion and fission technology. In both processes by-product reactions (e.g., carcinogenic hydrocarbons and radiation) produce undesirable effects in biological subjects. Tissue oxidases that hydroxylate aromatic hydrocarbons to carcinogenic compounds also function in a similar fashion in their reaction with lucigenin or luminol to produce chemiluminescence. We are studying this mechanism for use as a probe in cellular metabolism and as a useful analytical tool. We are investigating the interaction of radiation induced OH radicals with peptides of increasing complexity by electron spin resonance techniques in order to understand the radical interactions occurring in irradiated proteins. We are also involved in the development of potential new anti-neoplastic agents. Human granulocytic leukemia cells have been found to have abnormal nutritional requirements for compounds involved in purine biosynthesis. The enzymes responsible have been identified and we are engaged in the synthesis and evaluation of specific competitive inhibitors that will prevent leukemic cell proliferation.
Keywords: hydrocarbons; carcinogenesis; biological models; ionizing radiations; aromatics; cell proliferation; leukemia viruses.

106031 Chemical Effects on the Immune System. Perkins, E. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001560. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The hazard of cytotoxic industrial chemicals, coal conversion products and environmental pollutants (e.g., oxides of carbon, sulfur and nitrogen from fossil fuel combination, organic aerosols and compounds in aqueous by-products from oil shale retorting and/or coal gasification and liquefaction, heavy metal pollutants, and toxic agents from nuclear fuels) or their environmental catabolites on the immune system and related host defense mechanisms must be defined. Two general approaches are being studied: (1) establishment of technology to evaluate the activity of such compounds with regard to immunologic toxicity (i.e., screening tests to identify potentially hazardous agents and concentrations for deleterious effects); and (2) mechanistic studies to assess immediate damage and the late effects of immunodepression (e.g., as it relates to chemical carcinogenesis).
Keywords: immune serums; biological stress; tolerance; toxicity; chemical effluents; sulfur oxides; nitrogen oxides; coal gasification; coal liquefaction; metals; nuclear fuels; fossil fuels; fuel cycle; carcinogenesis; biological models; risk assessment.

106032 Athymic Mice in Malignancy Studies. Kraemer, P. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 003216. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Agents which induce tumors are of particular concern, since the interval between exposure and appearance of a diagnosable tumor may be tens of years. The most direct and best current procedure for determining tumorigenic potential of an agent requires the use of intact animals and waiting out their life span for results. More simple assays have been suggested using bacteria or mammalian cells in culture, but both of these approaches are not yet validated. Our present objective is to establish a nude mouse colony that will be viable and experimentally usable. The defect in the nude mouse which renders it so useful for transplantation studies at the same time makes the animal unusually sensitive to infection and requires nearly germ-free conditions. Therefore, our first priority was to establish procedures for maintaining a healthy population of animals and subsequently to establish a permanent breeding colony.

The overall goal is to establish distinctions between the growth characteristics of implanted normal and tumor cells. Cells exhibit a spectrum of growth characteristics which can be classified into three categories: normal, benign tumorous, and malignant. Benign cells can grow independently of normal control but remain localized, while malignant cells exhibit a tendency to invade adjacent tissue. It is not clear how these cells will respond when implanted into the nude mouse. Initial studies will obviously deal with chemicals known to render some of the necessary results to verify the integrity of the system.
Keywords: mice; carcinogenesis; biological models; bioassay; laboratory animals; inflammation.

106033 Kasugamycin Inhibition of Bacterial Sporulation. Bott, K. (Univ. of North Carolina, Chapel Hill, NC). **Project number:** 008258. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of the proposed research are to determine the mode of action by which the antibiotic Kasugamycin (KSG) inhibits endospore formation of Bacillus subtilis and to characterize the developmental stage at which sporulation is blocked. When deprived of a carbon or nitrogen source vegetatively growing cells of the bacterial genus Bacillus undergo an ordered transition from a vegetative form of cell to a heat-resistant dormant form known as an endospore. Since this transition is one of the simplest known forms of cellular differentiation it has been extensively used as a model system for the more complex forms of cellular differentiation found in higher organisms.
Keywords: bacterial spores; inhibition; antibiotics; bacillus; cell differentiation; biochemical reaction kinetics.

106034 Development of Short-Term Animal Test for Carcinogens Based on Early Enzyme Changes. Wainfain, E. (New York Blood Center, New York, NY). **Project number:** 008256. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this program is to develop a useful, short-term animal assay to screen potential carcinogens. Several different hepatocarcinogens have been found to cause alterations (in susceptible animals) in activity of rat liver transfer RNA (tRNA) methyltransferases that are apparent within a week and persist throughout chemical carcinogeneses. We will carry out experiments to determine whether these easily measurable and early changes in tRNA methyltransferase activity can be used as valid indicators of the initiation of pre-neoplastic change in vivo. We will investigate the effects of several additional hepatocarcinogens in order to determine whether the effect is general. We will also test the effects of some substances that are toxic to the liver, but not carcinogenic as well as carcinogens with target-organ specificity other than liver. The results of these studies with rats will demonstrate whether the effects of carcinogens on tRNA methylating enzymes are organ selective, or whether appearance of altered liver enzyme activity is a common effect of systemically administered carcinogens. Our results will serve to demonstrate whether the ability of carcinogenic and/or toxic chemicals to cause alterations in tRNA methyltransferases within one to three weeks is sufficiently reliable to permit utilization of this phenomenon as the basis for a screening test for carcinogenicity and/or toxicity of the test substances, and whether altered tRNA methyltransferase activity is a useful indicator for pre-neoplastic conditions.
Keywords: mutagen screening; animals; carcinogens; bioassay; liver; pathological changes; biological indicators; toxicity; transfer rna; rats.

106035 Marrow-Tumor Interpretations: The Role of Bone Marrow in Controlling Chemically Induced Tumors. Rosse, C. (Univ. of Washington, Seattle, WA). **Project number:** 008252. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Although a number of immune cell types have been defined which exhibit antitumor activity in vitro, the mechanisms operative in vivo are incompletely understood. In particular, little is known about the role of the bone marrow which continuously produces large numbers of lymphocytes whose function has not been satisfactorily explained. The proposed studies utilize two tumor models. In one, bone marrow cells have the capacity of retarding or completely preventing the growth of methylcholanthrene induced tumors; in the other, the tumor exerts a profound influence on hemopoiesis and significantly reduces or eliminates lymphocyte production by the marrow. The latter may include cells which mediate the regulatory influence the marrow apparently exerts on tumors.
Keywords: bone marrow cells; biological functions; tumor cells; growth; inhibition.

106036 Neutron Core. Schoenborn. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 003001. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(50); nuclear fusion(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Neutron scattering is a powerful technique for the analysis of biological structures, since it permits the elucidation of structural details not attainable by x-ray scattering or electron microscopy. Neutron scattering is particularly suited for the analysis of biological structures because of relatively large differences it detects between hydrogen and deuterium. Such neutron diffraction studies are made possible at Brookhaven by the presence of the high flux beam reactor and unique related facilities that have been made available to University biologists for low angle scattering as well as protein crystallographic studies. This proposal requests core support for the fixed cost of operating the Biology Department's stations at the reactor. This charge must be borne in full: it is based on supply of neutrons from the reactor irrespective of their experimental utilization. The costs of Brookhaven National Laboratory's high flux beam reactor are assessed on the basis of the fraction of beam ports being used by each program in relation to the total number of beam ports. In this case it is based upon the use of one-ninth of all beam ports. This is in accordance with the DOE manual, and charges each program its representative share of the total cost of operations.
Keywords: neutron diffraction; hfbr reactor; biological materials; research programs; financing.

106037 Mechanisms of Transfer of Energy and Biomass in Marine Coastal Ecosystems of the Pacific Northwest. Anderson, G.C. (Univ. of Washington, Seattle, WA, 98195). **Project number:** 006511. **Contract:** AT(45-1)-2225. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

The objectives are to understand the processes governing the communities of organisms in the water column, on the seabed, and in the surf zone of coastal Washington and Oregon. Studies of mechanisms of the transfer of energy and biomass are being conducted. A numerical model of phytoplankton production is being used as an investigative tool in the identification and quantification of the processes that determine the seasonal and vertical distribution of phytoplankton. Factor and cluster analyses of a large body of data have shown that five general variables control phytoplankton production in the northeast Pacific.
Keywords: coastal regions; washington; oregon; phytoplankton; aquatic ecosystems; aquatic organisms; mathematical models; distribution; seasonal variations; pacific ocean; productivity; energy transfer; sea bed.

106038 Radiation and Biophysical Studies on Viruses and Cells. Cole, A. (Univ. of Texas, Austin, TX). **Project number:** 006299. **Contract:** EV02832. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of these studies has been to investigate the effects of ionizing radiation on biological systems at the cellular and molecular level. Detailed studies have been carried out on ability of mammalian cells to repair damage caused in their nucleic acids and another study was aimed at studying radiation carcinogenesis. Various methods including cell survival and cloning, analytical and preparative ultra centrifugation, electron microscopy and high resolution thermal denaturation have been used. Studies have been carried out using both high and low LET radiations under normal (37 degrees C) and hyperthermic (42 to 43 degrees C) conditions. These studies at elevated temperatures showed inhibition of normal DNA repair for both high and low LET radiations, while survival studies showed hyperthermic potentiation after low LET radiation but no enhancement for high LET radiation. Bombardment of Chinese hamster ovary cells with partly penetrating alpha particles yielded similar results at those using partly penetrating electrons giving further strength to the argument that radiosensitive sites are situated at or near the nuclear periphery of interphase cells and dispersed in mitosis. Recent high resolution thermal denaturation studies of double-stranded viral RNA's demonstrate the duplex DNA, as well as native DNA, denatures in a discountinuous manner suggesting the existence of a number of cooperatively interacting regions of approximately gene-sized length. Rat thymus chromatin in various states of condensation has been taken as a model for damage produced by ionizing radiation to the genetic material of eukaryotes. Experiments under controlled conditions, where virtually all of the damage to DNA is by hydroxyl radicals, show that the DNA of chromatin is relatively little protected by either histones or nonhistones unless it is greatly condensed; in the latter case, it is protected only about 10-fold compared to free DNA.

Keywords: viruses; ionizing radiations; molecular structure; biological repair; cloning; hamsters; rats; hydroxyl radicals; carcinogenesis; dna; biological radiation effects.

106039 Radiation Mutagenesis and Yeast. Lawrence. (Univ. of Rochester, Rochester, NY). **Project number:** 002866. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim of this program is to examine in detail the genetic consequences and mode of action of the error-prone or mutagenic system for the repair of radiation-damage DNA in the eukaryote, Saccharomyces cerevisiae.
Keywords: saccharomyces cerevisiae; dna; biological repair; radiation injuries; mutagenesis.

106040 Ionizing Radiation on Cultured Cells. Griffiths. (Univ. of Rochester, Rochester, NY). **Project number:** 002865. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(75); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Since there is considerable data to indicate DNA as the critical target for radiation damage numerous attempts to correlate change in x-ray sensitivity to changes in the amount of DNA damage induced and to the changes in the ability of cells to repair this damage have been made. It is possible to study both damage to DNA and the repair of this damage by determining the integrity of the DNA synthetic process following insult from ionizing radiation, uv radiation, and chemical mutagens. Until recently the primary method for studying perturbations in DNA synthesis following environmental insult involved either pulse or continuous labeling with radioactive DNA precursors. Such kinetic studies have unequivocally shown that treatment of cultured mammalian cells with ionizing radiation, uv radiation, or chemical mutagens results in changes in the rate and/or amount of DNA synthesized. Recently new techniques, including DNA fiber autoradiography, have been developed which should allow for the elucidation of the molecular processes responsible for the perturbations in DNA synthesis observed after environmental insult.
Keywords: ionizing radiations; ultraviolet radiation; mutagens; biological effects; dna; radiation injuries; biosynthesis; biological repair.

106041 *Flux of Energy and Essential Elements Through the Pelagic* Portion of the Continental Shelf Ecosystem. Pomeroy, L. (Univ. of Georgia, Athens, GA, 30602). **Project number:** 006355. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This proposal is for the second year of development of a system of rapid and partially automated methods for evaluating the condition of the microbial portion of the living community of continental shelves. We have developed a system for continuous monitoring of salinity, temperature, transparency, and chlorophyll A. We propose to add to this continuous scanning of particle sizes, numbers, and volume. All data are recorded both on a multi-channel recorder and on magnetic tape. In addition we are measuring total adenylates and adenylate energy charge. We propose to directly measure respiratory rate, by oxygen demand, on samples concentrated on membrane filters. We also have a continuing program of microscopy, using a Zeiss research microscope at sea to observe living material with phase contrast and acridine organic fluorescence. We also use scanning electron microscopy to resolve the smallest organisms. During the coming contract year we propose to use this array to compare a portion of the shelf having little technological impact with one having heavy impact, specifically the South Atlantic Bight and the Western Gulf of Mexico off Louisiana or Texas.
Keywords: continental shelf; microorganisms; salinity; chlorophyll; temperature effects; gulf of mexico; louisiana; texas; baseline ecology.

106042 Inner Shelf Sediment Transport Experiment, Coastal Long Island (INSTEP). Swift, C. (Department of Commerce, Washington, DC, 20418). **Project number:** 007237. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Environmental transport and conversion of pollutants.

The goals of the INSTEP Program are to resolve the pattern (rates and directions) of sediment erosion, transportation, and deposition on the inner continental shelf off Long Island, and to assess the extent to which this sediment transport system bears contaminants from human activity. The INSTEP Sediment Transport Program includes an instrumentation and data analysis work unit. A concentration-velocity probe (CV probe) will measure sediment flux 100 cm off the bottom. A bottom concentration-velocity (BCV) probe will measure sediment flux profiles between 0 and 100 cm off the bottom. Software is being prepared for processing data from the two types of probes. In the suspended matter, work unit suspended matter concentrations will be correlated with near bottom fluid motions by means of CV probes. In the bottom erosion and deposition work unit, flux through and along the water-sediment interface will be measured with BCV probes. The bottom characterization work unit will support the sediment transport work units by gathering data on bottom characteristics.
Keywords: sediments; environmental transport; continental shelf; new york; water quality.

106043 Potential of Energy Extraction and Conversion Process in the Northern Great Plains for Heavy Metals Contamination and Consequent Uptake and Turnover in a Range Ecosystem Model. O'Toole, J.J. (Ames Lab., Ames, IA, 50011). **Project number:** 004135. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

This program is directed to the description, transport and environmental impacts of airborne pollutants from coal conversion facilities in the Northern Great Plains. Present efforts involve surveillance at a point source at Colstrip, Montana from a developing 2100 MW Minemcuth Power Plant. Studies underway include elemental mass balance, source term characterization, trace element composition, chemical speciation and transport, and dispersal and maturation of the aerosol, including characterization of its organic components. Ecosystem impacts have included baseline pre-operational surveys of the pre-operational surveys of the terrestrial and aquatic ecosystems grading into post-operational ecosystem impacts. Vegetation biomass productivity, diversity, plant pathology and secondary faunal effects are being correlated with changes in air pollutants and toxic element titers in the ecosystem. Atmospheric transport studies involving air monitoring, plume tracting, wet and dry aerosol deposition, vegetation scavenging (impaction) are underway. Laboratory studies on heavy metal effects on algal growth and production, and uptake of the elements in terrestrial and aquatic macrophytes are underway. Food chain studies on bioconcentration of toxic elements from emissions are being carried out.
Keywords: great plains; metals; contamination; terrestrial ecosystems; uptake; air pollution; coal liquefaction plants; coal gasification plants; montana; monitoring; chemical analysis; environmental transport; plumes; food chains; environmental impacts; aerosols.

106044 Atmospheric Effects of Coal Conversion Facilities. Gehrs, C. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 004081. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Because of the wide variety of effluent gases and vapors likely to be associated with synfuel production facilities (hydrocarbons, acid gases), a significant potential exists not only for concern about the effects of synfuels emissions directly, but also for formation of secondary pollutants of the photochemical oxidant type which may in turn be problematic. At present, the most widely accepted method of assessing the impacts of air emissions is through the use of open-top field exposure chambers. During FY 78 such chambers have been in operation at a field site on the ORNL reservation. Plots containing white oak, yellow poplar, shortleaf pine, and loblolly pine seedlings, and others containing soybeans are established. Each replicate block contains one plot exposed to ambient air, one exposed to charcoal filtered air, and a third plot to ambient air without an open-top chamber. All seedlings will be evaluated for growth differences at the end of the growing season, and the response will be expressed in terms of the ambient levels of SO2, O3, and acid rain measured at the site during the course of the growing season. Data and experience from the FY 78 growing season will identify potential modifications in equipment or experimental design which might be desirable during the deployment of the system at a gasifier site. This data will also be utilized to determine the minimum number of replicate blocks required at a particular field site. During FY 79 the key objective is to initiate studies to characterize the pre-operational and operational air quality at a field site adjacent to a coal gasification facility, and establishment of the relative rates of productivity of vegetation exposed to those levels of air quality.
Keywords: gaseous wastes; coal gasification plants; environmental impacts; trees; ornl; plant growth; sulfur dioxide; ozone; acid rain; aerosol monitoring; air pollution.

106045 Control of Gene Expression in Mammalian Cells. Anderson, C. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001385. **Contract:** EY-76-C-02-0016. **Supported by:** Depart-

ment of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(30); oil and gas(20); oil shale(20); nuclear fission(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Knowledge of the molecular events regulating gene expression in eucaryotes is essential before techniques can rationally be devised to modify gene expression. Our studies of these events will use human viruses as a model system for analyzing the control of gene expression in human cells. Adenoviruses 2, 5, and 12 are capable of transforming tissue culture cells into tumor producing cells; thus, virus-induced cell transformation specifically alters the control of cell growth. These viruses also can be used as sensitive probes for the damage caused by biologically active substances (radiation, carcinogens, pollutants, drugs) on cellular processes (e.g., DNA, RNA, and protein synthesis) since these viruses use many host cell systems in their own replication. We are particularly interested in the study of chromosome damage and RNA metabolism and in the mechanism of protein synthesis as described below. It is hoped that our studies will contribute to an understanding of how radiation and chemical carcinogens induce cancer in man. We will also attempt to develop an efficient method for the controlled transfer of genetic material into and between animal cells. A eucaryotic plasmid from yeast might be developed into a suitable vehicle for gene transfer in animal cells. Such a system could have profound implications for agriculture and medicine as well as basic research in gene control.
Keywords: tissue cultures; viruses; gene recombination; animal cells; carcinogenesis; biological models; ionizing radiations; pollution; drugs; chromosomal aberrations; rna; proteins; biosynthesis; metabolism; chemical effluents.

106046 Properties of Mammalian Cells Transformed by Tumor Viruses. Hough, P. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001387. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The goal of this project is to develop means for localizing individual molecular species within cells and tissue at the resolution of the electron microscope. A molecular species is identified either by its intrinsic fluorescence or by chemically attaching a fluorescent conjugant or by combining it in situ with a fluorescent antibody. The place of the project within the objectives of DOE is to provide a new tool for the early detection of cellular change and thus to acquire a better understanding of the underlying molecular and cellular mechanisms of cancer. The intrinsic fluorescence of DNA and a newly-developed fluorescent antibody will be applied in the study of chromatin structure. Such structure is crucial to a basic understanding of the de-differentiation of the cell leading to cancer. Further, the fluorescent antibody will be applied in the study of actin-containing cytoplasmic structures which, judging by observations on cellular transformation, play a key role in transmitting growth-control information from the cell surface. The fluorescent antibody will permit localization of antigens at 10,000x magnification and up, ten or more times the useful magnification of the light microscope. The general technique should have wide applicability in health effects research.
Keywords: mammals; animal cells; carcinogenesis; viruses; tumor cells; biological models.

106047 Chemical and Environmental Mutagens. Shairer, L.A. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 002414. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Methods developed for studying the effects of physical mutagens utilizing the tradescantia genetic test sytem can be applied with very little modification to chemical mutagen investigations. Also, dose response data from physical mutagen treatments can be used for baseline comparisons with data from chemical mutagen experiments. Present data indicate that the system is sensitive enough to detect a significant increase in mutation frequencies at levels well below 0.1 ppM for some gaseous mutagens. Research will continue using various chemicals and air pollutants suspected or known to be mutagenic. Greater efficiency of the test system will be sought, through basic genetic and cytological studies designed to elucidate mutational mechanisms, a breeding program aimed at obtaining more sensitive clones, devising more effective chemical mutagen exposure methods and improving dosimetry. Clean air facilities will be used to stabilize background spontaneous mutation frequencies and to determine whether these mutations are the result of inherent genetic instability or are induced by unknown environmental mutagenic agents. A mobile monitoring vehicle will be employed to assess the mutagenic hazards of ambient air pollution and of industrial pollutants in a few specific areas. Data from exposures to low concentrations of both pollutants and known mutagens singly or in combination will contribute to the overall assessment of the potential genetic hazard to man of environmental mutagens.
Keywords: tradescantia; mutagen screening; technology transfer; mutagens; mutation frequency; gases; dose-response relationships; environment; monitoring; air pollution.

106048 Cytochemistry. Smith, P. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 000259. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is oriented toward the development and application of cytochemical procedures as biophysical, cytological probes for the identification and quantitation of enzymes and protein constituents in cells and in their subcellular components. We use specific peptides coupled to 4-methoxy-beta naphthylamine as cytochemical substrates for the biochemical assay and localization of proteinases in tissues, cells, and isolated organelles. Ultrastructural studies are also conducted to identify binding sites of cytochemical markers, using the transmission electron microscope for the localization of electron-dense analogs of fluorescent compounds.
Keywords: cytology; enzymes; peptides; electron microscopy; tissues; animal cells; ultrastructural changes; organoids; biological models.

106049 Somatic Cell Mutations. Thompson, L. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 000261. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This project utilizes somatic cells in culture, Chinese hamster line CHO, to develop better assays for detecting mutagenic pollutants, to develop specific procedures for selecting temperature-sensitive (TS) conditional mutations, and to study the conditions that result in the expression of these chemically induced recessive mutations. The significance of sister chromatic exchange (SCE) as a presumptive indicator of mutagenesis is being evaluated by comparing SCE production with specific locus mutations by different chemical mutagens. Results to date for one locus (HPRT) indicate nonproportionality between the two responses. With procedures employing (3-H) amino acids to select specifically for protein-synthesis mutants, a large number of TS mutant strains have been isolated. These comprise six genetic complementation groups, each representing mutations for a specific aminozoyl-tRNA-synthetase protein. Because these ethyl methanesulfonate (EMS) induced mutations are recessive and have occurred over a wide range in frequency, studies are aimed at clarifying the dependency of mutation rate on gene dosage (e.g., x-linked vs autosomal) and specific mutagen. To test whether wild-type cells have one or two functional genes at a specific tRNA-synthetase locus, selections for forward mutation will compare the rates of wild type and revertant lines that are hemizygous at that locus.
Keywords: mutations; somatic cells; hamsters; bioassay; optimization.

106050 Folate Mutants/Methanol-Related Mutagenesis. Taylor, R. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 000264. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this research is to define the enzymic regulation of folate/one-carbon metabolism and to develop and validate new genetic markers in these pathways for use in pollutant-mutagenicity assays. This research will also provide needed information about the cellular metabolism and genetic toxicity of pollutants that yield metabolically active one-carbon fragments. Our experimental approach is at the in vitro cellular and molecular level, employing primarily Chinese hamster ovary (CHO) cell lines. Several CHO mutants have been shown to lack an active folylpolyglutamate synthetase as the basis for their multiple auxotrophies. Two auxotrophic mutants requiring only glycine are presently being characterized; other mutants will be derived by mutagen treatments. Once characterized biochemically, each mutant will then be evaluated as a possible mutagen-test system. A CHO triple auxotroph shows promise as a reversion assay system for energy-related mutagens that cause specific DNA-base substitutions. In addition, normal CHO cells and folate mutants will be employed to determine the mechanisms by which methanol metabolites damage cells and their macromolecular components. The mutagenicity of methanol and its metabolites will be measured with both forward drug resistance and reverse auxotrophy to prototrophy genetic markers.
Keywords: mutagenesis; biological models; methanol; mutants; toxicity; coal industry; health hazards; bioassay.

106051 Mammalian Membrane Mutants. Shore, V. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 000265. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project concerns the molecular mechanisms by which certain mutations are expressed in animal cells and by which environmental pollutants perturb blood cell differentiation, lymphocyte properties, and plasma proteins and lipoproteins. The research focuses on changes in the cell surface and on the biochemical and biophysical characterization of glycoprotein markers associated with mutations that affect membrane transport function, the Na/sup +/-- K/sup +/-activated ATPase, and sensitivity to ouabain. The differentiation process and cellular immunocompetence will be assessed by changes in cell surface markers and in membrane properties. Plasma and urine constituents are indicators of tissue functions associated with synthesis, catabolism, and excretion of plasma constituents. They are also predictive of secondary damage to physiological processes that depend on an abnormal plasma constituent. These secondary effects include pathological processes, e.g., atherogenesis, as well as normal ones. Those plasma constituents involved in transport of the pollutant will affect that transport and hence the dose-response to pollutants of cells, tissues and the individual.
Keywords: mammals; cell membranes; mutants; animal cells; blood cells; lymphocytes; ouabain; mutagenesis; biological models.

106052 DNA, Chromatin, Chromosomes. Belhorn, R. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 000266. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study addresses the molecular basis for the involvement of DNA and chromatin in the expression of normal and mutant genes in eukaryotic genetic material. Many mutagenic agents produce lesions in chromatin in nonrandom fashion, a higher incidence occurring in heterochromatin or at the junctions of euchromatic and heterochromatic segments. Our previous research on satellite DNAs in the kangaroo rat genus dipodomys provides chemical markers for heterochromatin as well as evidence that this material may be involved in evolutionary species formation and also in determining the response of the genome to injury. We are studying the separation of the two forms of chromatin by utilizing hydrodynamic parameters and sequence-specific restruction endonucleases. Chromatin fractions obtained are characterized with respect to types of DNA sequences and distributions of chromosomal proteins. Such studies will also include the relative binding and rate of turnover (repair) of mutagens and coal effluents (or their metabolites) to the various types of DNA and chromatin isolated from treated cells. The protein transformations that occur in spermatogenesis are studied as a different example of chromatin condensation. Through isotopic labeling of chromatin proteins, we are analyzing the composition of fractionated mammalian chromosomes sorted by flow microfluorometry.
Keywords: dna; chromosomes; chromatin; genetic variability; rats; mutagenesis; biological models.

106053 Repair and Mutagenesis in Yeast. Prakash, L. (Univ. of Rochester, Rochester, NY). **Project number:** 002868. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objective of this research is to investigate the molecular and genetic mechanisms of cellular repair of damaged nuclear and mitochondrial DNA and to determine the effect of cellular repair mechanisms on genetic recombination and on the induction of nuclear and mitochondrial gene mutations. These problems are being studied in a simple eukaryotic organism, the yeast Saccharomyces cerevisiae, where both mutants with repair deficiencies exist and a well-defined mutational system is available. Specific aims of the research are to: (1) understand the molecular mechanisms of cellular repair of damaged nuclear and mitochondrial DNA in an eukaryotic organism, to determine whether the same or different genes control repair of both types of DNA, and to characterize the types of repair processes occurring; (2) determine the effect of repair capacity on both the quality and quantity of induced mutations; (3) determine the enzymatic defect in various repair-deficient mutants, particularly those which have significant effects on mutation and/or recombination; and (4) study the genetic control of nuclear and mitochondrial gene mutation.
Keywords: saccharomyces cerevisiae; biological repair; dna; gene recombination; gene mutations.

106054 Regulatory Mechanisms of DNA Synthesis. Eberle, H. (Univ. of Rochester, Rochester, NY). **Project number:** 002867. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This work contributes to the understanding of how DNA replication and cell division are regulated in bacterial and eukaryotic cells and how chemical, physical, and biological agents can lead to the alteration of the normal regulation of these processes. Work leading to understanding the mechanisms of regulation and to the isolation and characterization of regulatory sequences from normal (and eventually malignant) cells may allow a better understanding of the mechanism of carcinogenesis and lead to more sensitive or specific assays for the detection of carcinogenic agents.
Keywords: dna replication; control; bacteria; cell cultures; mutagens; biological effects.

106055 X-Ray Analysis of DNA-Drug Interactions. Sobell. (Univ. of Rochester, Rochester, NY). **Project number:** 002861. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

These studies have permitted a detailed understanding of the nature of drug intercalative binding to DNA and this has given rise to a general structural model to explain all intercalative drug binding. Also, as a consequence of these studies, the probable sequence of events that allows DNA to open in order to accept an intercalative drug or dye has been reconstructed. This work has led to a deeper understanding of DNA structure and function and also most certainly promises to give additional information about other important drug-DNA associations. It also has provided important insight into how mutagens and carcinogens bind to DNA and this may have important impact in environmental toxicology considerations.
Keywords: drugs; dna; chemical bonds; biochemical reaction kinetics.

106056 Mechanisms of Shale Pollutants on Hematopoiesis. Steinkamp. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 004061. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this health effects program is the application of modern automated flow-systems technologies to develop rapid and sensitive analytical blood cell analysis methods for estimating damage to the human hematopoietic system from exposure by inhalation to physical and chemical toxic agents associated with synthetic fuel production primarily from oil shale using small-animal model systems. We will apply unique flow-systems cell analysis and separation technologies developed at LASL to assess toxicological dose damage relationships to blood cell formation tissues of model animal systems by analysis of peripheral blood cells, since they subsequently reflect the state of cell production and thus can serve as early indicators of potential damage. This will ultimately provide a basis for extrapolation and establishment of guidelines for estimating risks to workers and the exposed population. The current plans are to adapt cell preparation and staining methods previously developed for flow systems and to characterize peripheral blood cells from model animal test systems such as the mouse, rat, and hamster using the multiparameter cell separator and multiangle light-scatter system. Results during the past year consisted of developing a simple procedure for obtaining leukocyte buffy coats from small animals, continuing evaluation of acridine orange (AO) as a potential fluorescent dye for characterizing leukocytes, initial measurement of leukocyte enzymatic esterase activity using fluorescein diacetate (FDA), correlation of cell volume with AO and FDA fluorescence measurements, and identification of abnormal human erythrocyte morphologies based on multiangle light scattering.
Keywords: hematopoietic system; blood formation; biological models; blood cells; toxicity; oil shale industry; chemical effluents; biological indicators; bioassay; man.

106057 Role of Immune Responses in Experimental Chemistry Toxicity and Carcinogenicity. Smith, D.M. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 004062. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This program was initiated in FY 1976 to study basic immunofunction in animals during recovery from chemical insults and preceding and during carcinogenesis so that the immune system may be assessed in an intelligent fashion as a prophylactic or therapeutic measure in dealing with such health hazards to the human population. An animal model was developed that would parallel the human situation and provide a wide spectrum of information. Techniques with the rat and hamster have proven successful, and appropriate tests can now be performed with lymphocytes from spleen, thymus, and blood. Nine tests can be used on a single animal to detect

perturbations in specific lymphocyte number, functions, and interactions. The tests will be applied to aromatic hydrocarbon-induced carcinogenesis of the respiratory tract (benzo(a)pyrene) and chemically-induced (nitrosamines, dimethylhydrazine) carcinogenesis of the gastrointestinal tract. Carcinogenic properties of aromatic hydrocarbons alone and along with other potentially synergistic agents in immunologically deprived animals will be determined. Oil shale extraction by-products to be studied include polycyclic aromatics, organic amines, thioethers, organic acids, esters, phenols, organometallic compounds, alkanes, alkenes, and potentially toxic trace metals.
Keywords: immunity; biological functions; carcinogenesis; rats; hamsters; benzopyrene; nitroso compounds; amines; lungs; gastrointestinal tract; lymphocytes.

106058 Biochemical Genetics of Yeast. Sherman, F. (Univ. of Rochester, Rochester, NY). **Project number:** 002869. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

An iso-cytochrome C system is being employed for investigating: (1) isolation and characterization of structural and regulatory mutants for both iso-1 and iso-2 cytochrome C; (2) identification of amino acids inserted by various nonsense suppressors and other translational suppressors and the determination of the efficiencies of suppression; (3) determination of the specific action of numerous mutagens; (4) gene conversion studies and examination of the relationship of recombination frequencies and nucleotide alterations; (5) use of E. coli plasmids for cloning the CYC1 and CYC7 genes which determine, respectively, iso-1 and iso-2-cytochromes C; and (6) characterization of mRNAs specifying the two iso-cytochromes C and their measurements in normal and mutant strains.
Keywords: yeasts; genetics; cytochromes; purification; amino acids; mutagens; biological effects; gene recombination; messenger-rna; cloning.

106059 Analysis of Cytochrome Mutants. Stewart. (Univ. of Rochester, Rochester, NY). **Project number:** 002870. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The major objectives of this research are to: (1) identify the replicated products of reaction of mutgens with functional genetic material in an organism having a nuclear complexity and organization similar to that in man; (2) establish the genetic code used by this organism for the translation of nucleotide sequences in DNA into amino acid sequences in protein; and (3) prepare and identify many structural variants of a protein enzyme, cytochrome C, encoded by the functional genetic material being examined to find what mutationally-induced changes in the protein are innocuous and what changes are detrimental to its biosynthesis and to its properties.
Keywords: mutagens; genetic effects; biochemical reaction kinetics; genetic mapping; biological models; cytochromes; purification.

106060 DNA Metabolism of T-4 Phage. Wiberg. (Univ. of Rochester, Rochester, NY). **Project number:** 002871. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The general aim of this program is to understand how a relatively simple organism, the bacterial virus T4, expresses its genes. Studies include work on regulation of virus protein synthesis, effects of the virus on host DNA, and control of viral DNA synthesis. T4 mutants are used as tools to probe these processes since they can give insight into the intracellular role of specific enzymes and genes. The techniques are genetic and biochemical. A number of mutants affected in these various processes have been isolated and attempts are being made to isolate others, e.g., one defective in regulatory functions in addition to those in which we already have mutants.
Keywords: bacteriophages; genetics; dna; proteins; biosynthesis; metabolism.

106061 Pulmonary Biochemistry. Mavis. (Univ. of Rochester, Rochester, NY). **Project number:** 002873. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the goal of this program to identify and characterize key enzymes of lung metabolism beginning with the enzymes potentially involved in pulmonary surfactant synthesis because of the importance of surfactant to lung function and because the location and synthesis of pulmonary surfactant in the alveolar epithelium make surfactant production and function directly susceptible to inhaled toxins.
Keywords: lungs; enzymes; purification.

106062 Dynamics of Bone Mineralization. Neuman, W. (Univ. of Rochester, Rochester, NY). **Project number:** 002874. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this work are threefold: (1) to define the basic properties of the bone membrane system in terms of normal function; (2) to define the role of the bone membrane in controlling the fluxes of a variety of bone seekers to and from bone; and (3) to define in vitro the effects of exposure to bone seekers on the normal function of the bone membrane. In addition to the main interest in the bone membrane, increasing emphasis is being placed on agents which are recognized as controlling cellular processes in bone. This includes studies of the metabolism and effects of parathyroid hormone, calcitonin, vitamin D metabolites, and the more recent diphosphonates.
Keywords: skeleton; in vitro; cell membranes; biological functions; dynamic function studies; bone seekers; radionuclide kinetics; biological radiation effects; metabolism; parathormone; calcitonin; vitamin d.

106063 Radiation Chemistry of DNA. Bernard. (Univ. of Rochester, Rochester, NY). **Project number:** 002875. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Ionizing radiation, both as a therapeutic tool and an environmental hazard, continues to be an ever present, if not growing, influence on human lives. The main means of treating cancer is still radiation therapy. The simultaneous application of drugs and radiation is now at the clinical testing stage and the improved efficiency of killing cancer tissue is one example of how basic radiation chemistry research has led to improved clinical methods. Ionizing radiation is, however, a two-edged sword and in the long run it is not likely to have its impact on humanity as a therapeutic agent but instead as a hazard in our environment. Immediate sources and potential sources of ionizing radiation continue to grow. Accompanying this growth is an increase in the risk of mutation and death due to either accidental short-term exposure or long-term background exposure to ionizing radiation. With the immediate importance of ionizing radiation in treating cancer and the long-term concern for the risks in using ionizing radiation in technology and weapons, the question of how ionizing radiation kills or mutates a living cell continues to be very pressing.
Keywords: dna; ionizing radiations; biological radiation effects.

106064 Nucleic Acid Replication. Dunn, J.J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000047. **Contract:** EY-76C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We are studying at the molecular level the processes that regulate the synthesis of functional T7 and adeno messenger RNAs. Most of these processes involve protein-nucleic acid interactions and a major part of our effort is directed at determining the nucleotide sequence of those portions of nucleic acids that have important functions in synthesis and processing of messenger RNAs. By determining the sequence of wild-type and mutant forms of regulatory signals we not only obtain important information concerning the mechanism of regulation but also the mechanism of mutagenesis.
Keywords: viruses; messenger-rna; biosynthesis; nucleotides; biological functions.

106065 Mechanisms of Radiation Lethality. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000162. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To fully appreciate the effect of potentially harmful environmental factors on living cells it is important to understand the response of cells to lesions in their DNA. Understanding the molecular basis of these responses may assist in predicting consequences to be expected from specific cases of exposure to potentially mutagenic or lethal factors. Our studies focus upon achieving a better understanding of: the biochemical details of DNA repair, the response of replication complexes to damaged DNA, and DNA damage-induced biochemical changes that produce further physiological consequences. Studies of the recognition and removal of lesions in DNA are being performed with extracts from repair deficient bacterial mutants. Also, the response of an in vitro DNA replication system to damaged template is being used to investigate potentially mutagenic events at the replication fork. One effect of DNA damage is derepression of operons and subsequent physiological changes, includ-

ing cessation of respiration and cell death. Thus, to better understand the cause of death in irradiated cells, we are studying the effect of cyclic AMP, which regulates many inducible operons, on the control of respiration in ultraviolet irradiated cells and on irreversible biochemical changes associated with death.
Keywords: dna; biological repair; dna replication; response modifying factors; ultraviolet radiation; biological radiation effects; respiration; amp; mortality; pathological changes; cell cultures; in vitro.

106066 Carcinogen Screening. Novelli, G. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000164. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is designed to develop methods for the isolation, purification, characterization, and mechanism of action of human cancer-specific transfer factor, immune RNA, and lymphokines that could contribute to increased effectiveness of immunotherapy of human cancer. Since these factors act in the same concentration as hormones, a large scale effort is required to obtain sufficient material for characterization. This will be carried out in our pilot plant facility with material obtained from a normal human lymphoblastoid cell line activated by co-cultivation with different human cell lines.
Keywords: purification; immune serums; immunotherapy; chemical properties; lymphocytes; man.

106067 Low Angle Neutron Diffraction. Carlson, R. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000048. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The main objective is to obtain information about biological structures by neutron and x-ray scattering studies. The objects of study have been chosen because of their importance for understanding biological control. The enzyme complex, Aspartate transcarbamylase, is being examined in the hope of determining the structures of forms present in equilibrium and also the kinetics of the conversion. The rates of metabolic processes depend on such changes which have thus far not been amenable to study. An additional objective is to develop simple methods for obtaining structural information about membranes from dispersions of membrane vesicles, which are the most native state in which purified membranes can be obtained. These methods should be useful in studying both the native structure of, e.g., surface membranes involved in photosynthesis, and also the modifications of this structure during activity or after treatment with the pollutants. A major new direction in FY 78 will be to initiate studies on chromosomes. The genetic depositary units are nucleic acid protein complexes of remarkable identical structure throughout eukaryotic organisms. Chromatin occurs as a beaded string with beads of DNA and protein of a highly conserved amino acid sequence. Large quaternary structural transformations of chromosomes are observable during cell division but little is known about the spatial organization and matins components. Neutron scattering from chromatin will reveal the spatial arrangement of DNA and the various protein complexes and will allow the analysis of specific histones.
Keywords: neutron diffraction; x-ray diffraction; aspartic acid; enzymes; cell membranes; biomimetic processes; surfaces; photosynthesis; nucleosomes; dna; chromosomes; structural chemical analysis.

106068 Oxidative and Free Radical Mechanisms Underlying the Actions of Pollutants. Borg, D.C. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000049. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Fundamental molecular and cellular damage associated with possible carcinogenesis/mutagenesis from hydrocarbons and other pollutants derived from fossil fueled energy conversion and utilization processes are studied. Metabolic activation of some classes of carcinogens/mutagens produces free radicals as the ultimate reactants with DNA, etc. These damage reactions are examined with continuous-flow reactors for use with Q-band electron paramagnetic resonance (EPR). Another goal is to develop a simple semi-empirical prescreening road applicability using spin-label methods to provide a rapid, presumptive evaluation of DNA binding of test compounds incubated with activating enzyme systems. The spin-label assay would screen for a chemical property that should correlate with carcinogenesis (and mutagenesis), being a necessary (if insufficient) condition for carcinogenesis to ensue. Other aspects of the molecular toxicology of pollutants are also investigated, emphasizing oxidative and free radical mechanisms, often using EPR techniques. Reactions underlying the toxicity of oxidizing pollutants (ozone, NOx, SOx) are studied, including free radical chain reactions that destroy membrane lipids or initiate inflammation. Hydroxyl radicals and superoxide anions are often involved. To characterize these reactions further, an interdepartmental project is proposed to utilize pulse radiolysis methods and to provide an on-line EPR facility at the BNL dynamitron electron accelerator.
Keywords: radicals; hydrocarbons; carcinogenesis; dna; electron spin resonance; metabolic activation; ozone; nitrogen dioxide; sulfur dioxide; lipids; cell membranes; superoxide radicals; hydroxyl radicals; radiolysis; pulse techniques; toxicity; biological pathways.

106069 Studies of Biological Structures by Scanning Transmission Electron Microscopy. Wall, J.S. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000225. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A new scanning transmission electron microscope (STEM) has been constructed at Brookhaven for the purpose of biological structure determination at 2 angstrom resolution on frozen, hydrated specimens. The STEM is the only one of three such instruments presently operating in this country equipped for low temperature studies and offers many capabilities surpassing those of conventional electron microscopes. The method of image formation is similar to that of a television set, one point at a time. The high information collecting efficiency of the STEM allows imaging of biological molecules with an order of magnitude lower radiation damage than other electron microscopes. The STEM can easily image unstained biological molecules (e.g., DNA) and single atoms heavier than bromine.
Keywords: electron microscopes; construction; transmission electron microscopy; molecular structure.

106070 Recombination and Repair of DNA. Setlow, J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001286. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objectives of this program are: (1) to understand the molecular basis of biological damage (inactivation and mutation) by pollutants and radiation and the repair of such damage; and (2) to understand the molecular events taking place during the recombination that results in genetic exchange as well as the recombination that results in DNA repair. The bacterium Haemophilus influenzae is useful for these studies, mostly because a large number of mutants that have been isolated are deficient in various steps of repair of recombination, and also because it has a very efficient transformation system.
Keywords: dna; biological repair; gene recombination; pollution; ionizing radiations; biological effects; mutagenesis; molecular structure; haemophilus.

106071 Regulation of Hematopoiesis. Odell, T.T. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000151. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The central objective of this project is to understand the maturation and the regulation of rapidly proliferating cells of the blood-forming tissues. The megakaryocyte-platelet system has been emphasized. Knowledge of the regulation of cell renewal systems in vivo will provide fundamental background information that can be used in assessing effects of deleterious environmental agents or abnormal physiologic conditions that interfere with normal cell turnover and with the maintenance of normal levels of cells in an organism. Cell systems having high rates of turnover are prime candidates for the expression of cell transformations that can culminate in cell populations in which normal control of proliferation has been lost. Past results from this project have contributed to current knowledge of the characteristics and timing of the maturation of megakaryocytes. The process of maturation of this cell line in which the cells become highly polyploid during the course of their maturation provides a unique model for investigation of perturbed regulation. Investigations to identify humoral agents that regulate this system are in progress.
Keywords: blood formation; control; maturation; in vivo; bone marrow cells.

106072 Growth and Regeneration. Skinner, D. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000158. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

All the information for a cell's functions is encoded in its DNA. Various environmental insults, whether they be carcinogens, mutagens, or teratogens, have been shown to have a direct interaction with DNA, some binding irreversibly, some sensitizing it such that there occurs single- or double-strand breaks. Studies on benzpyrenes, the most potent carcinogens derived during coal conversion, show that 80% of the binding is to the N2 of guanine, while 10% is to adenine. The latter causes a strain on the helical structure, producing single-stranded regions. At this time, it is impossible to determine if either binding site is a more carcinogenic hot spot, however, the paradigm for a naturally occurring A+T-rich DNA is the crab satellite Poly D(A-T) (more than 95% A and T residues) whereas other satellites contain either repeating pairs of triplets of G residues on one strand. In either case, such satellites may serve as mops for carcinogens, and moreover, as naturally occurring DNAs, are potentially ideal model systems for studying carcinogen metabolism. Our work is on their physical and chemical characterization at various structural levels and on their function.
Keywords: dna; crustaceans; biological models; biological functions; chemical properties; physical properties.

106073 Interaction of Fossil-Fuel Derived Toxic Metals with Biological Membranes. Schneider. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002118. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); oil and gas(20); oil shale(20); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Changes in cell surfaces upon transformation to the malignant state have been observed but these are phenomenological, not consistent from system to system and the mechanisms by which they occur are unknown. At least some forms of cancer are believed to be caused by tumor viruses. These viruses acquire lipoprotein envelopes by budding through the most cell membrane during their release. This process requires that the cell membrane be altered by viral infection so that it includes budding sites enriched in viral proteins and possibly some cellular proteins, while excluding others. The viruses then have the ability to alter the organization or regulation of synthesis (or both) of cell membrane proteins. Given that the nature of membrane changes may be a function of the effector of the carcinogenic process, studies of these changes may allow determination of agents causing malignancy in populations exposed to a variety of potential oncogenic substances.
Keywords: cell membranes; oncogenic transformations; carcinogens; biological effects; morphology.

106074 X-Ray Diffraction. Einstein, J. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001471. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Toxins, carcinogens and mutagens, the hazardous by-products of various types of energy production, first encounter the human organism at cellular membranes. To learn more about molecular interactions at membrane surfaces, we are studying Ricinus toxin, which after being bound to specific membrane receptors of human cells is passed into the cells by endocytosis. X-ray crystal structure determination of this toxin and of its complexes with moieties of receptors will explain the specificity of toxin-receptor interaction and will be the first step toward understanding the triggering of endocytosis. We are also working by crystallographic methods on the molecular structure of the variable-half dimer of Bence-Jones protein len, an immunoglobulin light chain excreted by cancer patients having multiple myeloma. This would be the first structure for the K-4 class of light chains, which contain a six-residue insertion adjacent to the antigen-binding site. Studies of complexes with small molecules would elucidate the specificity of the dimer binding site, expected to be highly analogous to that of the complete immunoglobulin.
Keywords: cell membranes; toxins; molecular structure; immunoglobulins; carcinogens; mutagens; biological effects; crystal structure.

106075 Protein Chemistry. Hartman, F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001472. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Chemicals released into the environment, whether from coal conversion or other sources, pose potential hazards to man because these pollutants can be acutely toxic, carcinogenic, mutagenic, or teratogenic. An understanding of these adverse health effects requires a knowledge of the interaction of chemicals with biological systems and understanding of the enzymology of replication and transcription as interference of these latter processes can contribute to carcinogenic, mutagenic, and teratogenic activity. To learn more about enzyme mechanisms, we attempt to characterize enzymic active sites with chemical probes. Specifically, affinity labeling is used, a procedure whereby a chemical reagent is endowed with a high degree of specificity for the active site by incorporating into its structure by organic synthesis those functional groups of the natural substrate that are required for binding. Identification of active-site residues aids in understanding the two most unique properties of enzymes: (1) their stringent specificity, and (2) their enormous catalytic efficiency. Present work emphasizes enzymes involved in carbohydrate metabolism.
Keywords: enzymes; specificity; chemical bonds; receptors; catalysis; affinity; carbohydrates; metabolism; biological pathways; biomimetic processes; biochemistry.

106076 EPR Studies of Membrane Structure. Pushkin, J. (Univ. of Rochester, Rochester, NY). **Project number:** 002896. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In conjunction with the use of paramagnetic divalent cations, electron paramagnetic resonance (EPR) is a powerful tool for investigating many aspects of Mn2+ binding to phospholipid (PL) bilayers. Mn2+ is particularly useful for such studies both because it is a good chemical analog to Ca2+ and because it has a characteristic strong signal when free in aqueous solution that broadens markedly upon complexation. Independence of Mn2+-PL binding on lipid composition, salts, temperature, anesthetics, and other surface-active agents are being examined. These studies, besides probing cation-PL interactions, will shed light on the mechanism of anesthesia and other membrane-related phenomena. The immediate driving force for active Ca2+ uptake by mitochondria appears to be an inside-negative membrane potential set up by outwardly-directed proton pumping. Recent evidence from this laboratory, however, indicates that Ca efflux transpires through a separate mechanism, which is insensitive to the uptake inhibitor, ruthenium red (RR). Current research is aimed at elucidating the efflux system.
Keywords: biochemical reaction kinetics; electron spin resonance; cell membranes; phospholipids; manganese ions; cations; mitochondria; calcium ions; uptake; membrane transport.

106077 Intestinal Epithelial Transport of Metals. Kimmich, G. (Univ. of Rochester, Rochester, NY). **Project number:** 002902. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

An ultimate aim of the project is to achieve a full understanding of epithelial transport systems in terms of their molecular mechanism. Agents which interact specifically with different elements of the transport system can be of enormous benefit in establishing the nature of function of each of the systems which must operate in order to allow transepithelial solute fluxes. For this reason we intend to evaluate the degree and nature of interaction of a variety of toxic metals with the epithelial transport systems as potentially useful probes of membrane functional events. This endeavor offers the dual possibility of further discerning the characteristics of epithelial transport as well as providing basic information regarding the nature of toxic metal interactions with biological membranes.
Keywords: gastrointestinal tract; epithelium; membrane transport; toxic materials; elements; biological effects.

106078 Impact of Thermal Loading and Other Water Quality Parameters on the Epizootiology of Aeromanas hydrophila Infections of Centrarchids. Esch, G.W. (Wake Forest Univ., Winston-Salem, NC, 27109). **Project number:** 007058. **Contract:** 79-EV00900. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Studies will be conducted on the epizootiology of Aeromonas and Epistylis among largemouth bass in Par Pond, Aiken, SC. An effort will be made to assess the impact of thermal effluent, dissolved oxygen, organic loading and several other water quality parameters, and on the nature and course of the disease produced by these organisms in largemouth bass. The serotypes of several strains of Aeromonas, isolated from diseased fish, will be compared with those isolated from the water column. Body condition of infected and non-infected bass will be compared with several blood parameters, including sodium, potassium, iron, total iron-binding capacity and thyroxine. Antibody titers of infected and uninfected bass from thermal and ambient locations will be compared on a seasonal basis. It is hoped that the results from these studies will ultimately permit

us to predict epizootic outbreaks in reservoirs in the southeastern U.S. or prevent such outbreaks as might otherwise have occurred.
Keywords: water quality; thermal pollution; water pollution; fishes; organic compounds; diseases; aeromonas; infectivity; thermal effluents; biological effects; temperature effects.

106079 Geographic Analysis of Thermal Equilibria: a Bioenergetic Model for Predicting Thermal Response of Aquatic Insect Communities. Vannote, R.L. (Academy of Natural Sciences of Philadelphia, Avondale, PA, 19311). **Project number:** 008255. **Contract:** 79-EV10259. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objectives of this project are to: (1) develop a new technology for evaluating the ecological aspects of thermal variation in rivers; (2) collect over a large geographic area a uniform set of ecological data on natural systems to test a specific hypothesis developed from our White Clay Creek studies; (3) refine the model for use in evaluating and predicting the response of lotic species to thermal alteration; and (4) test the model on an array of manipulated systems. This study is important because ecologically relevant parameters of biological systems, which are easily and inexpensively measured, may be used to: (1) evaluate how much rivers of various sizes and geographic locations can be warmed or cooled without serious ecosystem disturbance; (2) provide a sensitive basis for continual evaluation of the impact at various distances downstream from the warm (or cold) water discharge; and (3) provide a method for predicting the effects of riparian vegetation and channelization projects. Our study will provide the first data set collected over a large geographic area using uniform research methods, an element now lacking completely in the field of thermal ecology. This void makes regional discussion difficult and often dictates costly studies at each proposed development site which are never comparable due to non-uniform data collection.
Keywords: invertebrates; communities; aquatic ecosystems; biological models; insects; thermal pollution; temperature effects; water pollution; biological stress.

106080 Red Cell Cytoskeleton. Kirkpatrick. (Univ. of Rochester, Rochester, NY). **Project number:** 002881. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall objectives of this project are to elucidate the role of the erythrocyte protein spectrin in maintenance of red cell membrane structure and flexibility, both for its intrinsic interest and as a model for membrane cytoskeletons in other cell types, and to use this model system as a screening tool for effects of heavy metals on membranes and supporting structures.
Keywords: erythrocytes; cell membranes; molecular structure; metals; toxicity; biological indicators.

106081 Paramagnetic Probe of Membranes. Gunter, T. (Univ. of Rochester, Rochester, NY). **Project number:** 002879. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The long term goals of this research are to: (1) provide a detailed mechanistic understanding of mitochondrial divalent cation transport; (2) isolate one or more of the mitochondrial divalent cation transporters and reconstitute calcium transport in cytochrome oxidase vesicles using only mitochondrial proteins. This procedure will then be tested by comparing the properties of the isolated complex(es) with those of transport mechanism(s) in the mitochondrion; (3) synthesize a picture of the physiological significance of mitochondrial divalent cation transport; and (4) determine the effects on the mitochondrial system of the presence of pollutant ions such as the lead ion, the mercuric ion, the cadmium ion, the arsenite ion or the arsenate ion, and the lanthanides and relate these findings to effects on both cation transport and oxidative phosphorylation.
Keywords: mitochondria; membrane transport; cations; biochemical reaction kinetics; metabolism; elements; biological effects.

106082 Bioinorganic Chemistry. Feldman, I. (Univ. of Rochester, Rochester, NY). **Project number:** 002876. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Everyone is exposed to the metal ions put into the biosphere during both energy production and consumption. Many of these metals are toxic, even in minute concentrations. Undoubtedly a major reason for the toxic action of some metals is their interference with the normal biological reactions of useful metals, e.g., magnesium. No physiological reaction is more critical than the enzymatic dephosphorylation of adenosine triphosphate (ATP) since most of the energy transfer in the living cell occurs via this reaction. The normal biological activator in this reaction is the magnesium ion, MG2+. It is generally believed that the catalysis involves the Mg, ATP2- complex. Since most divalent and trivalent metal ions form very much stronger complexes than does Mg2+, it seems that most ingested metals would interfere with enzymatic ATP dephosphorylation if they were not preferentially complexed by other physiological constituents or at sites not involved in this reaction.
Keywords: metals; cations; biosphere; biochemistry; magnesium compounds; atp; phosphorylation; catalysis; toxicity.

106083 Biochemical Genetics of Yeast. Sherman, F. (Univ. of Rochester, Rochester, NY, 14642). **Project number:** 002869. **Contract:** EY-76-C-02-3490. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to: (1) isolate and characterize structural and regulatory mutants for ISO-1 and ISO-2-cytochrome c; (2) identify amino acids inserted by various nonsense suppressors and other translational suppressors; and (3) determine the specific action of numerous mutagens. Genetic and biochemical studies of the yeast saccharomyces enrichment procedures for both forward and reverse mutations will be conducted. A series of deletions makes it possible to map point mutants and to estimate their positions relative to the ISO-1-cytochrome c sequence. The primary structures of ISO-1-cytochrome c and ISO-2-cytochrome c are determined by the genes CYC1 and CYC7. The CYC7 locus is shown to be on the right arm of chromosome v near the min 1 and mak 10 markers. This locus contains distinct structural and regulatory regions.
Keywords: saccharomyces; mutagens; genetic effects; cytochromes; mutants.

106084 Developmental Neurobiology. Herschman, H. (Univ. of California, Los Angeles, CA, 90024). **Project number:** 000460. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We have developed and characterized cell lines from tumors of the rat, human, and mouse nervous system which exhibit characteristics of normal glial and neuronal cells. Characteristics include hormone responses, synthesis of neurotransmitters and associated enzyme systems and membrane ion transport properties of neurons. These cell lines are now being used to characterize environmental effects on cellular expression of neuronal and glial function. Metallothionin is a small cysteine-rich protein product in liver in response to cadmium exposure. We can induce metallothionin synthesis in (1) clonal cells derived from rat liver and (2) HeLa cells (a human tumor line) growing in a serum-free medium. The prostate specific acid phosphatase is elevated in sera of patients with prostatic cancer. we have (in collaboration) developed a radioimmunoassay for this enzyme. In a double blind assay of control and patient sera, the RIA is much more sensitive than the enzyme assay in detecting cancer patients at an early stage of disease. Epidermal growth factor stimulates cell division on nondividing murine fibro-blasts. We have characterized receptor-binding, dose response, and time-course variation of growth control. Variant cell lines non-responsive to EGF have been selected and characterized.
Keywords: tumor cells; cell cultures; rats; man; mice; nerve cells; environmental effects; biological functions; acid phosphatase; radioimmunoassay; fibroblasts; growth; stimulation.

106085 Cellular and Molecular Biology. DeVellis, J. (Univ. of California, Los Angeles, CA, 90024). **Project number:** 000459. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We are utilizing a combination of in vivo and tissue culture systems to study the effects of environmental pollutants, hormones and various drugs on the development and functional differentiation of nervous tissue. Base-line characteristics of the system are being determined at the molecular and cellular level in order to quantitate the interactions of pollutants generated by coal combustion and to establish threshold dose levels due to chronic and acute exposure to the pollutants. One of the specific biochemical markers of brain differentiation (gylcerol, phosphate dehydrogenase GPDH) is found in only one population of brain cells (oligodendroglia). Since GPDH is regulated by hormones and since oligodendrocytes synthesize and maintain myelin, this system provides an excellent and unique opportunity to define the effects of contaminants on the hormonal response, viability and metabolic function of an important population of cells. Each molecular step in the regulatory process can now be measured including hormone uptake, binding to specific receptor, nuclear binding of hormone-receptor complex, specific rate of GPDH synthesis and the amount of functional mRNA. Since greater

than 95% of all human brain cell tumors are gliomas, the system allows the investigation of the mutagenic and carcinogenic effects of pollutants on these oligodendroglia.
Keywords: in vivo; tissue cultures; pollution; hormones; drugs; biological effects; ontogenesis; nerve tissue; coal; combustion products; mutagenesis; carcinogenesis.

106086 Biosynthetic Control. Fulco, A.J. (Univ. of California, Los Angeles, CA, 90024). **Project number:** 000457. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

An intensive investigation of how various environmental stresses (such as temperature changes and hydrocarbon pollution) affect cell membrane function and integrity is being undertaken using several species of bacilli as well as other bacteria as experimental organisms. This study is designed to elucidate the following: (1) the mechanisms by which environmental temperature changes elicit adaptive alterations in membrane lipid metabolism and particularly unsaturated fatty acid biosynthesis; and (2) the comprehensive examination of bacterial cytochrome P-45-dependent long-hydrocarbon-chain hydroxylation, the kinetics and mechanisms of the cell-free hydroxylation systems, and the identification of the hydroxylation products and of the structural and chemical characteristics of the substrate-binding sites on the P-450 cytochromes. In vivo studies will include the determination of those factors leading to induction of P-450 systems and the metabolic fate of the hydroxylated alkyl chains, particularly as components of cell-membrane lipids.
Keywords: bacteria; cell membranes; temperature effects; hydrocarbons; biological effects; metabolism; cytochromes.

106087 Developmental Regulation. Harary, I. (Univ. of California, Los Angeles, CA, 90024). **Project number:** 000449. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

We are developing the heart and skeletal muscle cell culture system to create simple well defined models in which to evaluate cytotoxicity and carcinogenesis. In the skeletal muscle system we are studying the effect of heavy metals on each step of development and on the functioning multinuclear muscle fibers. In the heart we are defining the internal and external parameters which control development and the maintenance of specific function such as the rate of specific protein synthesis, beating rate, Ca/sup ++/ utilization, control of cyclic AMP levels and the role of cell division and growth. Specifically we will study the reciprocal control of Ca/sup ++/ and cyclic AMP with the beating rate, and the purified enzymes, soluble cycle AMP phosphodiesterase and membrane bound adenyl cyclase, which control the cyclic AMP level. We are also studying the control of lipoprotein lipase in these cells as a measure of an essential function. In addition we will study the changes in chromatin in both developing skeletal muscle and heart cells. It is necessary to define the system clearly and accurately to provide models in which quick, quantitative and pertinent answers will be easily attained.
Keywords: cell cultures; heart; muscles; biological models; elements; biological effects; ontogenesis; control; biological functions; amp; proteins; biosynthesis; carcinogenesis.

106088 Plant Cell Wall. Lamport, D. (Michigan State Univ., East Lansing, MI). **Project number:** 000199. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This task is concerned with determining the structure, function and metabolism of extensin, the hydroxyproline-rich protein present in the primary cell wall of most green plants. Current work is directed at the determination of the structure of extensin released from the cell walls of in vitro cultures of higher plants. We are attempting to release extensin from the cell wall be several techniques; after further purification, we will subject the released fragments to structural analysis. Ultimately we expect to describe how the extensin polypeptide backbone relates to the rest of the cell wall structure. For this reason we are also studying the structure of extensin precursors and other soluble hydroxyproline-rich glycoproteins.
Keywords: cell wall; plant cells; proteins; molecular structure; biological functions; metabolism; cell cultures.

106089 Physical Biochemistry. Haug, A. (Michigan State Univ., East Lansing, MI). **Project number:** 000202. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We investigate environmental adaptation processes in biological membranes. We had found that the membrane lipid fluidity in procaryotic cells is regulated and kept virtually constant despite changes of growth temperature and nutrient supply. Therefore, the membrane lipid fluidity and related molecular parameters are used to study physico-biochemically adaptation mechanisms of pro- and eucaryotic cells in response to environmental stress. The aim is to define key mechanisms which limit plant productivity under diverse environmental conditions. In thermophilic mycoplasmas, which live in a harsh environment (pH 2, 56 degrees C), glycoproteins and glycolipids are isolated in order to obtain information on their protective role for the cell. Large quantities of long chain alkyl glyceryl ethers seem to stabilize the membrane; also bivalent metal ions rigidify the membrane.
Keywords: plant cells; cell membranes; lipids; biological stress; fluid flow; glucoproteins; glycerol; ethers; metals; cations; biological adaptation; productivity; biological pathways.

106090 Quantitative Microscopy. Young. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 002168. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Clinical studies in humans.

This project will establish a coordinated program for the early detection of serious and delayed health effects, including cancer and mutation, in workers and other persons at risk for significant exposure to noxious pollutants from fossil fuel technologies. A battery of tests will be applied to samples of blood, urine, and semen. The tests will measure chromosome aberration and sister chromatic exchange rates, frequency of mutant hemoglobin in red cells, enzyme and apolipoprotein profiles of serum, mutagenicity, enzyme profile and cytological abnormality in urine, and frequency of abnormal sperm. These tests currently are in use under development in this laboratory, and they all are designed to detect precancerous lesions and genetic damage in man. Their application will allow detection of hazardous situations early enough to take remedial action and to safeguard the health of the individual and society. This project will: (1) identify those tests that measure significant genetic and carcinogenic effects induced by exposure to fossil fuel pollutants; (2) validate the epidemiology and dose-response of the tests; and (3) apply the tests as personal dosemeters to monitor exposure of workers for potential health effects caused by fossil fuel pollutants.
Keywords: chromosomes; sister chromatid exchanges; hemoglobin; spermatogonia; personnel; health hazards; diagnostic techniques; occupational diseases; blood; urine; apolipoproteins; preventive medicine; medical surveillance; microscopy.

106091 Optical Probes of Macromolecular Structure. Sutherland, J.C. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001823. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Spectroscopic techniques play an important role in understanding the biological effects of uv. We are using action spectroscopy (the relative efficiency with which different wavelengths produce a given effect) to determine the molecular target for malignant transformation and to identify photochemical lesions responsible. Using absorption and fluorescence spectroscopy, natural and magnetic circular dichroism and related techniques, we are probing the photophysical and photochemical events which convert uv radiation into a biologically important lesion. In the case of one uv induced lesion, the cyclobutyl pyrimidine dimer, we are also studying the physical and photoenzymatic mechanisms of monomerization, i.e., lesion reversal. We are developing new spectroscopic techniques and instrumentation to answer questions about uv induced photophysical processes which are unanswerable with existing methodology.
Keywords: ultraviolet radiation; biological effects; oncogenic transformations; biological repair.

106092 PR Repair Enzymes. Sutherland, J.C. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001824. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil shale(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The major cellular process standing between uv damage and its harmful effects is DNA repair. The major uv lesion is the cyclobutyl pyrimidine dimer, formed between adjacent pyrimidines on a DNA strand. Photoreactivation is unique among DNA repair processes in its specific action on pyrimidine dimers; the photoreactivating enzyme binds to a dimer-containing region of DNA, the complex absorbs a photon of near uv or visible light, and the dimer is monomerized to its constituent pyrimidines. This problem involves

a study of the biochemistry and photophysics of photoreactivating enzymes, the biology of photoreactivation in mammalian, invertebrate, plant and bacterial cells, and the use of photoreactivation as a diagnostic tool in determining the role of pyrimidine dimers in uv-transformation.
Keywords: ultraviolet radiation; biological effects; dna; photoreactivation; pyrimidines; enzymes; dimers.

106093 NMR Studies of Membrane Structure. McLaughlin, A.C. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001825. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Membranes are involved in many of the biochemical functions of the cell such as the selective uptake of nutrients. They are intimately involved in other physiological and immunological functions such as conduction of the nervous impulse and recognition and destruction of foreign cells. Membranes also appear to be the site at which promoters of the carcinogenic process, such as by-products of fossil-fuel technology, disrupt normal growth-limiting control of cells and permit latent genetic changes with a carcinogenetic potential to emerge. Cellular and sub-cellular membranes thus play a crucial role in the overall viability of the cell, and many diseases can be directly traced to a malfunction in a specific membrane process. One of the important regions of the membrane is the interface between the lipid interior and the external aqueous phase. It forms the site of action of many drugs, antibiotics and mutual ions with the membrane. The fluidity of the membrane surface is thought to be a controlling factor in many phenomena associated with transformation of cells by chemicals or oncogenic viruses, aggregation of cells with antibodies, and selective destruction of cells by the serum complement system. This research will investigate the structure of the interface region in simple model membranes and then in more complex biological membranes. With this background information we hope to then investigate the effects of pathological disfunction such as chemical and viral transformation of complement-mediated cell lysis on the structure of biological membranes.
Keywords: cell membranes; nuclear magnetic resonance; surfaces; interfaces; biomimetic processes; structural chemical analysis; biological functions; membrane transport; lipids; oncogenic transformations.

106094 Alterations in Membranes, Lipids. Snyder, F. (Oak Ridge Associated Universities, Inc., Oak Ridge, TN, 37830). **Project number:** 001923. **Contract:** EY-76-C-05-0033. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The immediate goal of this project is to determine the extent that long-chain aliphatic and aromatic hydrocarbons SO2, NO2, ozone, and organic particulates produced in the manufacture of energy from nonnuclear fuels alter the biochemical integrity of membrane structure and organelles of mammalian lungs. Changes in the biochemical properties of the lung membranes caused by these pollutants will be correlated with the onset of morphological alterations as determined by histological analysis. Since differentiation of pulmonary tissue follows a strict developmental timetable, our studies will examine the effect of chemical toxicants on key enzyme systems that are integral parts of pulmonary membranes in mice and rats exposed to toxicants at different ages. The experimental approach in these experiments is designed to determine the effect of the pollutants on the quantitative distribution of marker enzymes associated with specific membranes (glucose-6-phosphatase, cytochrome C oxidase, ATPase, 5-nucleotidase, galactosidase, acyltransferases, acyl-coa synthetase, cytochrome B5 associated desaturases, and P-450 associated hydroxylases). Since most of these membrane-bound enzymes require lipid for the expression of their activity, they are expected to serve as highly sensitive systems for evaluating toxic alterations in the molecular organization of lipid-protein interactions in membranes.
Keywords: membranes; lungs; lipids; enzymes; cell differentiation; hydrocarbons; sulfur dioxide; nitrogen dioxide; ozone; particles; aerosols; mice; rats; toxicity; proteins.

106095 Aging. Sacher, G.A. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 000104. **Contract:** W-31-109-ENg-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This project intends to characterize the deterioration of metabolic and motor activity cycles of mice with age, and to examine two generic hypotheses about the cause and significance of their decrements. The causal hypothesis is that the deterioration is due to an altered dopamine: serotonin balance in the central nervous system. This hypothesis will be examined either by administering neurochemical treatments or by introducing environmental changes that presumably lead to an alteration of neuro-transmitter balance. The second hypothesis is that the coherence and amplitude of the diel activity cycle is a measure of general constitutional vigor, and a predictor of disease susceptibility and morbidity. This will be examined by correlating physiological measures with disease risks for the chemical and environmental factors tested. The environmental factors to be tested include a carcinogenic hydrocarbon and stack gases from a fluidized bed reactor.
Keywords: mice; life span; metabolism; age dependence.

106096 Biophysics. Danylu, S.S. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 000106. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A broad range of biophysical and biochemical studies are underway of biological function at molecular and cellular levels of organization. Three principle areas are being investigated. A comprehensive study is being made of structural and conformational properties of nucleic acids, proteins and their constituents in aqueous solution with the aim of relating such properties to biomolecular function and the influence of environmental agents on such function. This work is complemented by an x-ray crystallographic study of three-dimensional structures of immunoglobulins in the solid state. Bence-Jones proteins have been the principle immunoglobulin fragments of interest in this phase of the study but efforts are also underway to solve the parent IGG structure. Finally, an extensive investigation is being made of circadian phenomena in cellular and mammalian systems with the primary objective of relating circadian regulatory processes to specific molecular events.
Keywords: nucleic acids; chemical properties; molecular structure; proteins; immunoglobulins; daily variations; biological functions.

106097 Molecular Genetics and Environmental Mutagens. Kubitschek. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 001543. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); oil shale(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Repair of lesions produced by ultraviolet, near-ultraviolet, and visible light currently is under intensive study, as well as the nature of the DNA chromphore interactions and the kinds of lesions produced. These are of special interest because man is exposed to large integrated doses of these radiations. Photosensitized mutagenesis with acridine orange and other DNA-intercalating dyes indicate that production of lesions is associated with specific binding modes. Polycylic aromatic hydrocarbons also may intercalate in DNA and are under examination. In addition, we find synergistic increases in mutagenesis and lethality when mutagens are applied in concert, and several types of synergism are under active investigation. These are coupled with the investigation of error-prone SOS inducible repair mutagenesis, a pathway that may be characteristic of most strong mutagens. Termination of DNA replication may be a key step in error-prone postreplication mutagenesis, and controls for both initiation and termination are under study. A mammalian system (mouse myeloma) also is under development for studies of mutation rates in immunoglobulin genes and as a possible testing system for environmental mutagens.
Keywords: ultraviolet radiation; visible radiation; biological radiation effects; dna; radiation injuries; polycyclic aromatic hydrocarbons; synergism; mutagenesis; dna replication.

106098 Studies of Membranes from Human Cells. Packer. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 001305. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The damaging effects on biological membranes of environmental free radicals generated by radiation in the visible range and by atmospheric gases are being investigated to determine the temporal sequence and mechanism of damage at the membrane level and means to protect against it.
Keywords: visible radiation; air pollution; biological effects; cell membranes; man; damage; radicals.

106099 Neurobiology. Bennett. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 000112. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Experiments are planned in five major categories: (1) metabolic regulation and tissue specific function in model system in culture; (2) human mammary epithelial cells: hormonal and metabolic regulation; (3) the biological effects of environmental pollutants; (4) growth regulation of cells in culture; and (5) membrane properties of cells in culture.
Keywords: tissue cultures; metabolism; control; epithelium; man; cell cultures; hormones; metabolism; control; pollution; biological effects; cell cultures; growth; control; cell membranes; cell cultures; chemical properties.

106100 Genetic Study on Yeast. Martimer, R. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 000116. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(50); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The research supported on this project includes studies on the basic genetics of yeast and of applications of these studies to the development of environmental mutagen screening systems in this organism. Our basic genetic work includes development of the genetic maps of yeast and analysis of genetic segregation patterns in order to assess the validity of models of genetic recombination. We have developed a number of strains suitable for detecting forward and reverse mutation, mitotic crossing over, heteroallelic reversion, and cytoplasmic mutations. We are working on methods that will screen for nondisjunctional events and deletions. We will incorporate as many of these systems as possible into a single cell line. We are also reinitiating our studies on induced DNA double-strand breaks in yeast in order to evaluate the efficiency of heavy ions and chemical mutagens in inducing this effect. We are initiating a study to test the hypothesis that coronary disease has a mutational origin and hence can be classified as an environmental disease. Low density liproproteins from high risk subjects for the presence of mutagenic agents will be tested. We will also determine the capacity of these lipoproteins to transport and activate known carcinogens.
Keywords: yeasts; mutagen screening; genetic mapping; gene recombination; gene mutations; crossing-over; strand breaks; dna; mutagens; biological effects.

106101 Non-Nuclear Pollutants: Expression of Genetic Information. Ratlif, R.L. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 001876. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(90); solar(10) **R and D categories:** Biological effects of pollutants in experimental systems.

The object of this work is to determine if compounds present in the products of oil shale processing react with DNA after metabolic activation or after exposure to near-ultraviolet light and to determine if the products of such reactions are substrates for repair enzymes. We are interested in several aspects of this subject including which metabolic intermediates react with DNA, what sites on DNA are attacked, what the nature of the chemical reaction is, whether all DNa regions are equally susceptible, what the effects of such interactions are on template properties of DNA, what types of damage are recognized by repair enzymes, and how all these effects are modified by the presence of chromatin proteins. Several experimental approaches will be utilized including reacting polydeoxyribonucleotides with effluents from oil shale processing in the presence of enzymatic or ultraviolet activation. Products from these reactions suitably labeled with radioactive markers will then be analyzed in several ways to obtain information pertaining to the types of questions listed above.
Keywords: oil shales; waste water; biological effects; dna; biological repair; biochemical reaction kinetics.

106102 Biosynthetic Activity in Synchronized Mammalian Cells. Tobey, R.A. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000123. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Ongoing studies with carcinogens/teratogens of known mode of action suggest that such agents may be classified into discrete categories on the basis of a post-treatment kinetic rearrangement of cells around the cell cycle in a cultured cell system. Initially arrested or cycling populations of line CHO Chinese hamster cells are exposed to different doses of agent for various periods of time to ascertain levels representing chronic sublethal exposure. Besides measuring dose-response relationships, characteristic rearrangements of cells around the cell cycle are determined by a technique involving flow cytometry, cell number enumeration, and 3H-thymidine autoradiography. Examination of a variety of carcinogens/teratogens has revealed that agents of known biochemical mode of action induce characteristic patterns of kinetic rearrangement of cells around the cell cycle. Among distinguishable classes of agents are monofunctional and bifunctional alkylating agents, intercalating agents, and nucleoside competitive inhibitors.
Keywords: hamsters; cell cultures; synchronous cultures; mutagen screening; chronic exposure; cell flow systems; pattern recognition; mutagens; classification.

106103 Biochemical Effects of Radiation on Cells. Walters, R. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000124. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(80); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Using a mammalian tissue culture system which has been shown to mimic cells in vivo in a number of respects, the effects of trace elements (associated with shale oil technology) will be examined and compared with the effects of ionizing radiation. The parameters to be examined include DNA replication, DNA repair, ability of the treated cell to perform special functions as it undergoes reproductive death, and comparison of RNA transcripts in treated and control populations as a measure of possible phenotypic changes. Although synchronization of mammalian cells at specific stages in the cell cycle provides a very powerful tool with which to examine the effects of various agents on cellular function, it is imperative that one knows very precisely the point of synchronization in the cell cycle and the metabolic characteristics of the cell after synchronization. We have shown that treatment of mitotically synchronized cells with hydroxyurea and very high levels of 3H-thymidine allow G1 cells to enter S at the same time and rate as untreated controls.
Keywords: tissue cultures; elements; biological effects; dna replication; biological repair; biosynthesis; synchronous cultures; comparative evaluations; ionizing radiations.

106104 RNA and Protein Metabolism in Cultured Cells. Enger, M.D. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000125. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The synthesis, processing, and utilization of informational and regulatory ribonucleic acids and proteins are studied in normal, mutant, and growth arrested cultured mammalian cells. The knowledge and techniques developed in this basic effort provide a base for defining the effects of energy-related pollutants on genetic expression in cultured cells and thereby for defining the carcinogenic and teratogenic potential of such agents. The nucleoprotein nature of small, methylated RNAs was demonstrated, and particulate tRNA containing complexes were found. The distribution pattern among particulate forms of 19 aminoacyl tRNA synthetases was determined in extracts of normal and mutant mammalian cells. Alterations in informational RNA synthesis and processing were demonstrated to occur in cultured mammalian cells as a function of position in the cell cycle, in cells exposed to moderate doses of ionizing radiation, and in cells exposed to low levels of cadmium.
Keywords: cell cultures; synchronous cultures; mammals; rna; biosynthesis; pollution; genetic effects; ionizing radiations; cadmium compounds.

106105 Applications at High Speed Cell Analysis and Sorting to Biological Problems. Crissman, H. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000135. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this project are: (1) development of cell preparative and cell staining techniques designed to be compatible with high-speed flow systems in order to provide protocols for quantitative immunofluorescence and fluorescent enzymatic assay, as well as for determination of cellular DNA, protein, cell volume, and light scatter; (2) application of flow-systems techniques to assess the potential hazards associated with energy conversion or utilization of immunological, hematological, and respiratory systems, as well as on in vivo and in vitro cell systems; and (3) application of similar techniques in prescreening and diagnosis of human and animal diseases and malignant tumors.
Keywords: cell flow systems; cytological techniques; pollution; risk assessment; cell cultures; mutagen screening; bioassay.

106106 Regulation of Structure and Function Organ in Chromatin. Hildebrand. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000220. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this project are to: (1) monitor cellular metabolism and fate of fossil fuel-related pollutants; and (2) determine effects of these agents on regulation of gene structure and activity. The effects of certain trace elements (cadmium, zinc, selenium, bismith, copper, cobalt, arsenic, nickel, chromium) on chromatin will be investigated initially. Studies should be initiated later to examine the effects of agents associated with processing or the final products of coal or oil shale technology.
Keywords: cell cultures; mammals; pollution; biological effects; metabolism; biochemical reaction kinetics; elements; chromatin; cell flow systems; molecular structure.

106107 Structure of Nucliec Acids. Saponara, A. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000242. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This program examines the potential of agents related to oil shale processing to alter the patterns of production and utilization of messenger RNA by mammalian cells. We believe this to be a significant end point, since the normal cell expresses only a small fraction of its possible functions, and a relaxation of this stringent control is an early and persistent effect of exposure to a number of cancer-producing agents. In addition, agents which interfere with the proper selection of messenger RNA are prime suspects as teratogens. Cadmium at subacute concentrations causes a redistribution of cytoplasmic messenger RNAs between active and inactive forms. Work in progress will determine whether this redistribution is accompanied by alterations in the sequence complexity of these forms.
Keywords: oil shales; biological effects; messenger-rna; biosynthesis; biological functions; cadmium compounds.

106108 Histone Metabolism Structure and Function. Gurley, L.R. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000127. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to determine if the histone phosphorylation process might be a target for environmental toxicants produced by shale oil-based activities. Emphasis is being placed on the effects of cadmium and lanthanum on growth-related histone phosphorylations. The investigation of these metals has been chosen for two reasons: (1) they are expected to be discharged into the environment; and (2) they are known to interfere with calcium and cyclic-AMP metabolism which are involved with histone kinase activity, mitotic apparatus formation, and chromosome condensation. Using cultured mammalian cells, three different correlations have been made associating histone phosphorylation with the various chromatin condensations necessary for cell division. These correlations suggest chromatin condensation as a specific molecular process in which cadmium and lanthanum could affect cell proliferation through effects on histone phosphorylation.
Keywords: oil shales; pollution; biological effects; cell cultures; growth; histones; phosphorylation; cadmium compounds; lanthanum compounds; mammals; chromatin.

106109 Properties of the Cell Surface. Kraemer, P. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000128. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The goal of these studies is to define cellular parameters that would be useful in determining the potential health effects of oil shale pollutants. The focus is on cell surface and matrix parameters and carcinogenic and teratogenic effects. Putative in vitro parameters of malignancy such as anchorage dependence of growth will be studied in parallel with in vivo assays of cell behavior in nude (anthymic) mice. The former will include biochemical and behavioral studies of matrix molecules, especially glycosaminoglycans, and their role in anchorage. The latter studies will include attempts to improve the methodology of cell implantation so that a more complete estimate of the biological potential of any cultured cell population can be made. The hyaluronic acid of the matrix of cells grown in monolayer modulates the accessibility of the cell surface to exogenous agents. Cell variants with large amounts of surface hyaluronic acid are more easily detachable with trypsin or EDTA, while the converse is true for variant sublines lacking the ability to make hydaluronic acid.
Keywords: oil shale industry; health hazards; in vitro; mice; cytology; carcinogenesis; toxicity; oil shales.

106110 Environmental Carcinogenesis. Anderson, C. (Brookhaven National Lab., Upton, NY). **Project number:** 002995. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Many environmental pollutants that are byproducts of energy utilization are suspected of being carcinogens. Screening methods now being employed have one or more deficiencies. This program proposes to evaluate the use of the human virus, adenovirus stereotype 2, for its potential as a rapid method for screening mutagens active in human cells. The specific aims will be to devise a test system for potential carcinogens with the following characteristics: (1) the assay will utilize human cells; (2) the assay will be relatively rapid requiring, at most, 4 to 5 days; (3) scoring of the assay will be capable of automation and will thus allow the unbiased quantitation of results from many samples with little manual labor; and (4) the assay will be adaptable to biopsy material and may thus allow assessment of risk in individuals or specific populations. The method to be developed would be similar in principle to the widely-used Ames test but with human cells instead of bacteria. Mutagenic activity would be ascertained by measuring the reversion of well characterized viral mutants. Revertants would be identified by virus plaque assay or by an immunofluorescence assay for the synthesis of characteristic viral proteins.
Keywords: environmental impacts; carcinogens; mutagen screening; animal cells; adenovirus; optimization; performance testing; biological indicators; bioassay.

106111 Plant Cytology. Van't Hof, J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000006. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The prerequisites to understanding the mutagenic effects of ionizing radiation and chemical agents on higher plants are the elucidation of eukaryotic chromosomal DNA replication and the chromosome structure itself. The construction of a chromosome is an inherent component of the cell division cycle and upon the successful completion of mitosis, genetic information is equally distributed to each of the recipient daughter cells. Success is by no means left to chance. The parental cells born at some earlier mitosis progressed through an ordered sequence of physiological and biochemical states that assured an accurate inheritance to their progeny. This project is concerned with the effects of ionizing irradiation on the control of the cell division cycle and the regulation of chromosomal DNA replication. Increased emphasis is being placed on the identity of nucleotide sequences that constitute a replicon origin, the factors that are responsible for the staggered activation of replicon clusters, and the nature of the lesions produced by gamma-rays that impair replication initiation among these clusters. Also, cell division in higher plants has two dominant controls that function in G1 and G2, and the quest to determine their identity comprises a good portion of our effort. These two controls are highly radiosensitive and have the ability to recover from gamma-ray exposure.
Keywords: gamma radiation; irradiation; cell cultures; plant cells; biological radiation effects; cell cycle; cell division; dna replication; genetic control; biological repair.

106112 Plant Biochemistry. Siegel, H.M. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000011. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Primary productivity in marine and freshwaters is dependent on the photosynthetic abilities of the phytoplankton. Solar energy is captured for photosynthesis by specific photoreceptor molecules which include chlorophylls, carotenoids, and bile pigments. The structure and function of the phytoplankton photoreceptors and their associated proteins are under examination from dinoflagellate and blue-green algae. The carotenochlorophyll proteins from several species of dinoflagellate algae are being characterized. The structures of the bile pigments of blue-green algae are being further defined. These studies provide information on phytoplankton photosynthesis and the influence of environmental factors on phytoplankton growth and composition. The toxins of the phytoplankton, such as those of the toxic red tides, are hazardous to humans directly or following ingestion of toxins by animals used as food. The effects of environmental factors on the growth and toxin production of toxic red tide organisms are being investigated. The vacuole of the mature plant cell constitutes in excess of 90% of the total cell volume. Isolation procedures were developed for obtaining intact vacuoles permitting an examination of the structure, function and composition of the vacuole. A new program was initiated in FY 1977 which will continue these studies.

Keywords: plants; biochemistry; phytoplankton; photosynthesis; chlorophyll; carotenoids; bilirubin; biliverdin; algae; growth; cell constituents.

106113 Fine Structure of Cells. Ledbetter. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000012. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(30); nuclear fission(40); solar(30) **R and D categories:** Biological effects of pollutants in experimental systems.

This project seeks a better understanding of the relationships between structure and function in tissues, cells and cellular organelles. These relationships will be determined for organisms undergoing normal differentiation and development to establish a basis for interpreting cellular and organismal responses to various environmental factors. Among the environmental factors to be studied will be light and temperature regimes, chemical agents, gravity, and high flux magnetic fields. Where possible the cellular responses will be related to health problems involved in energy use. An example is the potential effect of high magnetic flux which result from the use of very high currents in electrical power lines. The principal tools are microscopes of three types: (1) conventional high resolution transmission electron microscopes (TEM) for the study of ultra thin specimens (especially sections, replicas, and isolated macromolecules); (2) a moderate resolution scanning electron microscope (SEM) utilizing secondary electrons to reveal surface topography and utilizing electron induced fluoresence to identify molecular species by intrinsic and tagged fluorescence; and (3) a high resolution scanning transmission electron microscope (STEM), available under Dr. J. Wall's project, to study biological structures through the use of specific heavy atom labeling and to study thick specimens for three-dimensional reconstruction.
Keywords: visible radiation; ambient temperature; carcinogens; mutagens; magnetic fields; gravitational fields; biological effects; animal cells; ultrastructural changes; biological functions; correlations; electron microscopy.

106114 Protein Chemistry. Shaw, E. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000013. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The anticipated greater dependence on coal as an energy source requires that attention be given to a possible increase in carcinogenesis or in degenerative states of the lungs that may accompany the mining and utilization of coal. Proteases are considered to be involved in these health problems in at least two ways due to a derangement of their normal balance by noxious influences: (1) loss of growth control at the cellular level resulting in neoplasia, and (2) excessive release of proteases from phagocytic cells causing irreversible damage to lung connective tissue. In this program biochemical studies are carried out on certain proteolytic enzymes thought to be involved in these processes on the basis of current knowledge. The goal of the work is to acquire information about the structure, specificity, and function of these enzymes particularly through the development of selective inhibitors. We are exploiting an approach to the design and synthesis of agents capable of inactivating enzymes by mimicking the structure of normal substrates. These agents (affinity-labels) can provide information about the function of an enzyme in a pathological situation and may also lead to therapeutic approaches.
Keywords: proteins; chemistry; coal mining; coal; carcinogenesis; health hazards; peptide hydrolases; biological pathways; biomimetic processes; enzyme inhibitors; lungs; carcinomas; phagocytes; affinity; biochemistry.

106115 Structure, Function, and Biological Activity of Naturally Occurring Proteinase and Peptidase Inhibitors. Elzinger, M. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000017. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

One of the basic properties of living systems is the ability to use energy stored chemically in various foodstuffs in order to move and carry out work. The contraction of muscles by large animals is the most graphic example of biological movement, but it seems now that most cells can move; it is perhaps best to view muscle contraction as a specialized form of cell motility. The proteins responsible for cell movement, both in muscle and non-muscle cells, are clearly related, but they exist in slightly different organizational arrays in various cell types. Cell motility is of obvious importance in the transport of cytoplasmic inclusions, such as chromosomes and secretory granules, as well as for the normal growth and development of tissues. Certain transformations to malignant (and less motile) cells appear to be accompanied by changes in the cytoplasmic structures that are made up of proteins associated with cell motility. In this program the detailed structures of these proteins are being studied, and the emphasis is to the two largest and most abundant, actin and myosin. We are working first of all on these proteins from muscle, and we are then comparing them with corresponding proteins from brain, blood platelets, and amoeba. The results are necessary for the molecular dissection of the basic contractile mechanism while the comparative studies permit correlation of slight differences in specific proteins with variations in the properties of normal and abnormal cells.
Keywords: muscles; actin; myosin; molecular structure; brain; blood platelets; amoeba; comparative evaluations; animal cells; motion; molecular biology.

106116 Nucleic Acid Structure. Studier, F. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000019. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Some of the most serious long-term consequences of environmental pollutants and radiation are at the genetic level and include the induction of mutations and cancer. An understanding of basic genetic processes is an important prerequisite for dealing with these problems. Bacteriophage T7 and its host E. coli provide an excellent system in which to study basic genetic processes. During infection, a single molecule of T7 DNA is introduced into the E. coli cell, where it redirects the metabolism of the host cell to produce new phage particles. Processes such as regulation of gene expression, replication of DNA, genetic recombination, and assembly of virus techniques. T7 DNA specifies about 30 proteins, and mutations that affect most of them have been found. Simple procedures for radioactive labeling, followed by gel electrophoresis, permit resolution and identification of individual T7 RNAs, proteins, and intermediates in DNA replication and recombination. An understanding of basic genetic processes in this simple system should provide useful models for understanding similar processes in more complex plant and animal systems. The T7 system itself, and the techniques developed for studying it, are finding wide application in studies on the detailed biological effects of mutagens, carcinogens and radiation.
Keywords: escherichia coli; bacteriophages; dna replication; gene recombination; tracer techniques; ionizing radiations; carcinogens; mutagens; biological effects; mutagenesis; molecular biology; dna; molecular structure.

106117 X-Ray and Neutron Diffraction, Study of Biological Structures. Schoenborn. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000021. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The goals of structural biology are to understand biological function in terms of molecular structures, to determine the cause of molecular diseases, and to provide structural solutions to effect cures. The knowledge of the three-dimensional architecture of proteins, membranes and larger complexes is a necessary prerequisite. While x-ray scattering has been the classical tool for these investigations, neutron scattering enables the elucidation of structures and structural details impossible by x-ray investigations. Such neutron diffraction studies are made possible at Brookhaven because of the presence here of the high flux beam reactor.
Keywords: x-ray diffraction; neutron diffraction; structural chemical analysis; proteins; cell membranes.

106118 Neutron Diffraction Studies of Protein. Kossiakoff. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000022. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Structural studies using x-ray diffraction have led to a dramatic increase in our knowledge of the important chemical features and conformational relationships involved in the action of enzymes. Many of the important questions involved in understanding enzyme functions concern ionization states and the microenvironment of particular groups in the protein. In this aspect neutron diffraction offers advantages over x-ray diffraction. The protonation states of the functionally important residues of an enzyme and the interacting water molecules have been shown to be responsible for many chemical characteristics and are extremely influential in determining the catalytic effectiveness of the enzyme. It is of obvious importance that a comprehensive understanding of the structure-function relationship of the enzyme requires a detailed knowledge of the protein-water structure. The major shortcoming of an x-ray structure is that the location of the hydrogen atoms cannot be observed and therefore must be inferred from the stereochemistry of the backbone atoms.

This method of extrapolating hydrogen positions tells very little about the actual chemical interaction taking place between groups within the protein. However, neutron diffraction from protein single crystals is a very powerful method for determining the hydrogen and deuterium positions, thus making it a much better technique to probe protein structures.
Keywords: proteins; neutron diffraction; structural chemical analysis; enzymes.

106119 Accumulation in Plants. Wagner, G. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000028. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Available evidence indicates that certain heavy metals and hydrocarbons which are products of coal utilization processes are being and will be released into the environment. At the very least, local plant communities and subsequently animals and man will be exposed to these pollutants. We face these realities with little understanding of the effects of environmental toxins on plants at the cell level. New methods have recently been developed for the physical separation from plant tissues of intact vacuoles, cytosol and organelles. This method is the only available method for obtaining preparations of intact vacuoles and cytosol, the two major fluid compartments of mature plant cells. It is now possible to make a more detailed analysis of the subcellular location of natural plant substances and of unnatural substances accumulated from the environment. An understanding of the site(s) of accumulation in plants will allow detailed studies designed to determine the mechanisms of accumulation and of tolerance and toxicity in the case of toxins taken up from the environment. Examination of the membrane transport processes which lead to vacuolar accumulation should improve our understanding of the role(s) of the vacuole in osmotic balance, detoxification, metabolite storage and other processes.
Keywords: metals; hydrocarbons; air pollution; land pollution; biological accumulation; plants; plant cells; membrane transport; cytological techniques; cell constituents.

106120 Microbial Genetics. Lacks, S. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000029. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Healthy growth and development depend on normal functioning of the genetic material, DNA, which governs all cellular activity. Mutations of the DNA cause genetic deficiency and disease, including cancer, in present and future generations. The production of energy often releases into the environment agents, such as ionizing radiation and carcinogenic chemicals, that are highly mutagenic to DNA. In this context basic knowledge of the reactions undergone by DNA within cells is necessary. This project contributes to such knowledge by investigating the enzymatic cleavage and methylation of cellular DNA and the genetic transformation of cells by addition of DNA to them. Pneumococcol bacteria are altered by DNA isolated from genetically different strains. Questions of particular interest are how the very large donor DNA molecule enters the cell and how parts of this molecule recombine with DNA of the host cell. Recent findings have implicated a particular pneumococcal DNAse in the entry process. In addition, other DNAses of pneumococcus are characterized and their roles in transformation and other cellular functions are investigated. Bacterial transformation provides a unique opportunity to treat DNA with noxious agents in vitro and test their effect in vivo. Knowledge of the molecular mechanisms of transformation will enhance the utility of such systems in assessing damage to DNA. An understanding of DNA uptake by bacteria should prove useful in genetic engineering, that is, in attempts to reverse the effects of genetic deficiency and disease by introduction of DNA into cells of higher organisms.
Keywords: pneumococcus; dna; biochemistry; gene recombination; ionizing radiations; carcinogens; mutagenesis; molecular biology; dna-ase; enzyme activity.

106121 Drosophila Cytology and Genetics. Grell, R.F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000177. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); nuclear fission(30); solar(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Meiosis provides for the precise partitioning of the genetic material from the double amount into the single amount present in a gamete. Deviations from the strict equality of distribution are deleterious or lethal to the zygote. Heat, chemicals and radiation disturb the process. Many aspects of normal meiosis as well as its alterations by external agents remain obscure. We know that recombination between members of a chromosome pair produces a physical tie which is critical for proper separation. Our combined genetic, electron microscopic and autoradiographic studies of the early oocyte reveal that both pairing between homologues which precedes their recombination and probably the recombination event itself occur much earlier than previously thought. Temperature studies show profound alterations in recombination and chromosome distribution by heat at this early time. Mutagenization has produced new rec mutants which drastically alter recombination and which are sensitive to alkylating agents suggesting defective DNA repair. Mutants with increased sensitivity may be useful for mutagen testing. Comparisons of normal and mutant behavior at the genetic, biochemical and EM levels should provide insight into the way errors originate and operate during gametogenesis.
Keywords: drosophila; meiosis; gene recombination; chromosomes; dna; biological radiation effects; hyperthermia; mutagens; genetic effects; temperature effects; biological repair; mutagen screening; errors; autoradiography; electron microscopy; cytology; genetics.

106122 Yeast Mutagenesis. Lemont, J.F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000178. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); nuclear fission(30); solar(30) **R and D categories:** Biological effects of pollutants in experimental systems.

The yeast saccharomyces cerevisiae is used as a model eukaryotic microorganism with which it is possible to carry out coordinated genetic and biochemical studies of mutagenesis induced by ultraviolet light, ionizing radiation and chemical mutagens. Since a good deal of induced mutagenesis is known to be genetically controlled, attention is focused on the various cellular processes responsible for mutation fixation and mutation expression through the use of single-gene mutants that confer unusually high or low mutation sensitivity. Such mutants are almost always involved in one or another form of DNA repair. One form called error-free reduces mutagenicity by replacing damaged chromosomal regions with a copy of the original undamaged segment, while another form called error-prone repairs genetic damage inaccurately and thereby causes fixation of lesions in the form of inheritable mutations. Thus, repair processes strongly influence the fate of premutational lesions as well as affect the recovery of viable cells.
Keywords: saccharomyces cerevisiae; mutagenesis; dna; biological repair; mutations; ultraviolet radiation; ionizing radiations; mutagens.

106123 Microbial Mutagenesis and Cell Division. Adler, H.I. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000179. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

New assays will be developed for energy related chemical mutagens. These will be based on bacterial systems and will emphasize practicality and ease of performance. One such assay under development is a modification of the Salmonella typhimurium-histidine system. This widely used assay is adapted to a microscopic technique which should be easy to perform, require very little material and be readable in a matter of hours rather than days. Another potential assay is based on the use of Lactobacillus caseii, a bacterium with nutritional requirements similar to some mammalian cells. One class of bacterial mutants, affecting x-ray sensitivity and cell division, will be studied in depth. A technique has been developed that should allow us to identify one or more of the biochemicals controlling normal cell division. Little is known of this process in any organism and increased knowledge should help us understand both normal cell division and the aberrant cell division processes associated with several disease states, most notably cancer.
Keywords: mitosis; mutagenesis; mutagens; salmonella typhimurium; histidine; bioassay; lactobacillus; biological pathways; biochemistry.

106124 Effects and Uses of Chromosome Aberrations. Russell, L. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000184. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Induced chromosome aberrations present a genetic risk to human populations since they are produced and transmitted with relative ease from treatment of some germ-cell stages by a variety of mutagens. This many-sided project (in contrast to others that use chromosome aberrations mainly as indicators of damage) concerns itself with the causation, phenotypic effects, and further use of special chromosome aberrations. Among aberrations selected for study are those that produce disturbances in male fertility, including complete sterility. The nature of the infertility and the cytological abnormalities found are being related to the type of mutagenic

treatment that produced them. Other aberrations are selected for their usefulness as tools in the detection of newly-induced mutations. This method is yielding data on mutagenesis supplementary to those obtained in specific-locus studies, and the information will have a bearing on estimation of human risk. Yet another group of aberrations is selected for their usefulness in the study of gene-dosage effects. The results have practical implications in that unbalanced gene dosages are often transmitted to children of human carriers of chromosome aberrations. The specifical significance of the zygotic stage in the genesis of chromosome aberrations is also being studied.
Keywords: chromosomal aberrations; mutagenesis; fertility; cytology; spermatogonia; mutagens; sterility; genes.

106125 Protein Synthesis: Aberrant Control. Stulberg, M. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000233. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The investigations involve the control and fidelity of protein biosynthesis with emphasis on the aberrant effects of chemical mutagenesis, viral carcinogenesis and aging on the system. We utilize eukaryotic, cell-free, protein-synthesis systems to analyze critical components isolated from organisms and cells made abnormal by treatment with mutagenic and carcinogenic agents. Messenger RNA (mRNA) and transfer RNA (tRNA) are isolated from reticulocytes of mutagen-treated sheep and tested for ability to support globin synthesis with fidelity. If abnormal effects on these parameters are discovered, the components are analyzed for alterations at the molecular level. Analogous studies, with senescent mice, are performed to correlate aging syndromes with abnormalities at the molecular level. Mouse myeloma tumor mRNA and AKR and AMV tumor virus RNAs are tested for control of translational function. In addition, we are examining the involvement of specific tRNA in the structural integrity of AMV tumor virus RNA and the effect of modification of primer tRNA on the mechanism of viral carcinogenesis. The modifications consist of both chemical and biological alterations to the tRNAs and mRNAs produced during mouse AKR tumor virus infection.
Keywords: mutagens; carcinogens; life span; biological effects; proteins; biosynthesis; viruses; mice; reticulocytes; messenger-rna; transfer rna; mutagenesis; carcinogenesis; biological functions; molecular biology.

106126 Photophysics of Macromolecules. Longworth, J.W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000282. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The measurement of the lifetime of fluorescence of proteins and nucleic acids is now feasible, using an instrument developed in this laboratory, with functioning computer analysis codes. Preliminary studies with a homogeneous family of proteins, Bence-Jones proteins, have disclosed a wide diversity of fluorescence spectrum, yield and lifetime, and suggested that there may be underlying structural relationships. The lifetime and fluorescence intensity are strongly dependent upon temperature, and a study of both with temperature will be used to study the channels of energy dissipation available to proteins and nucleic acids. Fluorescence anisotrophy will be used to study electronic energy transfer and the internal motion of tryptophyl residues in proteins.
Keywords: proteins; nucleic acids; fluorescence spectroscopy; temperature dependence; molecular structure; energy transfer.

106127 Environmental Insults to DNA. Rahn, R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000283. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

As a result of the proposed increase in the use of coal as an energy source, it can be assumed that higher levels of hydrocarbons, metal ions and peroxides will be generated and set free in the environment. Our project is concerned with the interactions between these pollutants (or their biologically active metabolites) and cellular DNA because in many instances DNA is considered to be the sensitive target in a cell. However, only in rare cases has the biologically important lesion(s), caused in DNA by a potentially hazardous agent, been well characterized. One difficulty lies in detecting, by chemical or physical methods, the low levels of damage which can be biologically significant. The establishment of a relationship between a DNA lesion and some biological endpoint in complex organisms may take many years. In order to simplify the problem of identifying those environmental agents which can alter the genetic apparatus in a biologically significant fashion, model in vitro systems containing DNA are being studied. Of particular interest is the use of light to: (1) probe by spectroscopic methods the altered structure of chemically modified DNA; and (2) induce photodynamic reactions between DNA and those classes of compounds related to energy production such as polyaromatic hydrocarbons, organic dyes or peroxides. In this way the photolytic decomposition of pollutants in the envrionment can be related to the probability of causing changes to DNA exposed under similar conditions.
Keywords: polycyclic aromatic hydrocarbons; metals; peroxides; biological effects; dna; ultrastructural changes.

106128 Chromosome Chemistry. Olins, D.E. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000284. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Employing electron microscopy we have demonstrated that eukaryotic chromosomes consist of repeating globular elements, the nu bodies. We have isolated and characterized monomer nu bodies. We have estimated the DNA and histone protein secondary structures from laser-Raman spectra. We have begun an examination of the conformational states on nu bodies. In addition, we have demonstrated the existence of higher order packaging of nu bodies into 20 to 30 nm diameter fibers.
Keywords: chromosomes; electron microscopy; dna; histones; nucleosomes; structural chemical analysis.

106129 Studies on Mutation Induction in Haemophilis. Kimball, R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000286. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(30); oil shale(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Coal conversion and other fossil fuel technologies produce a tremendous variety of chemicals, part of which may be mutagenic or carcinogenic for humans. Rapid screening methods have been developed to use bacteria to test for such effects. Too little is yet known, however, about the mechanisms by which such effects are produced; consequently it is difficult to extrapolate with confidence to humans or to generalize from results with a few type materials and compounds. It is important, therefore, to understand more thoroughly how initial damage to bacterial DNA is converted to the final mutation by repair and replication enzymes. THe present program has the goal of obtaining such a better understanding using the bacterium, Haemophilus influenzae, which has some unique advantages for this purpose. With this bacterium, it is possible to take DNA out of the cell at any time and then put it back by transformation. In addition, there are a number of repair and replication mutants available, and biophysical methods can be used to study the nature and fate of the damaged DNA. To date a partial classification of mutagens has been made according to their action.
Keywords: fossil fuels; mutagen screening; haemophilus; biological indicators; mutations; dna; biological repair; dna replication; enzyme activity; mutagens.

106130 Molecular Genetics. Barnett, W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000288. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

It is well known that certain chemicals are highly specific in their mutagenic action; nitrosomethylurethane, ethidium bromide, and streptomycin are, for example, highly mutagenic to organellar DNAs and quite innocuous to the nuclear genome. Since the integrity of the organelle genomes is as important to the eukaryotic cell as the nuclear genome, both from the standpoint of inherited abnormalities and toxicity, we have developed a screening test, using yeast, for determining the potential genetic hazard of the various synfuel representative class compounds. These compounds are currently being tested for mutagenicity.
Keywords: synthetic fuels; mutagen screening; yeasts; mutations; biological indicators; dna; mutagenesis.

106131 Molecular Carcinogenesis. Bissell, M. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 003228. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this multifaceted task is to understand the fundamental mechanisms involved in cell-cell and cell-environment interactions to regulate gene expression in normal and malignant tissues. A critical evaluation of how cells interact with their environment should lead to elucidation of how cells retain their normal state

under hostile conditions or how they become diseased and cancerous and how they age. Most culture systems used for studying malignancy, however, are inadequate in that little or no attention is paid to in vivo situations and to defining conditions for accurate response to biological perturbations. Our approach has been to set up model systems with well defined functions and with relevance to the physiological state of the tissue in vivo. In doing so, we are not only defining some tissue-specific functions of the cells under study, but also their entire intermediary metabolite patterns, their growth properties and some of their membrane functions. The extensive and unique facilities of this laboratory including the use of specific activity tracers and two-dimensional chromatography and autoradiography, flow cytometry, and many specific biochemical and biophysical techniques, coupled with our many years of expertise with cultured cells, allow us to approach the above problems in a novel fashion, not possible elsewhere. Energy technology is developed for the benefit of mankind. Appropriate biological indicators of hazard to man cannot be developed without understanding the underlying mechanisms that keep him healthy and functioning.
Keywords: carcinogenesis; biological indicators; animal cells; biological models; in vivo; cell flow systems; genetic effects; cell cultures; biochemistry; molecular biology; oncogenic transformations.

106132 Enzymatic Studies of Radiation Damage. Laskowski, M. (Roswell Park Memorial Inst., 666 Elm St., Buffalo, NY, 14263). **Project number:** 006200. **Contract:** EY-76-S-02-3225. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The discovery that venom phosphoidesterase belongs to the group of single-strand specific nucleases once again placed emphasis on this enzyme. A homogeneous enzyme is available and it is hoped that the method may be improved with respect to yield. Then characterization of this enzyme as a protein may be attempted. The specific cleavages on PM2 DNA have already been located and locations of phi-X174 DNA are being studied. It is planned to study other viral DNAs. It is also hoped that nucleases of this type may reveal novel details of superstructure of chromatin (normal and damaged). An effort to improve the yield of homogeneous venom phosphodiesterase will be made. With luck we may have enough material for characterization. The mechanism of the reaction will be studied further. The characterization of sites recognized by the enzymes of this group will remain the major task.
Keywords: nucleases; biochemical reaction kinetics; dna; esterases; phosphatases; venoms.

106133 Differential Gene Expression in Neurospora crassa Cell Role of RNA-Dependent DNA Polymerase. Dutta, S.K. (Howard Univ., Washington, DC, 20059). **Project number:** 006204. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Purification and characterization of RNA-dependent DNA polymerase (RDDP) in N. crassa and the role of this enzyme in differentiation, gene amplification and RNA mediated transformation will be investigated. The enzyme reverse transcriptase is of considerable significance not only for oncogenic viruses but also for its role in normal cell development, differentiation and antibody formation. In E. coli it has been shown that transforming RNA is first transcribed into a complementary DNA by RDDP enzyme which is integrated into genome of recipient cells, which becomes transformed. RNA mediated transformation has also been observed in N. crassa. The enzyme RDDP will be isolated and characterized as to its nature and immunological relationships and will be measured quantitatively in different cell types of N. crassa. Estimation of, and role of, RDDP in rRNA gene amplification in cell types will be done using standard nucleic acid hybridization and enzymolobical procedures. RNA mediated transformation will be studied using auxotrophic mutants of N. crassa.
Keywords: antibodies; antibody formation; dna; rna; transcription; nucleic acids; neurospora; polymerases; cell differentiation.

106134 Repair and Cell Cycle Response in Cells Exposed to Environmental Biohazards. Billen, D. (Univ. of Tennessee, Knoxville, TN, 37916). **Project number:** 006711. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

A wide variety of environmental agents are known which induce damage in DNA leading to inhibition of DNA synthesis or faulty replication. We are using both bacteria and mammalian cells to assess the roles of DNA polymerases and other DNA metabolic enzymes and factors in DNA repair, replication and recombination. We plan to determine the roles of various substrates, cofactors and enzymes of DNA metabolism in DNA synthesis after irradiation or chemical damage, using bacteria and cultured mammalian cells made permeable to small molecules and enzymes. We will determine the relative importance of strand breaks and nucleotide damage in both induction of primer sites for DNA synthesis and in reduction of biological activity of transforming DNA. Genetic studies will provide information about the metabolic pathways used to repair the various kinds of damage induced. Treatment of permeabilized cells with enzymes specific for different kinds of damage will provide information about induction and removal of damage sites in DNA. Information from studies on mammalian cells and DNA repair mutants of bacteria will be correlated with data on DNA synthesis to provide further insight as to repair processes.
Keywords: dna replication; biological repair; polymerases; biosynthesis; bacteria; animal cells; biological pathways; dna; biochemical reaction kinetics.

106135 Molecular Mechanisms of the Epithelial Transport of Toxic Metal Ions Particularly Mercury, Cadmium, Lead, Arsenic, and Zinc. Wasserman, R.H. (New York State Coll. of Veterinary Medicine, 717 VRT, Ithaca, NY, 14853). **Project number:** 007052. **Contract:** E(11-1)-2792. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Cadmium pollution, primarily a result of industrial processes, is currently the subject of increasing environmental concern. The ingestion of high levels of cadmium in humans has recently been associated with cases of bone, kidney and intestinal disorders which, in turn, have been linked to toxic effects of cadmium on vitamin D and calcium metabolism. Investigations were done that were designed to describe the mode of intestinal transport of cadmium, as well as its known toxicity. Dietary cadmium administration has been shown to exert a profound toxic effect on the intestinal absorption of calcium and a number of parameters associated therewith, including several intestinal enzyme systems. In addition to this direct effect on calcium absorption, cadmium inhibits the ability of experimental animals to respond to vitamin D and vitamin D metabolites. Brief exposure of the intestine to moderate and high levels of cadmium results in considerable structural alteration, in spite of the fact that little cadmium is actually absorbed. The prolonged retention time of cadmium in intestinal tissue undoubtedly contributes to its toxicity. These studies show that one of the primary toxic effects of cadmium is at the intestinal level. More recent studies were concerned with the effects of zinc on cadmium metabolism and on the metabolism of zinc per se. Also investigations on the metabolism of arsenate absorption have been accomplished.
Keywords: metals; cadmium; ingestion; human populations; toxicity; vitamin d; calcium; metabolism; diet; zinc; synergism; arsenates; intestinal absorption; inhibition.

106136 Study of Influence of Hormones on Transport of Cations into and out of Bone. Talmage, R. (Univ. of North Carolina, Chapel Hill, NC, 27514). **Project number:** 006071. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This application is to study the control of ion entry and removal from bone. Calcium control is the central theme. This ion is essential for normal functioning of soft tissue and is central to the metabolism of bone. Our thesis is that rapid calcium fluxes into and out of bone are in actuality fluxes between two fluid compartments, the ECF and bone fluid. It is our postulate that plasma calcium concentrations are controlled by metabolic control of only the efflux of this ion from bone. In the coming year, we plan to compare 45Ca fluxes with those of 85Sr, when both nuclides are given 1 to 10 hours prior to hormone treatment. If calcium is moved intracellularly by metabolic processes, strontium should also be moved. But there should be a discrimination factor. We also plan to renew our use of EHOP as a second method for distinguishing between metabolic and physico-chemical processes. A third project will entail the use of metabolic inhibitors. The first will be actinonyocin D to extend observations made 12 years ago. At that time it was noted that this antibiotic in a few hours produced changes in plasma 45Ca which could not be explained. We hope we will now be able to explain the results.
Keywords: hormones; bone cells; calcium; metabolism; calcium 45; strontium 85; inhibition; biological models.

106137 Radiation Biophysical Study of Biological Molecules. Fluke, D.J. (Duke Univ., Durham, NC, 27706). **Project number:** 006174. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this work is to understand how ionizing and excitational radiations damage or alter living cells and the molecules and active principles characteristic of living processes. The various

manifestations of error-prone repair (ERPR), and their degree of overlap, constitute the major current background, including uv-induced resistance to ionizing radiation, induction of lysogenic phage, and uv mutagenesis, among others. The operation of various host cell repair systems, differentiated by available mutant strains, can reveal some distinctions between ionizing and excitational radiation damage in bacteriophage. Ultraviolet action spectroscopy is a principal procedure, together with comparisons of induction curves for the various cell processes and ERPR manifestations studied, in the light of the various genetically differentiated bacterial cell strains available. Test objects of the study include a number of strains of E. coli and related bacteriophages.
Keywords: ionizing radiations; ultraviolet radiation; irradiation; escherichia coli; bacteriophages; genetic radiation effects; mutations; radioinduction; biological repair; host-cell reactivation; errors; mutagenesis; molecular biology.

106138 Mechanisms of Recombination and Function of DNA in Bacteria. Guild, W.R. (Duke Univ., Durham, NC, 27706). **Project number:** 006175. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Mechanisms of gene transfer and recombination in pneumococcus are being investigated. To have other genetic tools for comparison to transformation, heretofore the only gene transfer assay in pneumococcus, recently discovered phages are also being studied. At this time, we are examining the effects of various mutations of the recipient cells on transformation, transfection, phage recombination, a gene transfer process resembling tranduction in some properties, and on the sensitivities of the cells themselves and of the above processes to radiation and other agents. In related work the process of intragenic recombination between closely spaced mutations is being characterized in terms of its dependence on the length of intracellular donor DNA strands and on the presence of dimers in the donor DNA.
Keywords: pneumococcus; gene recombination; dna replication; biological radiation effects; genetics; biochemistry.

106139 Research Program in Molecular Biophysics. Kasha, M. (Florida State Univ., Tallahassee, FL, 32306). **Project number:** 006179. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The Institute of Molecular Biophysics at the Florida State University represents an interdisciplinary research program which focuses on the study of the role of basic physical properties of molecular systems in determining biological functions. A major purpose is to gain understanding of underlying mechanisms of energy transformation and utilization at the molecular level in biological systems. The program is supported by nine faculty members whose research falls roughly into the following three areas: (1) molecular physics (Michael Kasha, Leo Mandelkern and William Rhodes) which is concerned primarily with physical properties of biomolecules and underlying physical mechanisms; (2) molecular biology (J. Herbert Taylor, Randolph Rill and Siwo de Kloet) which deals with structures, properties and mechanisms involving RNA, DNA, nucleoproteins, chromosomes and other aspects of molecular genetics; and (3) radiation and photobiology (T.P. Williams, Kurt Hofer and Peter Hohann) which is concerned with the role of light and effects of higher energy radiation in biological processes such as vision, photosynthesis, and radiation damage.
Keywords: molecular biology; research programs; florida; biophysics; molecular structure; radiobiology.

106140 Support for 44th Symposium, Cold Spring Harbor Laboratory. Watson, J.D. (Cold Spring Harbor Lab. of Quantitative Biology, Cold Spring Harbor, ME). **Project number:** 006518. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The Cold Spring Harbor Symposium is held each summer on biological topics that seem ready for general scrutiny and review. This year the 43rd Symposium will be held and the topic will be DNA: Replication and Recombination. As in past symposia, a list of speakers has been put together but the actual program will not be put together until just before the meeting. This enables each speaker to choose his material and revise it as late as possible. Replication and repair of DNA are major items in the Genetics Section of the General Life Sciences Program. Radiation and many chemicals interfere with DNA replication. Cells that turn over rapidly, e.g., hematopoietic and gonadal, are frequent targets of pollutants because of interference with replication. Understanding repair has been an important part of our program because it will tell us about the resiliency of cells to environmental pollutants. The speakers' list contains several of our contractors.
Keywords: dna replication; gene recombination; meetings; biological repair; dna.

106141 Development of New Techniques of Using Radiation in the Genetic Improvement of Warm Season Grasses. Burton, G.W. (Univ. of Georgia, Athens, GA, 30602). **Project number:** 006190. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to: (1) study the use of radiation and mutagens to alter the protein quantity and quality in pearl millet grain; (2) continue to assess the economic value of mutants created by irradiating sterile triploid turf bermudagrasses; (3) study techniques of using irradiation to increase the winterhardiness of sterile coastcross-1 bermudagrass; (4) study the degree of heterosis that may result from crossing specific irradiation induced mutants with the normal inbred; (5) continue to study the economic value or irradiation induced mutants in pearl millet; (6) study techniques of using irradiation to induce resistance to the devastating rust disease caused by Puccinia substriata var indica that appeared for the first time in the summer of 1972 (assuming the disease recurs); (7) evaluate the use of mutagens to produce cytoplasmic male sterility; (8) continue our cytogenetic studies on the products of irradiation breeding; and (9) evaluate the use of radiation to control reproductive behavior in plants. IAEA will analyze samples for protein. Standard agronomic procedures will be used to assess the economic value of promising mutants. Regular cytogenetic techniques will be used to study the inheritance and linkage relationship of radiation induced mutants.
Keywords: ionizing radiations; mutagens; irradiation; millet; grass; genetic radiation effects; mutations; radioinduction; plant breeding; disease resistance; economics; reproduction; biological radiation effects; mutagenesis.

106142 Nucleic Acid and Protein Metabolism During Seed Embryogenesis. Dure, L.S. (Univ. of Georgia, Athens, GA, 30602). **Project number:** 006192. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) to isolate mRNA for cotton seed storage proteins; (2) to synthesize cDNA to mRNA; and (3) to measure concentration of storage protein mRNA during cotyledon development. The methodology exists for isolation of specific mRNA, and for synthesis of cDNA to mRNA. The procedure includes attempts to purify storage protein, prepare antibodies to its subunits, prepare mRNA for the subunits by double immunoprecipitation from polysomes, prepare cDNA with reverse transcriptase, and carry out cDNA:RNA hybridization and cDNA:DNA reassociation.
Keywords: cotton plants; seeds; ontogenesis; dna; rna; proteins; metabolism; hybridization; biosynthesis; biochemistry.

106143 Relationship at DNA Repair Processes to Mutagenesis and Carcinogenesis in Mammalian Cells. Evans, H. (Case Western Reserve Univ., Cleveland, OH). **Project number:** 007606. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

An important issue in carcinogenesis and mutagenesis is addressed: whether post-replication repair of DNA (error-prone repair) is the molecular event for initiation of carciongenesis and for induction of gene mutations. It is proposed to get at this problem by a novel mutagenization and selection technique using infection with damaged cytocidal viruses which can be reactivated only if cells have active repair systems. Thus, one can select repair deficient mutants. The efficiency of the process is not known. The investigators cite the body of literature which indicates that this is an efficient selection method in microbial systems (E. coli and Bacillus subtilis). The authors have chosen a mouse cell line O3H1OTON1/2 which is widely used for cell transformation studies. The mutant marker for first analysis will be for ouabain-resistant cells. The cytocidal virus chosen is the polyoma virus which is efficient as far as infection of these mammalian cells.
Keywords: cell cultures; mice; mutagenesis; carcinogenesis; polyoma virus; dna; biological repair.

106144 Regulation of Nucleic Acid and Protein Synthesis: a Background Study Related to the Biological Effects of Radiation. Zamecnick. (Massachusetts General Hospital, Boston, MA). **Project number:** 006708. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This proposed program is an effort to uncover regulators of protein synthesis in living systems. It is hoped that a deeper understanding of the mechanisms by which such regulation is accomplished in normal cells will lead to a better perception of the aberrations which lead to the deficient protein synthesis associated with radiation damage, and the excessive protein synthesis of neoplasia. A particular dinucleotide (AP4A) has been discovered which is associated with rapid cell growth, and an effort is being made to define its function. A triadecamer deoxynucleotide has also been synthesized which may inhibit oncogenic viral replication.
Keywords: nucleic acids; proteins; biosynthesis; nucleotides; neoplasms; viruses.

106145 Development of New Fluorescent Markers for Chromosome Study. Tsou, K.C. (Univ. of Pennsylvania Hospital, 3400 Spruce Street, Philadelphia, PA, 19104). **Project number:** 007448. **Contract:** EE-77-S-02-4330. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The project objective is to develop new markers for chromosomes that can be used for monitoring genetic damage due to environmental factors. The approach includes the synthesis of fluorescent markers that can interact with DNA in different manners. Synthesis of a new series of acridine analogs has been done and their structure--DNA interaction studied.
Keywords: chromosomes; dna; biosynthesis; fluorescence; biological indicators; genetic effects; tracer techniques; dyes; acridines; optical properties; genes; mutagenesis.

106146 Effect of Mutagenic Agents on the Initiation of DNA Replication in Mammalian Cells. Taylor, J.H. (Florida State Univ., Tallahassee, FL, 32306). **Project number:** 007780. **Contract:** EP-78-S-05-5854. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the project is to test the ability of mammalian cells to react and recover from exposure to ionizing radiations, ultraviolet light, alkylating mutagens, and DNA crosslinking agents. Mammalian cells in culture which can be highly synchronized with respect to the cell division cycle are exposed to the above agents for short periods and techniques are developed to measure quantitatively the effect on the cell's ability to initiate DNA replication. Effects from three agents have been shown. An antibiotic (Actinomycin D), a drug (bromodeoxyuridine), and x rays (250 Kvp) were all shown to inhibit initiation under prescribed conditions.
Keywords: x radiation; irradiation; synchronous cultures; animal cells; biological radiation effects; dna replication; inhibition; ultraviolet radiation; actinomycin; budr; mutagens; alkylating agents; biological effects; biological recovery.

106147 Services-Securing Investigator Support Information and/or Scientific Area Searches. Freeman, M. (Smithsonian Science Information Exchange, Inc., Washington, DC). **Project number:** 006580. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Funding is provided for the preparation of Science Information Exchange data sheets.
Keywords: information needs; information systems; information; management.

106148 Damaging Effects of Visible Light. Williams. (Florida State Univ., Tallahassee, FL). **Project number:** 007807. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); nuclear fission(20); solar(20); hydroelectric(20) **R and D categories:** Biological effects of pollutants in experimental systems.

When rats are exposed to low intensities of light for extended periods of time, they suffer the death of their visual photoreceptors. The intensities at which this occurs are all within the range which humans experience daily. (Indeed, some are too low for comfortable reading.) The following proposal is aimed at elucidating the mechanisms whereby the damage occurs. Specifically, the proposal considers photodynamic oxidation of retinal cells as a possible cause of damage and, eventually, death. A brief review of the importance of photodynamic action is given and its relationship to visual cells is pointed out. It is shown, for example, that the components of visual pigments, themselves, are candidates both for producing singlet oxygen (a known cellular oxidant) and for becoming damaged. Thus, a reasonable (since it is synthesized from known results) scheme is proposed as one possibility: retinaldehyde, the visual chromophore, sensitizes the production of singlet oxygen which then oxidizes the highly unsaturated fatty acids of the membrane lipids. The oxidation products (chiefly aldehydes), in turn, attack amino groups on the visual pigment protein, opsin, and render it unable to properly regenerate visual pigment. Two measurements of the severity of photodynamic damage will be made: lipofusin fluorescence in receptors will be determined and the rate and extent of pigment regeneration will be ascertained. A progress report is included and preliminary results on the two assays of damage are given.
Keywords: visible radiation; chronic exposure; rats; biological effects; retina; pigments; oxidation; carboxylic acids; photochemical reactions.

106149 Cell Surface Sugars and Cell-Cell Adhesion. Rando, R. (Harvard Univ., Boston, MA). **Project number:** 008262. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To study the topological distribution requriement of cell surface sugars engaged in adhesive behavior, we will study the Concanavilin A induced agglutination of bovine erythrocytes modified by the above techniques as a model system. Bovine erythrocytes are not normally agglutinable by Con-A, but can be rendered so by the addition of alpha-D-mannose residues to the cell surface. We desire to study the topological differences between those mannose residues that allow for Con-A induced agglutination and those that don't. To get at the notion of sugar structures as specific codons we will incorporate defined cell surface sugars to cells that normally undergo homotypic adhesive behavior such as L-6-transformed skeletal muscle cells, liver cells, and fat cells and determine whether or not heterotypic cell-cell adhesion will occur. Finally, certain cell lines, such as Ricin II resistant BHK cells and human fibroblast W138 cells, which have had their cell surface sugars content lowered, also show lowered homotypic cell-cell and substratum adhesiveness in addition to, in the case of W138, increasing their rate of DNA synthesis. We will attempt to restore the wild phenotypes by the selective readdition of certain cell surface sugars, thereby correlating these sugars with the observed physiological effects manifest in their absence.
Keywords: animal cells; biochemistry; cattle; erythrocytes; cytology.

106150 Study of the Mechanism of Carcinogenesis by Carcinogens Which are Negative in the Ames Test. Borek, E. (American Cancer Research Center, Lakewood, CO). **Project number:** 008092. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(50); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Some carcinogens which are not mutagens, and therefore are negative in the Ames test, were observed to elevate the progesterone levels in the sera of immature chicks. The phenomenon is not restricted to the chick as the target animal; in male rats, too, progesterone level is highly elevated after the administration of ethionine. This is a great advantage because the physiology of hormone production is better known in rodents. The tumor promoter phorbol ester also elevates progesterone levels. Since we have established that elevation of progesterone in target animals is an attribute of a class of carcinogens which are negative in the Ames test, and that the phenomenon is not restricted to the chick, we plan to explore the mechanism of progesterone elevation in the rat. We will also continue testing other carcinogens which are negative in the Ames test, such as compounds of Be, Cd, Co, Cr, Fr, Pb, Ni, Ti, and Zn.
Keywords: carcinogenesis; biological models; mutagen screening; carcinogens; chickens; rats; progesterone; phorbol esters; beryllium; cadmium; cobalt; chromium; francium; lead; nickel; titanium; zinc.

106151 Photobiology and Photochemistry of Ribonucleotides. Gordon, M.P. (Univ. of Washington, Seattle, WA). **Project number:** 006309. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The effect of ultraviolet light on a small self-replicating RNA molecule, MDV-1, will be studied. The number of cytosine residues hydrated per lethal event will be ascertained. Attempts will be made to determine if certain sites in the molecule are specifically damaged by uv, and these sites will be located since the complete sequence of the molecule is known. The nature of the protection against uv of encapsulated RNA by TMV protein will be investigated. These studies will involve investigations of the possibility of energy transfer within the RNA chain using fluorescent labeled RNA and fluorescent labeled polyribonucleotides. Further studies will be made of the combined in vitro and in vivo photorepair of the cyclic double stranded DNA from caulifower mosaic virus. This DNA and TMV RNA will be used to simultaneously assess the effects of various environmental factors on the ability of the local lesion host, Datura stramonium L., to photoreactivate DNA and RNA, respectively.

Keywords: ultraviolet radiation; biological effects; rna; strand breaks; biological repair.

106152 Dissolved Organic Matter and Lake Metabolism. Wetzel, R.G. (Michigan State Univ., East Lansing, MI). **Project number:** 006375. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The focus of these continuing investigations is on integrated studies of the qualitative and quantitative cycling of particulate and dissolved organic carbon in lakes and the mechanisms controlling this dynamic cycling in eutrophication. Emphasis is placed on the abiotic and biotic sources and fates of dissolved organic matter (DOM), the interactions of DOM in inorganic nutrient cycling, and the relationship of these mechanisms to nutrient physiology and metabolism of phytoplanktonic, sessile algal, macrophytic, and bacterial populations. Experimental evaluation of regulatory mechanisms of growth and carbon cycling has yielded quantitative insight into control interactions among: (1) the microflora of the pelagial zone; (2) the littoral photosynthetic producer-decomposer complex; and (3) allochthonous inorganic-organic influxes. Quantification of carbon fluxes among these components, their influence on one another, and nutrient control mechanisms are fundamental to determination of functional rates of eutrophication.
Keywords: metabolism; lakes; water pollution; organic compounds; eutrophication; mineral cycling; nutrients; aquatic ecosystems; biological models.

106153 Season Climate Prediction. Knox, J. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** 004157. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project provides the funding support for the technical leadership of the DOE effort in seasonal climate predictions, including the application of existing research based techniques to climate predictions suitable for estimating energy demands, tailoring of these products to DOE user needs, and seeking new avenues of improvements in prediction methods for the time scale of 30 days to perhaps a year. The goal of this project is to actively involve several established groups presently exploring and testing seasonal climate prediction methods in providing seasonal forecasts more responsive to DOE needs than are now available from NOAA.
Keywords: climates; forecasting; coordinated research programs.

106154 Effects of Energy on Climate. Knox, J.B. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** 003234. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(20); oil shale(20); solar(10) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The potential climatic effects of increasing energy use have recently become of increased concern because of growing energy usage both in the United States and throughout the world. This project deals with evaluating the potential climatic response to such energy related effects as: (1) increased atmospheric aerosol loading (stratospheric and tropospheric) due to energy generation and energy-related activities; (2) surface albedo changes resulting from deforestation, oil spills, solar collectors, and resource extraction; and (3) atmospheric heating from heat rejection due to large-scale energy prduction.
Keywords: energy consumption; environmental impacts; climates; global aspects; aerosols; albedo; thermal pollution.

106155 Regional Haze Effects on Climate. Wesely, M.L. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 003196. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant measurements technology.

Episodes of increased haze occur periodically over large portions of the United States, especially during the summer. While the most noticeable effects are reduced visibility and whitened skies, calculations have shown that, due to increased aerosol scattering and absorption, the rate at which the atmosphere and the earth are heated can be altered substantially by the presence of haze. The suspended particulate material in question derives from gases and particles emitted from both natural and anthropogenic sources at the surface of the earth. With the expected greater pollutant emissions due to increased combustion of fossil fuels, regional-scale episodes of increased haze will probably intensify and occur more frequently; in turn, this may cause a change in the average solar radiation balance, and the resultant net gains or losses of heat may eventually affect regional weather and climate. This program examines the present spatial and temporal variations of haze in the eastern half of the United States, primarily via measurements of atmospheric turbidity, and evaluates changes in heating rates that occur with a view toward developing and testing models capable of assessing the effects of changes in these phenomena.
Keywords: usa; air pollution; environmental effects; particles; aerosols; climates; ambient temperature; regional analysis; earth atmosphere; temperature measurement.

106156 Radiation Effects of Clouds and Aerosols. Laulainen, N.S. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 003058. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant measurements technology.

This project emphasizes simultaneous measurements of aerosol physical, chemical and radiative properties and of the solar radiation field at various levels within the urban planetary boundary layer to determine the relative properties of atmospheric, energy-related (AER) aerosols, clouds and the interactions between clouds and AER aerosols which affect the radiative properties of cloud/aerosol systems. This study expects to use data collected from surface and aircraft observations during clear and cloudy days, over various surface albedos and for various aerosol loading conditions.
Keywords: aerosols; physical properties; chemical properties; radiant heat transfer; atmospheric chemistry; solar radiation; clouds; albedo.

106157 Assessment of Current Climate Information Relating to Energy Planning. Baer, F. (Univ. of Maryland, College Park, MD, 20742). **Project number:** 008237. **Contract:** 80-EV10235. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The purpose and plan of this project is to assess the current status of atmospheric prediction, modeling, data accumulation, and analysis in relation to energy planning. This information should allow us to advance recommendations regarding future activities in these areas and how such efforts will improve energy planning. Concurrently we will be able to establish the best ways to utilize the climatic information now in hand for optimizing present energy planning.
Keywords: climates; data compilation; evaluation; energy policy; optimization.

106158 Gasifiers in Industry. Gehrs, C.W. (Oak Ridge National Lab., Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 003157. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

DOE will (in FY 79) select either Shelby County, TN, or Henderson County, KY, for development of a medium Btu gasification facility that will be operable as early as 1981. An environmental monitoring program (EMP) is developed for DOE/ET in each of these conceptual contracts. This program is intended to ensure compliance of the specific facilities wih regulations. The EMP is not designed to provide data for assessing the potential environmental implications of medium Btu gasification technologies in general. This proposal is designed to do the latter. We will (1) evaluate the proposed sites for their usefulness in field related environmental activities, (2) design such research, (3) review the environmental monitoring program to determine what aspects of research are being fulfilled in this program, and (4) implement the salient research not covered in the EMP for the successful site. Initially studies will be on baseline characterization to allow ecological effects and transport, transformation, and fate studies when the plant is operating. Atmospheric and aqueous emissions will be studied with emphasis on aromatic hydrocarbons, nitrogen compounds, and sulfur compounds in both media. Particulates, SOx and NOx, will also be studied in the atmospheric component of the program.
Keywords: coal gasification plants; synthesis; intermediate btu gas; monitoring; environmental impacts; site selection; ecology; gaseous wastes; liquid wastes; polycyclic aromatic hydrocarbons; nitrogen compounds; sulfur compounds; particles; sulfur dioxide; nitrogen dioxide; air pollution; water pollution.

106159 On the Dynamics of Climate. Gates, L.W. (Oregon State Univ., Climate Research Inst., Corvallis, OR, 97331). **Project number:** 007987. **Contract:** 79-EV10053. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

A comprehensive research program will be conducted on the dynamics of climate through the coordinated pursuit of six activities: (1) research with global atmospheric general circulation models; (2) research with global oceanic general circulation models; (3) research with coupled general circulation models of the atmosphere-ocean system; (4) research with statistical-dynamical climate models; (5) supporting research on selected theoretical and computational problems; and (6) the assembly and analysis of selected climatic data. Emphasis will be given to the simulation of seasonal and interannual climatic variability with as efficient models as possible, to the systematic analysis and documentation of each model's performance in comparison with observed data, and to the study of selected climatic processes in the ocean-atmosphere system.
Keywords: climates; mathematical models; dynamics; earth atmosphere; seas; data acquisition; data analysis; seasonal variations.

106160 Dendrochronology of the Bristlecone Pine. Ferguson, C.W. (Univ. of Arizona, Lab. of Tree Ring Research, Tucson, AZ, 85721). **Project number:** 007871. **Contract:** EE-78-A-28-3274. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This study seeks to document bristlecone pine chronology using dated specimens from the White Mountains of Southwestern U.S. and to use dendrometric data and samples to calibrate isotopic ratio methodology related to biosphere contribution of CO2 in the global atmospheric pool. A master bristlecone pine chronology will be developed for a 10,000-year time span. Samples of dated wood will be made available to other laboratories for calibration of carbon isotopic ratio methodologies.
Keywords: pines; carbon dioxide; global aspects; carbon cycle; isotope ratio; age estimation; optimization.

106161 Coordination of Technical Planning for the Department of Energy Carbon Dioxide Effects Research Oceanographic Subprogram. Ostlund, H.G. (Univ. of Miami, 4600 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** 007869. **Contract:** 79-EV10020. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The Miami Tritium Laboratory will coordinate the carbon dioxide effects research oceanographic subprogram. The coordinator will be responsible for interfacing the field and laboratory programs involving the ship scheduling and the organization of participants from different scientific institutions.
Keywords: carbon dioxide; environmental effects; oceanography; climates; ships.

106162 Coral Growth Rings and the Temporal History of Nuclear 14C and 90Sr/Sr in the Surface Ocean. Brocker, W.S. (Columbia Univ., Lamont-Doherty, Geological Observatory, Palisades, NY, 10964). **Project number:** 007868. **Contract:** 79-EV10041. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

As revealed by the geosecs data in the Atlantic and in the Pacific Oceans, the difference of bomb-produced carbon-14 between the equatorial zone of upwelling (15 degrees north to 15 degrees south) and the adjacent temperate downwelling zones (15 degrees to 45 degrees) is about fivefold. A numerical model which quantitatively accounts for these carbon-14 profiles and hydrogen-3 profiles in the Pacific Ocean predicts that the carbon-14/carbon for equatorial and northern temperate surface waters should begin to diverge from one another in the late 1960's and that both the hydrogen-3 and strontium-90 content of equatorial surface waters should have decreased by about 17% per year since 1965. To verify and to improve this upwelling model, we propose to reconstruct the temporal history of bomb carbon-14/carbon and strontium-90/strontium records for the equatorial and temperate surface mixed layer of various specific regions of the ocean from the growth rings in corals. A plan to use density and oxygen-18/oxygen-16 variations to ascertain the chronology of growth ring of coral samples over the last few decades is also proposed.
Keywords: atlantic ocean; pacific ocean; surface waters; radioactivity; carbon 14; strontium 90; tritium; radiation monitoring; corals; animal growth; oxygen 16; oxygen 18; isotope ratio; isotope dating; fallout deposits; geographical variations; upwelling; water currents.

106163 Investigation of the Surface Water pC02 in the Equatorial Pacific Ocean. Takahashi, T. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 007867. **Contract:** 79-EV10229. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

An investigation of the partial pressure of CO2 exerted by the equatorial surface water of the Pacific Ocean during five selected legs of the NORTEX Shuttle Program (16 legs total) between Hawaii and Tahiti (scheduled in January 1979 through June 1980) is proposed. The major objective for this proposed investigation is to determine the seasonal and geographic variability of the CO2 partial pressure in the equatorial Pacific surface waters. The results will be pertinent to assess the dynamic balance of the CO2 exchange between the atmosphere and the oceans, and the fate of fossil fuel CO2 released in the atmosphere.
Keywords: surface waters; pacific ocean; equator; carbon dioxide; pressure measurement; seasonal variations; geographical variations.

106164 Natural Catalysis of CO2/HCO3 Reaction in Surface Sea Water. Broeker, W. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 007865. **Contract:** 79-EV10242. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The gas exchange rate estimated from GEOSECS surface radon data is about 30% lower than that estimated from GEOSECS bomb 14C data. As suggested by Berger and Libby (1969), the CO2 exchange might be enhanced by the catalyzing effect of carbonic anhydrase leaking from marine organisms. An experiment is designed to directly ascertain the extent of catalysis of the CO2 going to HCO3 reaction in sea water (via carbonic anhydrase or any other natural catalyst) by carrying out RN-0-2-CO-2 evasion (or invasion) measurements in deck tanks on sea water collected in equatorial upwelling areas. Because of their high biological activity these areas should show a larger than average effect. As the CO2 exchange rate in equatorial areas must be known in order to calibrate upwelling models based on the distribution of bomb produced 14C, these experiments are essential to the transient tracer program in the equatorial ocean.
Keywords: carbon dioxide; carbonates; seawater; water chemistry; chemical reactions; catalysis; carbon cycle; upwelling.

106165 Successional Forest Stands as Sinks for Atmospheric Carbon Dioxide. Gates, D.M. (Univ. of Michigan, Biological Station, Ann Arbor, MI, 48109). **Project number:** 007863. **Contract:** 79-EV10091. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to make as precise an evaluation as possible of the rates of carbon dioxide exchange for the successional regrowth forests of Michigan to be followed by an evaluation of boreal forests to the north. The approach is to engage in a series of field measurements on the properties of the most significant forest stand plants growing in Michigan. Measurements will be made with the oak-hickory stands of Northern Michigan. Species in Northern Michigan will include aspen, birch, cherry, beech, maple, oak, whole and red pine, white cedar, spruce, fir and hemlock. Particular attention will be given to the aspen stands of Northern Michigan since this successional tree species (Populus deltoides and P. grandidentata) dominates the cutover lands of very large regions. Techniques for measurement of photosynthesis by whole leaves will be applied to these plants growing in the field.
Keywords: forests; carbon dioxide; trees; photosynthesis; revegetation; michigan; sinks.

106166 Studies, Analyses and Technical Support to EV Offices. Wisniewski, J. (Mitre Corp., 1820 Dolley Madison Blvd., McLean, VA, 22102). **Project number:** 007860. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

MITRE will assemble and print a status report which will serve as a vehicle for presenting highlights of DOE's Carbon Dioxide and Climate Research Program. MITRE will expand and update the present international survey. This will include: (1) soliciting and classifying responses from researchers outside the United States; (2) reviewing recent publications to find others working in the field and to determine the current state-of-the-art; (3) contacting organizations which promote or financially support CO2 studies; and (4) comparing the current international activities with the existing or proposed DOE program of research. In addition, MITRE will perform a technical assessment of the international projects. MITRE will prepare briefings and small working documents and perform other working tasks as needed. MITRE will survey program analysis techniques and will recommend application to the CDCRP Program.
Keywords: carbon dioxide; environmental impacts; climates; research programs; planning; us doe; international cooperation; technology assessment.

106167 Historical C-14 Measurements from the Atlantic and Pacific Oceans. Fairhall, A.W. (Univ. of Washington, Dept. of Chemistry, Seattle, WA, 98195). **Project number:** 007852. **Contract:** 79-EV10010. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to evaluate the existing data base relative to questioning the role of the ocean in assimilating fossil carbon. The approach is to retrieve the 14-C and CO2 measurements taken over the past 20 years and format the data into a useable hard copy form, tabulating it by time, geographic location, and depth. Ancillary measurements will include salinity and temperature, which were taken at the same time, although many of these data will have to be obtained from the log books of the various cruises of which the 14-C sampling program was a part. The only laboratory observations that need to be finalized are 13-C measurements on approximately 200 alignots of CO2 in breakseal tubes. These measurements are necessary to correct the raw 14-C counting data for fractionation effects.
Keywords: carbon 14; carbon dioxide; salinity; temperature measurement; carbon 13; data acquisition; data analysis; fossils; seas; sinks; time dependence; depth; isotope separation; carbon cycle; atlantic ocean; pacific ocean; tracer techniques.

106168 Study of the Abundance of Carbon Dioxide in the Atmosphere and its Exchange with Oceans. Keeling, C.D. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 007769. **Contract:** ER-78-A-28-3264. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to study the content and variability of carbon dioxide in the earth's atmosphere and in surface sea water and the exchange of carbon dioxide between the atmosphere and the ocean. As a WMO central CO2 calibration facility, the Scripps Laboratory will maintain WMO primary reference gases, provide secondary reference gases to national programs, and participate in intercalibrations between national central laboratories and field stations. The Laboratory will also assist the WMO program to measure CO2 worldwide by observing CO2 in tropical regions and in the southern hemisphere. Observations of the rate of increase in CO2 partial pressure with total carbon and alkalinity will be made at three to six fixed ocean stations. The rate of change of CO2 partial pressure with total carbon and alkalinity will also be measured in the laboratory to insure correct interpretations of the field data. Detailed model studies of the time dependent global carbon cycle will be made to improve on predictions of the fraction of CO2 from combustion which will accumulate in the air during the next several thousand years, and the long-range climatic and environmental impact of this accumulation.
Keywords: carbon dioxide; earth atmosphere; seas; tropical regions; carbon cycle; mathematical models; environmental impacts; global aspects; monitoring; climates; chemical reactions; spatial distribution; surface air.

106169 Atmospheric CO2 Abundance: An Archival Study of Spectroscopic Data. Stokes, G.M. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** 003064. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The purpose of the proposed research is to determine a pre-industrial value of the atmospheric carbon dioxide abundance that is of sufficient quality to serve as a test of global models of the carbon cycle. The proposed determination of a pre-industrial CO2 abundance will be based on a hitherto unexpected source of data, the measurements of the near-infrared solar spectrum that have been accumulated since the mid-1890's for astronomical purposes. Since a spectroscopic program of this kind has not been previously attempted, a special approach to the problem is required, which entails two related projects. The first is an analysis of new spectroscopic data to be accumulated with the Fourier transform spectrometer (FTS) of the Kitt Peak National Observatory (KPNO). This analysis will enable a detailed identification of possible sources of systematic error that may arise in the study of data which were not specifically collected for the determination of telluric abundances. The second is the identification and evaluation of archival solar spectra that may be suitable for this study and their analysis. In general this analysis will proceed in a reverse historical order, working back toward the spectra of S.P. Langley accumulated in the 1980's.
Keywords: carbon dioxide; earth atmosphere; carbon cycle; mathematical models; infrared spectra; near infrared radiation; solar radiation; abundance.

106170 Scientific Direction of the DOE CO2 Program and Supporting Research. Machta, L. (NOAA, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** 008103. **Contract:** 79EV10103. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to provide scientific direction of the DOE CO2 program, particularly in the area of the carbon cycle research and climate modelling. The approach is to: (1) advise DOE on the relevance, program priorities, and other scientific characteristics of proposal received by DOE; (2) conduct site visits, attend meetings, evaluate accomplishments, propose program modifications, and perform such other scientific management tasks as may be needed; (3) contact scientific institutions and organizations to encourage proposals as may be required to insure a comprehensive program; (4) conduct such studies and research as may be needed and can be undertaken to support the first three tasks; (5) maintain technical liaison with the U.S. Climate Program Office and the relevant research at the U.S. government agencies; and (6) report periodically to the DOE as required on the work of the group and other technical items of significance to the DOE.
Keywords: carbon dioxide; carbon cycle; climates; mathematical models; management; research programs; information needs; us doe; greenhouse effect.

106171 Gases in Sea Ice. Kelley, J.J. (Univ. of Alaska, Naval Arctic Research Lab., Barron, AK, 99723). **Project number:** 008091. **Contract:** 79-EV10217. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to investigate the composition and transport of gases in sea ice. The approach is to: (1) prepare reports and journal contributions on existing data collected previously; (2) obtain support data from the Far North Station FRAM 1 in the spring; (3) obtain much needed long-term data on gases in sea ice, particularly over a summer season; (4) commence observations on the dynamics and distribution of hydrogen in sea water - a technique has been developed and is ready for field tests; and (5) concentrate on rates of exchange of gases, particularly CO2 which will yield insight on whether the release of this gas from the polar ice is important to climate modification and the global CO2 budget in general.
Keywords: carbon dioxide; arctic ocean; ice; data compilation; climates; gases; chemical composition.

106172 International Meeting on Dendro-Isotopic Research. Broecker, W.S. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 008087. **Contract:** 79-EV10037. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to operate a conference on the isotopes of C, O, and H in tree rings. The conference will offer a means of sorting out promising from unpromising lines of attack and will provide a preliminary assessment of the utility of several methods of obtaining paleoclimatic and paleobiomass information from isotopic records in trees. It will consist of a three-day meeting designed to bring together the people involved in the isotope work with people knowledgeable in the area of tree physiology and dendrochronology. This meeting, to be held 23--25 May 1979, would be the first international meeting concentrating on this area of research.
Keywords: meetings; carbon isotopes; oxygen isotopes; hydrogen isotopes; isotope dating; climates; trees; carbon cycle; carbon dioxide; paleontology.

106173 Problem Definition and Feasibility Workshops Terrestrial Biosphere Subcomponents on the Global CO-2 Balance. Loucks, O. (Butler Univ., Inst. of Ecology, Indianapolis, IN, 46208). **Project number:** 008085. **Contract:** 79-EV10040. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

An in-depth analysis for three areas of program development in terrestrial biospheric components of the global carbon dioxide balance will be conducted. Three topics will be approached: (1) the potential contribution of cultivated or drained organic soils; (2) the contribution of eutrophication in freshwater systems to the CO-2 balance; and (3) the potential for temperate zone forests to have served as a CO-2 sink since their devastation in the late 19th century. The Institute will use its consortium relationships to convene recognized specialists in each of the above areas for the purpose of developing an explicit action plan which will identify the most feasible research approaches and the timing required for thorough analysis of these topics.

Keywords: feasibility studies; carbon dioxide; biosphere; terrestrial ecosystems; global aspects; ecological concentration.

106174 Large-Scale Deliberate Tracer Releases in the Oceanic Thermocline. Broecker, W.S. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 008083. **Contract:** 79-EV10038. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

Conventional oceanographic observations including fallout tracers cannot distinguish between the roles of isopycnal and vertical mixing. If we are to answer the question regarding their relative importance, we will have to conduct purposeful tracer experiments. As such experiments will be expensive and politically controversial, careful pre-planning will have to be done before they are seriously proposed. The technical, environment, and political aspects of such experiments will be investigated.
Keywords: tracer techniques; carbon dioxide; seas; technology assessment; political aspects; environmental impacts; oceanography; mixing.

106175 Modeling Ecosystem Impacts of Climatic Change from Energy Development and Use. Cooper, C.F. (San Diego State Univ., San Diego, CA, 92182). **Project number:** 008080. **Contract:** 79-EV10039. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

An assessment and evaluation will be made of theories and techniques for predicting ecological effects of climatic change resulting from accelerated energy development. Emphasis will be on the influence of climate on primary and secondary productivity and on the structure and distribution of ecosystems. The research is expected to lead to an improved ability to predict ecological consequences of climatic change. Emphasis will be on simulation and statistical models, field and laboratory observation and experimentation, and paleoecological studies. Particular attention will be given to the level of aggregation in ecosystem-climate models and to the potential role of satellite observations. The principal product of the research will be a carefully documented monograph on modeling ecosystem-climate relationships.
Keywords: climates; environmental impacts; energy source development; modifications; energy consumption; mathematical models.

106176 Support of International Research Activities on the Global Carbon Cycle. White, G.F. (Univ. of Colorado, Boulder, CO, 80309). **Project number:** 008059. **Contract:** 79EV10022. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective of this project is to advance international cooperation in assessing possible changes in the global carbon budget. The approach of this project is (1) to convene an international conference on the role of terrestrial vegetation in the global carbon cycle on methods for appraising changes; (2) to conduct an international workshop on global carbon cycle modeling; and (3) to undertake a project on the biogeochemical cycles (a scope study of global carbon).
Keywords: carbon cycle; global aspects; international cooperation; meetings; plants; mathematical models; biogeochemistry; carbon dioxide; climates; research programs.

106177 AAAS-DOE Workshop on Environmental and Societal Impacts of a Possible CO2-Induced Climate Change. Burns, D. (American Association for the Advancement of Science, 1776 Massachusetts Ave. NW, Washington, , DC, 20036). **Project number:** 008057. **Contract:** 79-EV10019. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective of this project is to convene a workshop to examine the effects on the environment of possible CO2-induced climate change, and the social, economic and political consequences of this type of environmental change. The approach to this project is to hold the workshop on April 2--6, 1979, which will enable the workshop to draw in the ideas and papers presented at the World Climate Conference in Geneva, February 12--23, 1979. The workshop will take place in the Washington, DC, area.
Keywords: carbon dioxide; climates; environmental impacts; meetings; social impact; economic impact; political aspects; forecasting; variations; greenhouse effect.

106178 Expansion of Global Atmospheric Monitoring of Carbon Dioxide. Hanson, K.J. (National Oceanic and Atmospheric Administration, Boulder, CO, 80302). **Project number:** 007990. **Contract:** 79-EV10056. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The National Oceanic and Atmospheric Administration (funded in FY78 by DOE) initiated a five year CO2 measurement program at some 10 to 15 new stations worldwide. The program collects air in flasks which are sent to a central laboratory in Boulder, Colorado, for analysis by an existing NOAA facility. The stations are located in very clean air locations; special instructions are sent to the locations to guide observers in their procedure for exposing the flasks. The NOAA is gradually upgrading its Boulder facility to accommodate the increased number of flask samples.
Keywords: carbon dioxide; earth atmosphere; monitoring; sampling; surface air; global aspects.

106179 Sociopolitical Impacts of CO2 Buildup in the Atmosphere Due to Fossil Fuel Combustion. Markley, O.W. (2700 Bay Area Blvd., Houston, TX, 77058). **Project number:** 007980. **Contract:** 79-EV10021. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to identify major sociopolitical impacts associated with the long term of atmospheric CO2 and with extensive curtailment of fossil fuel exploitation rates. A high demand case was selected (4.5% average growth rate in fossil fuel use). Coincident levels of CO2 were predicted. Interrelations among phenomenon associated with predicted effects of CO2 are qualitatively described. Physical effects related to increased CO2 are modeled and related to environmental and social consequences.
Keywords: carbon dioxide; earth atmosphere; surface air; fossil fuels; combustion products; social impact; political aspects; climates; forecasting; mathematical models; greenhouse effect.

106180 Global Temperature Patterns 6000 Years Ago. Webb, T. (Brown Univ., Dept. of Geological Science, Providence, RI, 02912). **Project number:** 007874. **Contract:** 79-EV10097. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to construct a map of global temperature patterns during the period 6000 to 7000 B.P. from pollen data on land and from marine plankton data in the oceans. When this is complete, a globally-averaged estimate of the atmospheric temperature during this period will be calculated. This information will supply a data base for checking model-simulations of future climates and will complement the work of the Climate Research Unit at Norwich, England, in time periods within the past 3000 years. This project will involve work on Marine Data, on Southern and Eastern European Pollen Data, on African and Tropical Pollen Data, and on Canadian Pollen Data. For the global mapping, this work will be tied to ongoing work on Eastern North America and the Soviet Union and in Northwestern Europe.
Keywords: climates; earth planet; ambient temperature; mapping; pollen; plankton; age estimation.

106181 Geographical Patterns of Climatic Change Over Recent Milennia. Wigley, T.M.L. (Univ. of East Anglia, School of Environmental Science, Norwich, England NR47TJ). **Project number:** 007873. **Contract:** 79-EV10098. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to investigate the climate of the Little Ice Age in more detail on a hemispheric and possibly global scale; to examine the changes in climate which led into and out of this unique period; and to examine the period in relation to the two earlier cold periods. The approach will be comprised of: (1) a long time scale study, largely a consolidation of the previous project, Geographical Patterns of Climatic Change: 1000 BC--1700 AD; (2) a more detailed study of the Little Ice Age; and (3) an integration of studies with parallel pollen work, Lake Sediment Studies and Tree-Ring Analysis.
Keywords: climates; earth planet; age estimation; pollen; sediments; lakes.

106182 Improvements to the 14-C Measurement Facility. Ostlund, H.G. (Univ. of Miami, 4600 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** 008286. **Contract:** 79-EV10303. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Pollutant measurements technology.

This project will replace outdated electronic instrumentation for 14-C measurements, improve the power system, and acquire modern electronic diagnostic tools at the Miami Tritium Laboratory. **Keywords:** carbon 14; radiation monitoring; measuring instruments; seas.

106183 Kr-85 Measurement Facility. Broecker, W.S. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 008285. **Contract:** 79-EV10302. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Pollutant measurements technology.

The purpose of this program is to develop a facility for measuring Kr85 in sea water samples. To do this we must improve the conventional water samplers, develop a means of isolating the Kr, Ar, N2 fraction at sea, develop a means to purify the Ar-Kr fraction in the laboratory, and develop means to measure the Kr yield (isotope dilution and the Kr85 activity low level counting). The measurement is needed in connection with analog models designed to estimate the uptake of fossil fuel CO2 at high latitudes. **Keywords:** seawater; krypton 85; quantity ratio; samplers; fossil fuels; carbon dioxide; modifications.

106184 Construction of a 3H-3He Facility. Jenkins, W.J. (Woods Hole Oceanographic Institution, Dept. of Chemistry, Woods Hole, MA, 02543). **Project number:** 008283. **Contract:** 79EV10301. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The approach will be to build a new mass spectrometer for 3H and 3He analysis. A number of improvements over existing instruments are envisaged, which will result in increased sensitivity and linearity, reduced hydrogen background and reduced helium blanks. These would be accomplished by several modifications to the source, flight tube, analyzer magnet, detectors, and sample delivery system. Calculations indicate that the ultimate accuracies may be improved as much as two-fold by these improvements.
Keywords: tritium; helium 3; mass spectroscopy; mass spectrometers; design; accuracy.

106185 Development of Standards for Measurement of Atmospheric Carbon Dioxide. Hughes, E.E. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 008257. **Contract:** 79-EV10271. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This project concerns the production and certification of a Standard Reference Material (SRM) consisting of three concentrations of carbon dioxide in air at atmospheric levels. These standards would be certified to better than 0.1% relative (+- .03 parts per million by mole) and would serve in the future as standards for measurement of carbon dioxide in the atmosphere. These standards are intended to compliment those already existing, prepared by Dr. Dave Keeling of Scripps Institute of Oceanography, and to offer measurement continuity to CO2 monitoring programs.
Keywords: carbon dioxide; earth atmosphere; surface air; standards; aerosol monitoring.

106186 Carbon Dioxide Measurements in the Equatorial Pacific. Weiss, R.F. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 008236. **Contract:** 79-EV10228. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This proposal requests support for continuous shipboard measurement of the concentration of carbon dioxide in marine air and its partial pressure in the surface ocean water of the central tropical Pacific. This research represents a major portion of a cooperative effort by several laboratories to study the exchange of carbon dioxide between the atmosphere and the sea during the upcoming NORPAX Equatorial Experiment. The measurements proposed here will be made by a new gas chromatographic technique which provides exceptionally accurate analyses of carbon dioxide in small samples. In addition, the instrument will determine concentrations of nitrous oxide and methane in the same samples.
Keywords: carbon dioxide; pacific ocean; tropical regions; surface air; monitoring; gas chromatography; nitrogen oxides; methane; spatial distribution; carbon cycle.

106187 Symposium on Budget and Cycles of Trace Gases and Aerosols in the Atmosphere. Martell, E.A. (Commission on Atmospheric Chemistry and Global Pollution, Boulder, CO, 80303). **Project number:** 008235. **Contract:** 79-EV10219. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The Commission on Atmospheric Chemistry and Global Pollution will organize and conduct a Symposium on the Budget and Cycles of Trace Gases and Aerosols in the Atmosphere to be held at the University of Colorado, Boulder, August 12--18, 1979. The symposium will deal with gases of geophysical significance such as CO2, NOx, fluorocarbons, etc.
Keywords: atmospheric chemistry; global aspects; aerosols; meetings; air pollution; trace amounts; gases.

106188 Consequences of Hypothetical World Climate Change Produced by Increased Atmospheric Carbon Dioxide. Roberts, W.O. (Aspen Inst. for Humanistic Studies, 1919 14th St., Boulder, CO, 80302). **Project number:** 008176. **Contract:** 79-EV10281. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

Many research groups are at work on the important long-term task of understanding the effects of atmospheric carbon dioxide on world climate. Most experts expect that the carbon dioxide increase will continue, and that therefore a global climate warming will occur within 25 to 50 years, with attendant strong regional climate alterations. Few groups are examining the social, economic, geopolitical and ethical issues to be faced if the continued development of human societies produces this large environmental impact. This proposal describes a one-year preliminary analysis of the effects of carbon dioxide on human societies and human choices, with the objective of identifying participants, problems, methodologies and timetables for a longer, cooperative, sustained effort to discover how to meet this urgent environmental problem in ways that minimize any adverse effects. The proposal derives from discussions at a week-long planning workshop held at Aspen, 8--14 October 1978. **Keywords:** climates; carbon dioxide; surface air; global aspects; social impact; economic impact; environmental impacts; greenhouse effect; forecasting.

106189 Interpretation of Equatorial Hydrographic, Nutrient Element and Radioisotope Data. Broecker, W.S. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 008169. **Contract:** 79-EV10243. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The hydrographicc (temperature and salinity) and nutrient element NO3, PO4, SiO2, O2, total CO2, alkalinity...) data from the equatorial ocean carry an enormous amount of information with regard to the dynamics of mixing in this region of the ocean. Also, far more information can be extracted from the radioisotope data if it is interpreted in conjunction with the hydrographic and nutrient element data. We propose to exploit this information by making a careful study of the high quality GEOSECS and NORPAX data and by using, where possible, data obtained on earlier expeditions. The objective of this study will be to test and improve the upwelling model recently developed for the equatorial Atlantic. As the bomb radiocarbon distribution in the Pacific Ocean has the same basic characteristics as in the Atlantic, this model can be extended to the Pacific.
Keywords: carbon dioxide; carbon cycle; upwelling; atlantic ocean; equator; mathematical models; nitrates; phosphates; silicates; oxygen; hydrology; radionuclide migration.

106190 Bomb Radiocarbon Sections Along the Hawaii--Tahiti Shuttle Track. Stuiver, M. (Univ. of Washington, Depts. of Geological Sciences and Zoology, Seattle, WA, 98195). **Project number:** 008166. **Contract:** 79EV10216. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Pollutant measurements technology.

By taking advantage of the equatorial crossings to be made by the Norpax group during 1979, plans are to study the equatorial dynamics of the Pacific Ocean. The dynamics of equatorial upwelling is intimately connected with aspects of modeling of the oceanic uptake and distribution of fossil fuel CO2. The study will be made by measuring the spatial pattern and temporal history of bomb radiocarbon in the equatorial ocean and eastern boundary currents.
Keywords: pacific ocean; upwelling; tropical regions; carbon dioxide; spatial distribution; mathematical models; carbon cycle; carbon isotopes.

106191 Support of the Climatic Research Board. Epstein, E.S. (National Research Council, Climate Research Program Office, Rockville, MD, 20852). **Project number:** 008123. **Contract:** 79-EV10215. **Supported by:** Department of Energy, Washington, DC

(USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objectives are to provide advisory, review and evaluation services to the Federal government in the field of climate, and to undertake studies for the Federal government across a wide spectrum of climate problems that need to be considered in the development of the emerging national climate effort and the associated international climate program.
Keywords: climates; global aspects; mathematical models; meteorology.

106192 Assessment of the Possible Cryospheric Responses to a CO2 Induced Global Warning. Hollin, J.T. (Univ. of Colorado, Boulder, CO, 80309). **Project number:** 008122. **Contract:** 79EV10221. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

A CO2-induced warming might have an important impact on the cryosphere: mountain glaciers, the Greenland and Antarctic ice sheets, ground ice, seasonal snow cover, and sea ice. Such effects would be important for many economic activities, for sea level and, by feedback, for climate itself. We plan an evaluation of the possible effects. First, we will synthesize the extensive, but scattered data bearing on the glacial-meteorological theory, and then the historical-geological evidence from four previously warm periods, 1890--1940 AD, 6,000 BP, 11,000 BP and 125,000 BP. Second, we will analyze daily and monthly climatic data bearing on this problem, and make some empirical and numerical estimates of the climatic effect on snow cover and glaciers. Finally, we will publish maps and tables of the most likely cryospheric effects of seasonal or yearly temperature changes in different areas.
Keywords: carbon dioxide; climates; greenhouse effect; global aspects; arctic regions; environmental impacts; data compilation; meteorology; maps; seasonal variations.

106193 Nutrient Measurements for NORPAX. Williams, R. (Univ. of California, Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 008121. **Contract:** 79-EV10217. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This proposal is for the support of technical assistance at sea, the necessary supplies and logistics to collect and analyze nutrients (nitrate, phosphate, and silicate) from ten levels from 54 stations on eight Tahiti to Honolulu legs of the NORPAX (FGGE) shuttle. The samples will be analyzed by Geosecs Auto Analyzer procedures. One person is considered sufficient to maintain and operate the system during this time. Data will be presented as a hydrographic report consisting of tables, plots (vs depth), and sections (vs depth and distance along track).
Keywords: nitrates; phosphates; silicates; oceanography; mineral cycling; carbon cycle; carbon dioxide; ecological concentration.

106194 Technical Support for Collection of 14C Samples During FGGE. Williams, R. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 008120. **Contract:** 79-EV10218. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(75); nuclear fission(25) **R and D categories:** Pollutant monitoring.

This involves the technical support required for the collection of large volume (275 liter) water samples and the extraction therefrom of the carbonate for shipment to the University of Washington for analysis of 14C by Drs. Stuiver and Quay. It also includes the measurement, at-sea, of nutrients (O2, NO3, PO4, SiO3), total carbon and alkalinity. The at-sea operation will be performed aboard vessels supporting the NORPAX mid-equatorial experiment during March 1979 (aboard RV Gyre) and during November 1979 (aboard RV Wecoma). These vessels will make approximately bi-monthly expeditions between Honolulu and Tahiti and back. Hydrographic data will also be available for support of this work.
Keywords: carbon 14; carbon dioxide; carbon cycle; seawater; sampling; radioactivity; oxygen; nitrates; phosphates; silicon oxides; pacific ocean; spatial distribution.

106195 Enhanced Research Program on the Long-Range Climatic Effects of Increasing Atmospheric Carbon Dioxide. Washington, W. (National Science Foundation, P.O. Box 3000, Boulder, CO, 80307). **Project number:** 008119. **Contract:** 79-EV10220. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to improve the National Center for Atmospheric Research general circulation model and eventually to couple the model atmosphere to an ocean circulation model in order to: (1) build confidence that the models respond to the addition of CO2 in the same way as would the real system; (2) describe adequately the changes in the large-scale circulation patterns that will result in more significant regional and seasonal changes of both temperature and precipitation; and (3) determine how ocean circulations and temperatures of the oceanic upper mixed layers will be modified if there is a change in atmospheric temperature and circulation over a period of a few decades. The approach is to conduct a few well focused studies by devoting an incremental effort devoted specifically to the carbon dioxide problem to take advantage of the global circulation model and atmospheric/ocean global circulation model.
Keywords: climates; mathematical models; air pollution; carbon dioxide; ecological concentration; meteorology; atmospheric chemistry.

106196 Geochemical Determination of Biospheric CO2 Fluxes to the Atmosphere. Stuiver, M. (Univ. of Washington, Seattle, WA, 98195). **Project number:** 008113. **Contract:** 79EV10206. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(75); nuclear fission(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to make direct estimates of net biospheric fluxes during the past through the study of changes in 13C/12C isotope composition in cellulose from tree rings. The following areas are under investigation: (1) the influence of sample cellulose preparation on final 13C/12C ratios; (2) the influence of temperature on the 13C record; (3) the variability of 13C content within a single ring along the whole tree ring circumference; (4) the change in 13C/12C ratios when heartwood/sapwood boundaries are crossed; (5) the measurement of isotopic composition of several tree ring sequences from trees in isolated location; (6) 14C measurements (Suess effect) of selected samples; (7) measurement of 13C/12C ratios of atmospheric CO2 at a limited number of sampling sites; and (8) carbon reservoir modeling with the goal of obtaining the net absolute flux of biospheric CO2 to the atmosphere.
Keywords: carbon dioxide; earth atmosphere; geochemistry; biosphere; carbon 13; carbon 12; isotope ratio; trees; sample preparation; temperature effects; carbon 14.

106197 Effects of Hydroelectric Generation on Riverine Ecology. Becker, D. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000836. **Contract:** FY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: hydroelectric(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Effects of hydroelectric (conventional and pumped storage) generating facilities on aquatic ecosystems are investigated. Present tasks include an evaluation of effects of water level fluctuations on riverine biota below an installation. We are examining mortalities to adult and juvenile fish, fish-food organisms and effects on spawning and movements of fish. Future efforts will include effects of low water on development of salmon eggs and alevins in redds.
Keywords: hydroelectric power plants; ecology; environmental effects; fishes; aquatic ecosystems; rivers; mortality; reproduction.

106198 Field Research: SRC Pilot Plant. States, J.B. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** 003237. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop a strategy of environmental research which will facilitate the development of a safe technology involving the solvent refined coal process. The plan of attack is designed to be consistent with features of the DOE Environmental Development Plan for coal liquefaction and the coordinated plan for coal synfuels. The main research objectives are: (1) to chemically and biologically characterize the waste products of a developing coal-conversion process, solvent refined coal (SRC), from a pilot plant sited at Fort Lewis, Washington; (2) to determine the environmental fate and effects of SRC waste products; and (3) to ultimately obtain sufficient information to predict ecologically significant impacts of SRC waste products - air emissions, treated liquid process effluent, and residual particulate wastes from SRC processing all contain constituents capable of exerting adverse environmental impacts. The technical approach is to first correlate source terms on the basis on their biological effects to an exploration of their causative mechanisms.
Keywords: src process; pilot plants; solvent-refined coal; washington; chemistry; biological effects; environmental transport; environmental impacts; biological pathways; gaseous wastes; liquid wastes; toxicity.

106199 Coastal Shelf Transport and Diffusion. Hopkins, T.S. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000913. **Supported by:** Department of Energy, Washington, DC

(USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

The goal of this project is to understand the processes of transport and diffusion as they relate to the possible environmental effects of energy-related activities in the Mid-Atlantic Continental Shelf region. These processes must be understood because of their direct effect on the movement of pollutants and other materials and because of the important role of circulation processes in the dynamics of shelf ecosystems. While initial studies emphasized the coastal boundary region, present studies have increased the focus to shelf-wide problems. The research has been divided into five components: (1) coastal boundary layer; (2) shelf circulation; (3) water mass analysis, (4) water property dispersion; and (5) air-sea interaction. The observational phase of the original COBOL program will be complete by the end of FY 1978. The sparbuoy telemetry system, which has been considerably improved, will then be used as an observational facility for the remaining components. Other sources of observational data come from hydrographic cruises, an air-sea interaction buoy, the development of a deep shelf mooring, drogues, and laboratory disperson studies. Theoretical interpretations continue to integrate physical data into coastal ecosystems models. Internal cooperation continues with the Atmospheric Sciences and Instrumentation Divisions, as does external cooperation with Woods Hole Oceanographic Institution, Bigelow Laboratory, Oregon State University, Lamont-Doherty Geophysical Observatory, and others. Within the Oceanographic Sciences Division, the project is considered an integral and essential part of the DOE multidisciplinary research program to understand the impact of energy-related activities within the Northeast Coastal Zone.
Keywords: continental shelf; atlantic ocean; energy source development; environmental impacts; environmental transport; telemetry; data compilation; mathematical models; aquatic ecosystems; temperature gradients; salinity; diffusion.

106200 Primary Production and Utilization. Falkowski, P.G. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001370. **Contract:** FY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The Primary Production and Utilization Program is designed to provide basic quantitative information on the primary producers and their utilization by dominant herbivores in the context of the dynamics of the New York Bight ecosystem. Such information is necessary in order to understand the regulating and controlling factors for primary and secondary productivity in the coastal shelf waters and the mechanisms by which the significant factors work in the ecosystem. Without this understanding, the assessment and prediction of the effects of energy-related activities on the continental shelf will not be possible. Basic information on the effects of light (quality and quantity) and nutrients on phytoplankton growth ultimately can relate to the structure and function of phytoplankton communities. The disruption of timing and composition of the primary producers by energy-related perturbations would have effects on the structure and function of zooplankton communities. The mechanisms for this response can also be partially evaluated in laboratory situations. To relate laboratory-derived information to the ocean, it is necessary to use temporal and spatial scales relevant to the phytoplankton and zooplankton. The system selected is oriented toward this approach. Biological instrumentation is being developed that ultimately will permit continuous, real-time evaluation of significant variables.
Keywords: aquatic ecosystems; continental shelf; coastal waters; productivity; food chains; biomass; oceanography; nutrients; phytoplankton; zooplankton.

106201 Effect of LET and Microdistribution of Radiation on the Induction of Transformation In Vitro and In Vivo. Little, J.B. (Harvard Univ., Cambridge, MA, 02138). **Project number:** 007450. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Evaluating the steps in cell transformation is basic to the understanding of carcinogenesis. This research provides a vital link between in vivo lung carcinogenesis and in vitro cell transformation by alpha emitters. The influence of microdose distribution for high LET radiation on cell killing and transformation and their interaction to produce cancer will be evaluated. The models developed from this research will be useful in setting standards for the inhalation of alpha emitting radioactive particles.
Keywords: let; cell differentiation; carcinogenesis; biological models; radioinduction; alpha particles; microdosimetry.

106202 Carcinogenesis of SRC Materials. Renne, R. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001993. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is devoted to the exposure to and pathological effects produced by crude product and fractions derived therefrom on skin of mice. Other process samples will be tested in FY 1980.
Keywords: carcinogenesis; src process; skin; mice; solvent-refined coal; mutagen screening.

106203 Mutagenicity of Oil Shale Materials. Pelroy, R. (Battelle Pacific Northwest Labs.,P.O. Box 999, Richland, WA, 99352). **Project number:** 001994. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Utilization of oil shale as a prime fuel source will result in the release of a large number of organic and inorganic compounds from both spent shale material and shale processing. Rigorous animal toxicity tests for all these potentially carcinogenic or mutagenic agents would be expensive and time consuming. This project is therefore investigating the development and utilization of bioassays, employing microbial and mammalian cells in culture, as a screen for mutagenic and carcinogenic effect.
Keywords: mutagenesis; oil shales; spent shales; leachates; mutagen screening; microorganisms; cell cultures; animal cells.

106204 Repair of Hydrocarbon Damage. Goldthwaite, P. (Case Western Reserve Univ., Cleveland, OH). **Project number:** 008013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to understand enzymatic mechanisms of DNA repair. Further studies on the mechanism of action of endonuclease II of E. coli are proposed. These include a definition of the site of incision, an exploration of possible exchange reactions, and the enzyme inhibition by phorbol ester. The enzyme will be used as a probe to examine repair on nucleosomes and in repair deficient mammalian cells. Other substrates for the enzyme will be examined. A search for mammalian n-glycosidase enzymes is progressing. An examination of the type of damage due to gamma-irradiation which is recognized by endonuclease II is continuing.
Keywords: dna; biological repair; enzymes; reaction kinetics.

106205 Screening for Non-Random Mutagenesis. Goldsby, R. (Univ. of Maryland, College Park, MD). **Project number:** 007966. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In order to assess mutational risk from chemicals emanating from extraction and use of various forms of energy, we need efficient methods for mutation assessment in mammals. Goldsby's approach is to apply mutagen to cells and isolate temperature sensitive mutants. These mutants can be used as a class for quantifying the mutagenic capacity of any environmental insult. The objective here is to develop approaches that will lead to a greater capacity to control and detect mutagenesis in mammalian somatic cell cultures.
Keywords: mutagenesis; biological models; bioassay; mutagen screening; optimization; animal cells; animals.

106206 PAH Interactions with Proteins. Fugimoro. (Boston Biomedical Research Inst., Boston, MA). **Project number:** 007477. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This proposal is a study of some of the physical and chemical reactions of the widespread environmental pollutant benzo(a)pyrene which is a recognized carcinogen. The areas of study include the oxygenation of benzo(a)pyrene, the induction of photoreactions of proteins by B(a)P and the interaction of B(a)P with protein-nucleic acid complexes.
Keywords: polycyclic aromatic hydrocarbons; carcinogenesis; benzopyrene; chemical reactions; biochemical reaction kinetics; proteins; nucleic acids.

106207 Mutagenesis Test Systems: Development. Legator. (Univ. of Texas, Galveston, TX). **Project number:** 007965. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this proposed research is to carry out mutagenicity testing of chemical and chemical by-products used in or produced by operations in energy-related industries. The studies

will include analysis in man using the established cytogenetic technique along with body fluid analysis and a recently developed procedure for determination of alkylation of macromolecules. In addition to the studies with human subjects, mouse and Drosophila and in vitro systems will be employed. Coke oven emissions, benzene and its methylated derivatives, 1-2-4 trimethylbenzene and 1-3-5-trimethylbenzene, polycyclic hydrocarbons, 2 methylimidazole, 2-4 dimethylpyridine and dibenzylfuran have been identified as compounds likely to be evaluated.
Keywords: mutagenesis; chemical effluents; by-products; man; mice; drosophila; in vitro; in vivo; coke ovens; air pollution; benzene; polycyclic aromatic hydrocarbons; organic compounds; biological models; toxicity.

106208 Human Cell Carcinogenesis: Hydrocarbons. Selkirk, J. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002589. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies are designed to determine the carcinogenically active species of polycyclic hydrocarbons formed by incomplete combustion of fossil fuels. Human and rodent cells similar to the target tissue for these carcinogens are used to study formation, detoxification and macromolecular binding kinetics of the carcinogenically active intermediates. Comparison of susceptible and resistant species to malignant transformation is made with the goal of selecting the products or rate limiting enzymatic interactions critical for tumorigenic activity.
Keywords: carcinogenesis; metabolism; polycyclic aromatic hydrocarbons; reaction intermediates; metabolic activation; biochemical reaction kinetics; animal cells; oncogenic transformations.

106209 Development and Applications of Photosensitive Systems to Biological Studies. Reynolds, G.T. (Princeton Univ., P.O. Box 708, Princeton, NJ, 08540). **Project number:** 006477. **Contract:** 79-EV03120. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This program provides for the development and application of instrumentation, both hardware and software, for x-ray diffraction and bioluminescence studies. In the x-ray diffraction work an image intensifier, computer controlled vidicon system, will be applied to membrane structure studies and in addition will be applied to muscle structure and protein radiation damage studies. These three areas (membrane, muscle, and protein radiation damage) will constitute the research program in x-ray diffraction. The program in bioluminescence will study the structural sources and emission spectra of luminescence, as well as use the luminescence phenomenon as a tool in the study of function. In particular, work on an improved spectrometer (image intensifier) vidicon system will be initiated, and research will continue to: (1) study the effect of certain environment parameters on luminescence; (2) investigate time dependence of the spectral distribution of the light; and (3) continue investigations of radiation emitted in the nonvisible region (near infrared).
Keywords: photosensitivity; muscles; proteins; biological effects; near infrared radiation; x-ray diffraction; luminescence; equipment.

106210 Electron Microscope Studies. Crewe, A.V. (Univ. of Chicago, 5630 Ellis Ave., Chicago, IL, 60637). **Project number:** 006456. **Contract:** 79-EV02398. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

We propose to continue our work on the development of the stem with the aim of providing high resolution and new modes of contrast. In addition to this we will continue our investigations into radiation damage and mass loss effects. The ultimate purpose of this program is to provide instruments capable of microanalysis at the lowest possible level of spatial resolution.
Keywords: electron microscopy; sample preparation; spatial resolution; optimization; radiation effects.

106211 Radionuclide Imaging Systems. Beck, R.N. (Franklin McLean Memorial Research Inst., 950 East 59th St., Chicago, IL, 60637). **Project number:** 001612. **Contract:** EY-76-C-02-0069. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: medical applications(100) **R and D categories:** Clinical studies in humans.

This project is devoted to the development of instruments and imaging systems which will provide improved image quality and quantitative data for both stable and radioactive materials in patients, volunteer subjects, and experimental animals. Studies to minimize the radiation dose and examination time while improving image quality and maximizing useful data include: (1) optimum design of collimators for fluorescent x-ray; gamma-ray, and positron emission detector systems and other specific applications; (2) evaluation and comparison of efficiency, sensitivity, and pulse-height energy resolution for different types of solid-state detectors (Ge(Li), Si(Li), planar and coaxial and an ultrapure Ge detector) which have been studied extensively to optimize design parameters for a variety of applications including fluorescent detector systems; (3) use of Ge(Li) detectors to improve image contrast by scatter rejection and to implement the optimum weighted multichannel imaging mode; (4) development and completion of unique instrumentation for electronic analog image spatial filtering (ERDA patent initiated); (5) study of the characteristics of the transmission and scatter imaging modes by use of a 153Gd source and a high-purity Ge detector; (6) elucidation and confirmation of the relationship between the size and shape of the spot recorded for each detected gamma ray, and the spatial frequency response of the recording device; (7) image processing with the use of a coherent optical spatial filtering system and computer-generated filters; and (8) use of observer performance as the criterion for optimizing imaging system parameters, such as the compromise between collimator sensitivity and spatial resolution.
Keywords: patients; human populations; animals; radionuclide kinetics; images; scintiscanning.

106212 Photovoltaics Impacts. Bond, V. (Brookhaven National Lab., Upton, NY). **Project number:** 003448. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In close cooperation with other Brookhaven National Laboratory (BNL) departments conducting related studies (e.g., Medical Department), the Department of Energy will provide detailed mutagen-carcinogen screening for elements, compounds, and complexes which arise from all phases of photvoltaic technology. Testing will include the use of accepted bioassay techniques which will be applied to procaryotic, mammalian, and human cell systems.
Keywords: bnl; photovoltaic cells; bioassay; mutagens; mutagen screening; carcinogens; elements; organic compounds; inorganic compounds; complexes; health hazards; hazardous materials.

106213 Instrument Development for Flow-Systems Cell Analysis. Mullaney, P.F. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000136. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This program represents the major DOE commitment to development of flow cytometric techniques. Its objective is the development of flow systems techniques to satisfy DOE's requirements to screen cells for the biological impact of fuel-related materials. Under investigation are: (1) cellular fluorescence in two or more wavelength bands; (2) cellular light scattering measured simultaneously at 32 angles on flowing cells; and (3) life time/decay time measurements of fluorescent cells to determine the properties of the binding site of the dye and hence to probe the cellular biochemical constituents. In addition, state-of-the art methods of microelectronics are under development to aid in the solution of this problem. Advanced data analysis techniques (clustering algorithms, decision trees, etc.) under development support this program. This program has been responsible for all major advances and landmark patents in flow technology either in the United States or Europe. The basic flow analysis techniques, separation methods, multiparameter analysis techniques computerization, etc., have all been developed at LASL. At present, we are the only group successful in applying light scattering as a nondestructive cell identification method to algae, leukocytes, tumor, and other cell types. This group also participates in NCI/Japanese and NCI/German cooperation programs in automated cytology.
Keywords: cytology; measuring instruments; cell flow systems; measuring methods; animal cells.

106214 Modeling Cellular Effects of Coal Pollutants. Miller. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** 002741. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

An understanding of the mechanisms by which pollutants interact with mammalian cells and the ability of cells to modify sublethal toxic effects will contribute to the scientific basis for the assessment of risk to the human population from low level, chronic exposure to effluents from coal and other fossil fuel technologies. The purpose of this study is to measure the response of mammalian cells to certain pollutants from the fossil fuel technologies and to interpret these observations in terms of basic mechanisms of interac-

tion between cells and the toxic agent. The investigation will focus on the cellular response at low dose and dose rates where cellular repair mechanisms are expected to significantly modify biological expression of the chemically induced damage. Experimental research will be closely coordinated with the development of models which correlate parameters of pollutant interaction and cellular repair with the observed dose-response relationship. This approach has proved very successful in the investigation of biological damage from radiation exposure. Collaboration between theory and experiment will lead to a predictive capability for the biological effect at doses and dose rates where experimental data is difficult, costly and perhaps impossible to obtain. Furthermore, a comparison of the cellular responses to radiation and chemical insults will contribute to the understanding of the relative risk of energy production from nuclear and non-nuclear technologies.
Keywords: mathematical models; coal; animal cells; biological effects; fly ash; biological repair; dose-response relationships; technology transfer; biological radiation effects.

106215 Synchrotron Ultraviolet Project. Sutherland, J.C. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 003000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This project will demonstrate the potential of the synchrotron as a source of ultraviolet radiation for biophysical research. The techniques of optical spectroscopy are among the most powerful probes of the structure and function of biological molecules. The low output of conventional light sources restricts the precision of spectroscopic measurements in the critical wavelength region less than 300 NM, where protein and nucleic acids have strong, distinctive absorption bands. Spectral measurements that require high photon flux and polarized light could be improved dramatically by the use of synchrotron radiation. Three of the properties of synchrotron radiation that make it ideally suited for biophysical spectroscopy are: (1) its high intensity for wavelengths, 300 NM; (2) its inherent linear polarization; and (3) its excellent short term stability. A spectrometer patterned after the design of Sutherland, Cimino and Lowe (Rev. Sci. Instrum. 47: 358-360(1976)) will be constructed to demonstrate the feasibility of using synchrotron radiation for the measurement of a variety of parameters including fluorescence, natural and magnetic circular dichroism, linear and circular polarization of fluorescence, and fluorescence detected natural and magnetic circular emission.
Keywords: synchrotron radiation sources; ultraviolet radiation; absorption spectroscopy; biological materials; molecular structure; fluorescence.

106216 Applications of Pions, Muons, Advanced Electronics, and Computers to Medicine. Bradburn, J.N. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 000713. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: medical applications(100) **R and D categories:** Clinical studies in humans.

The Los Alamos Meson Physics Facility (LAMPF) provides intense beams of mu mesons and pi mesons which are respectively being evaluated for tissue analysis and cancer radiotherapy. Instrumentation for providing localized heating by means of radiofrequency current fields to selected tissue volumes has also been developed as a means of treating tumors. The technique has been applied to both animals and humans. The experimental data acquired on muonic x-ray spectra from normal and abnormal tisues will be analyzed with the aim of finding signatures linked to the diseased state. Additional experiments are planned to establish sensitivity limits for the determination of elemental composition and the usefulness of the technique in selected practical applications. The hyperthermia research using localized current fields will continue to be applied to spontaneous tumors in animals. Instrumentation already developed will be used in the field to treat the cancer-eye condition in cattle. Finally, preliminary work will begin in collaboration with University of New Mexico personnel to determine the feasibility of using bioelectric potential measurements as a means of detecting human breast cancers.
Keywords: muons; pions; heat treatments; neoplasms; radiotherapy; x-ray spectra; diagnostic techniques.

106217 Ecological Investigation of Alaska. Hanson, W. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 003272. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Clinical studies in humans.

The objective of this research is to provide an integrated program for the definition of the ecological consequences of resource developments in northern Alaska. Qualitative and quantitative results are obtained that describe: environmental costs incurred by petroleum resource extraction and transportation, including interaction of industrial activities with Arctic foxes, small mammals, tundra-nesting birds in the Prudhoe Bay oil field and along the Trans Alaska Pipeline and haul road; similar information from the Colville River delta for comparative purposes; baseline information on moose populations, caribou range use and quality, and lichen communities that are or will be impacted by resource developments; field experiments to determine lichen sensitivities to sulfur dioxide concentrations likely to be encountered near pipeline pumping stations; food chain transfers of stable and radioactive elements that utilize a data base of some 19 years for comparative purposes; and evaluation of oil field development activities on rabies and other physiological phenomena in foxes. A significant fraction of the research is coordinated through university subcontracts that utilize academic researchers in specific areas of expertise.
Keywords: alaska; resource development; environmental impacts; wild animals; populations; petroleum industry; terrestrial ecosystems.

106218 Development of Ecological Modeling: Systems Ecology. Burgess, R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000607. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This project develops systems analytic techniques when a need is identified in other divisional programs. Current work includes nonlinear stability analysis, estimation theory, time series analysis, spatial patterning and linearization. In each case, a deadline for transferral to mission projects has been established.
Keywords: ecology; mathematical models; technology assessment.

106219 Toxicology of Solar Heating and Cooling Materials. Hobbs, C.H. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002679. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Solar heating and cooling of residences could increase markedly over the next few years. This rapid expansion of the technology would result in the introduction of large quantities of new materials into buildngs. It appears that heat transfer fluids such as hydrocarbon oils, silicone oils, and glycol-water mixtures may represent the greatest potential hazard to human health. A review of the available toxicological information on these materials is nearing completion and the multi-tiered toxicological testing program has been initiated. Fifteen heat transfer fluids were surveyed for mutagenic activity using the Ames Salmonella/mammalian-microsome mutagenicity test. None of the fluids demonstrated significant mutagenic activity as tested; however, additional mutagenicity testing is being planned. Studies designed to evaluate dermal and ocular irritation and acute oral toxicity have been initiated to aid us in determining the toxicity of these fluids under the most likely routes of exposure in the occupational and home environment. The potential of some of the fluids for inducing arylhydrocarbon hydroxylase activity is being investigated and in vitro screening of artificially heat degraded fluids is being planned. Results from in vitro screens and other toxicological tests in progress will enable us to select those compounds requiring more extensive testing.
Keywords: heat transfer fluids; toxicity; glycols; hydrocarbons; residential sector; solar heating systems; solar cooling systems; evaluation; mutagens; testing; dermatitis; eyes; health hazards.

106220 Canine Tumor Immunology: Frederick Cooperative Study of Neoplasms. Shifrine, M. (Univ. of California, Davis, CA). **Project number:** 002792. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Aging female beagles on a life-span study of the effects of radionuclides have mammary tumors similar in morphology and behavior to those in women. Treatment by local injection of BCG is effective in guinea pigs in erradicating metastasis to draining lymph nodes. We propose to treat mammary tumor cases from our pilot study to determine the efficacy of BCG treatment in the dog as a model for man. Cobalt-60 high-risk dogs will be typed for histocompatibility antigens. This will provide information on the relation of Dog Leukocyte Antigens (DLA) types and radiation resistance and leukemogenesis, permit bone marrow (or other cells) transplantation into matched recipients, and provide data on such therapeutic approaches and data on mechanisms of leukemic recurrence in transplantation recipients.
Keywords: dogs; mammary glands; neoplasms; immunotherapy; leukemogenesis; dogs.

106221 Review of Internal Emitter Research. Stannard. (Battelle Pacific Northwest Labs., Battelle Blvd., Richland, WA, 99352). **Project number:** 002717. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will use bibliographic and personal interview research to prepare a definitive history of internal emitter toxicology research programs from the beginning of the major effort in the early 1940's to the present, including all radionuclides. The objective is a comprehensive information resource for use by scientists working on problems associated with nuclear energy technology.
Keywords: radioisotopes; health hazards; information systems; data acquisition; nuclear industry.

106222 Damage of Mammalian Cells by Social Radiation. Burk, H.J. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 003082. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to quantitate the damage induced in mammalian cells in vitro by sunlight and fluorescent light and use this damage rate as a baseline for evaluation of the cellular damage from other energy production related environmental mutagens. The experimental endpoints include mutagenesis, cell inactivation, chromosomal lesions, cell transformation, cell kinetics changes, and molecular and cellular repair processes in mammalian cells including human cells. There are two major applications of results of these types: (1) relating damage from various environmental mutagens-carcinogens to equivalent solar effects on cells, and (2) giving insights into the explanation for the enormous rate of skin cancer in the sun belt regions of the United States.
Keywords: solar radiation; animal cells; in vitro; biological radiation effects; mutagenesis; inactivation; chromosomal aberrations; oncogenic transformations; carcinogenesis; skin; carcinomas.

106223 Eastern Deciduous Forest Biome. Auerbach, S. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000611. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is designed to continue the data storage and retrieval system, maintain communication capability and continue a leadership role in the synthesis of the eastern deciduous forest biome program. The current effort includes the completion of several site, biome, and international synthesis volumes.
Keywords: data processing; forests; information systems.

106224 Feasibility Study: Environmental Research Park. Blanco, F.J. (Conservation Trust of Puerto Rico, San Juan, PR). **Project number:** 007786. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The work will consist of a one-year study to determine the feasibility of selected lands held by the Conservation Trust of Puerto Rico being recommended for inclusion in an environmental research park. The study will describe and assess the various ecosystems present. It will provide maps of the vegetation, soils and hydrology. The study will develop and characterize the flora and fauna of each of the ecosystems present. Based upon the data collected and analyzed, consideration will be given to the development of a proposal to designate the site as an environmental research.
Keywords: feasibility studies; puerto rico; nature reserves; plants; soils; hydrology; baseline ecology.

106225 Electronic Response Properties. Rhodes, W.C. (Florida State Univ., Tallahassee, FL, 32306). **Project number:** 007775. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The research is part of an on-going program of studies on the role of structure of biomolecular systems in determining their dynamic electronic properties. Methods of linear response theory and many-body theory are being developed and applied to the electronic response properties of biopolymers, especially polynucleotides and their components, for the purpose of determining the relations among structure, interaction specificity, and optical properties. Linear response theory, in the time-dependent Hartree approximation, is used to determine the effects of electron correlation on the density response function for the pi-electron systems of the nucleic acid bases. This permits the calculation of polarized absorption-spectra and the newly formulated frequency-dependent transition densities at various sites in the molecule. The latter will be used to study local interaction effects within and between bases. The linear response tensor for current density response in helical polymers is being developed in a manner which fully utilizes symmetry and exciton selection rules. This provides a relatively simple form which is easily calculated and which naturally emphasizes the role of molecular geometry in circular dichroism spectra. The nonlinear coherent and incoherent response of molecules to intense light is being studied, with particular emphasis on developing theoretical models for the rapidly growing field of infrared laser photochemistry. The effects of stationarity and frequency bandwidth of the light are being considered. One purpose is to explore the possible role of coherent modes and of nonlinear local responses in biological molecules in their normal functions.
Keywords: nucleotides; polymers; molecular structure; optical properties; nucleic acids; electrons; electron transfer; dichroism; absorption spectra; helical configuration; laser radiation; photochemistry; electronic structure.

106226 Ionization in Liquids. Bakale, C. (Case Western Reserve Univ., Cleveland, OH, 44106). **Project number:** 007776. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The main purpose of this study is to determine the role of quasi-free electrons biological processes which include radiosensitization, carcinogenesis, respiration, toxicity, and photosynthesis. Pulsed-conductivity technique will be used to study quasi-free electron transport and reactions at times ranging from 10/sup -10/ to greater than 10/sup -3/ seconds in model solutions designed to simulate post-ionization cellular conditions. Electron transport properties of membranes will be studied by measuring electron attachment rates of polar solutes, including biomolecules, solubilized in the structured water pool of reversed micelles. More fundamental studies of electron-dipole interactions hot electron reactions and polaron to conduction band electron transport transitions will also be conducted in non-polar liquids. A recently developed picosecond conductivity technique will be used to augment studies of these processes and subnanosecond dielectric breakdown phenomena.
Keywords: ionization; radiosensitivity; carcinogenesis; respiration; toxicity; photosynthesis; electron transfer; cell membranes; simulation; pulse techniques.

106227 Energy Transformation Processes in Molecular Electronic Systems. Kasha, M. (Florida State Univ., Tallahassee, FL, 32306). **Project number:** 007781. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This is a program of mechanistic spectroscopic studies of molecular excitation processes in complex environments. The specific areas involve (1) a newly discovered technique for detection of aromatic-molecule-oxygen interaction, (2) molecular phenomena induced by solvent cage environments, and (3) excited state consequences of hydrogen bonding. In keeping with the tradition of this laboratory, the research is designed to discover new phenomena on the most fundamental electronic-mechanism level. The applications of this research can be foreseen in basic biological, environmental, and industrial processes.
Keywords: aromatics; oxygen; chemical reactions; spectroscopy; molecular biology; hydrogen; chemical bonds; energy transfer; electronic structure.

106228 Advanced Imaging Concepts for Diagnostic Medical and Environmental Problems. Huth, G. (Univ. of Southern California, Los Angeles, CA, 90007). **Project number:** 007382. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); nuclear fission(60) **R and D categories:** Clinical studies in humans.

This research is centered on development of the new core technology of computer image processing and the application of this technology to basic studies of energy related environmental effects and areas of diagnostic and nuclear medicine. Additionally we are active in two other research areas: (1) the early detection and localization of lung cancer in the uranium mining population; and (2) development of a new room temperature operable, practical spectrometer for x-rays using mercuric iodide and directed toward low level detection of uranium and plutonium.
Keywords: image processing; environmental impacts; energy; diagnosis; nuclear medicine; diagnostic techniques; uranium ores; mining; lungs; neoplasms; x-ray spectrometers; x-ray spectra; uranium; plutonium; monitoring; optimization.

106229 Field-Flow Fractionation in the Analysis of Energy-Related Materials. (Univ. of Utah, Salt Lake City, UT, 84112). **Project**

number: 008264. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The purpose of this project is to initiate a long range program consisting of seven energy-related applications of field flow fractionation. These studies will include aspects of water soluble polymers, waterborne particles, airborne particles, crude and asphaltene fractionation, colloid formation in coal liquifaction, ultra-fine coal products, and particulates used in lubricants. We also propose to survey and perhaps initiate work with other significant energy topics that are discovered in the course of pursuing the specified goals.
Keywords: polymers; particles; aerosols; water pollution; air pollution; asphaltenes; fractionation; coal liquefaction; colloids; lubricants; chemical analysis; environmental materials; separation processes.

106230 Experimental Verification of Internal Dosimetry Calculations. (Georgia Inst. of Tech., Atlanta, GA, 30332). **Project number:** 008247. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission() **R and D categories:** Pollutant measurements technology.

This research is directed toward the development of experimental techniques for the evaluation of internal dosimetry calculations. There are three major objectives of this proposed research. The first of these is the development and refinement of dosimetric techniques necessary to obtain absorbed doses averaged over the entire volume of particular organs. This aspect of the research will involve a study of methods by which selected dosimeters can be utilized to obtain volume averaged doses. The second major objective will be to utilize these dosimetry systems to measure absorbed doses, in anthopomorphic phantoms, while simulating clinical nuclear medicine conditions. Finally, the results of the experiments will be compared to absorbed dose estimates obtained from Monte Carlo computer calculations which utilize the most recent MIRD techniques.
Keywords: dosimetry; nuclear medicine; simulation; biological models; monte carlo method; radiation doses; internal irradiation.

106231 Environmental Pollutant Characterization by Direct-Inlet Mass Spectrometry. Lagergren, C.R. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** 002324. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This program seeks to apply direct-inlet mass spectrometry (DIMS) to the detection, characterization and monitoring on a real-time basis of particulate airborne pollutants which arise from energy generating processes. The successful application of the technique requires that information, which is now lacking, as to the nature of the ionization produced from specific pollutant materials by surface ionization be developed. In this work a DIMS system will be assembled and experiments conducted to determine the ionization efficiency, cracking patterns and time history of signals produced by surface ionization of particles of selected pollutant substances. Appropriate apparatus will be constructed to provide sample particles of the molecules to be studied.
Keywords: mass spectroscopy; detection; monitoring; chemical composition; particles; aerosols; air pollution; ionization; air samplers; design.

106232 Synchronous Fluorescence/Matrix Isolation Method for Trace Organic Analysis. (Purdue Univ., Lafayette, IN, 47907). **Project number:** 008246. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This proposal involves the development and evaluation of a new fluorescence monitoring system that is expected to have significantly improved selectivity, detection limits, and versatility compared with conventional systems and coupling of the system with chromatographic and matrix isolation methods for complex samples. Primary emphasis is placed on polynuclear aromatic hydrocarbons in water and synthetic fuels. An image dissector tube will be used in a unique configuration to monitor fluorescence excitation and emission spectra simultaneously and special data processing or scanning modes will be used to record so-called synchronous fluorescence spectra with electronic control of the interval (delta lambda) between excitation and emission wavelengths. The project is planned in four major phases that include: (1) development of the image dissector/synchronous fluorescence (IDSF) system and evaluation of its performance charateristics for room-temperature fluorescence of single component samples; (2) evaluation of the IDSF system for synthetic multicomponent samples; (3) adaptation of the IDSF system to a matrix isolation (MI) system involving a heated chamber to sublime PAH's, a capillary diffusion tube, and a deposition window cooled to 14 degrees K with evaluation of synthetic samples; and (4) evaluation of the combined IDSF/MI systems for PAH's in chromatographic fractions of synthetic oils. This plan is intended to give a thorough evaluation of the image dissector based fluorescence detection system that has significant merit in its own right as well as an evaluation of its capabilities when used for low temperature fluorescence and with matrix isolation procedures.
Keywords: organic compounds; trace amounts; fluorescence; matrices; monitoring; chromatography; polycyclic aromatic hydrocarbons; water; synthetic fuels; design; water pollution monitors; measuring instruments.

106233 Real Time Monitor for Airborne Tritium. Yule, T. (Argonne National Lab., Argonne, Il, 60436). **Project number:** 003200. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant measurements technology.

The objective of this program is the development of real-time monitors for airborne tritium. The monitors are intended to be used at magnetic fusion facilities for real-time stack, area and portable monitoring. The proposed monitors will offer the following advantages over ionization chambers, which are presently used for similar tritium monitoring applications. The proposed monitors will: (1) be able to simultaneously determine the individual levels of oxidized tritium, HTO, and elemental tritium, HT; (2) have improved sensitivity, being able to measure less than once MPC-A of HTO, 5 x 10-6 MU-CI/CM-3; and (3) improve discrimination against ambient gamma rays and induced air activity. The monitors will contain two counting stages. At the first stage air containing HTO and HT come in contact with a barrier that is much more permeable to HTO than to HT and the air activation products. The HTO that permeates the barrier will be mixed with a counting gas and the activity counted with a proportional counter. A more effective background discrimination technique based on the energy and on the rise time of the pulses will be utilized in the proportional counting. Between the two stages the remaining HTO will be removed and the HT converted to HTO. The second stage will contain an HTO counter that is identical to that used in the first stage.
Keywords: tritium; monitoring; thermonuclear reactors; sensitivity; proportional counters; pulse rise time; design.

106234 Liquid and Sub-Micron Physics. Birkhoff, R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000720. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Pollutant measurements technology.

This project involves the study of the optical and electronic properties of submicron particulates and holes and also the electronic behavior of liquids. The approach involves the measurement of the scattering patterns of laser and low energy electron beams directed at submicron structures. We will learn the surface electronic structure of various particulates. These are midway in size between molecules and solids and are uncertain in behavior. We will look for collective electronic states, effects of point and dipole image exhaust filters, absorption of fibers (e.g., asbestos) in lung tissue, generation and removal from atmosphere.
Keywords: particles; surface properties; liquids; electron beams; laser radiation; scattering; electronic structure; research programs.

106235 Physics of Solids and Macromolecules. Arakawa, E. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000721. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(30); nuclear fission(30); nuclear fusion(40) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to study some fundamental properties of solids and macromolecules before and after exposure to selected pollutants. This program takes a basic approach to understanding and predicting the effects of pollutants on man and his environment. Photons with energies from the ir to the soft x-ray region are used to obtain reflectance, transmittance, and photoelectron yield. Such data can be analyzed with the bulk material thin film effects and interface properties such as surface roughness. In certain cases electron mean-free-paths and/or electron attenuation lengths can be obtained. Interpretation is in terms of energy levels in the solids and macromolecules and photon-electron, photon-plasmon, electron-electron and electron-phonon interactions in the systems. These basic observations have directed application to understanding, predicting, and possibly modifying the behavior of selected systems. Specific examples include the development of solar energy collectors, the prediction of the behavior of liquid lithium in a fusion reactor environment, and the measurement of electron mean-free-paths in communications

material. More generally, it is desired to understand the basic interactions occurring between normal cells in vivo and the subsequent effects of chemical and radiation assaults.
Keywords: molecules; photon collisions; reflection; photoelectric effect; films; surface properties; reflectivity; research programs.

106236 Instrumentation and Chemical Procedures for Radioactive Species. Wagman. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** 003072. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

Over the next 30 years, the nuclear power industry is expected to accumulate a quarter of a million tons of radioactive waste. Of this waste, greater than 10/sup 9/ cubic inches of activation and fission products will be produced for every cubic inch of 137-Cs, as well as greater than 10/sup 9/ cubic inches of transuranium isotopes for every cubic inch of 239Pu During the generation of this waste and its subsequent processing or storage, a small fraction will be unintentionally released to the environment. Various biological studies are now underway or proposed which must consider the uptake of these pollutants by biota as a definite problem. At the low levels of exposure that are required for health evaluation purposes in these biological studies, techniques to measure these activation products, fission products and transuranics in tissues are not available. The purpose of this program is to provide the necessary instrumental and chemical procedures such that the biological studies can be economically and scientifically accomplished. These instrumental measuring techniques will detect the low levels of activation products, fission products, and transuranics in biological and environmental systems. Since biological studies require the analysis of thousands of samples, inexpensive automated technique development will be emphasized.
Keywords: nuclear industry; nuclear power plants; radioactive wastes; leaks; measuring instruments; chemistry; radioactive materials; automation; radiobiology; biological radiation effects; design.

106237 Identification of Sulfur Heterocycles in Coal Liquids and Shale Oil. (Brigham Young Univ., Provo, UT). **Project number:** 008240. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant characterization and analysis.

The carcinogenic potential of complex mixtures of polycyclic aromatic compounds, which are present in fossil fuels, has stimulated much effort by researchers to identify individual mixture components. Considerable work has been done in the past on the polycyclic aromatic hydrocarbon fractions of coal derived products, and considerable work is being done presently on the nitrogen heterocycles. One area that has been neglected somewhat is the sulfur heterocycle fraction. In the work proposed herein, analytical techniques will be developed to separate and identify sulfur-containing polycyclic aromatic hydrocarbons in both coal liquids and shale oil. New approaches include the use of glass capillary-column gas chromatography in conjunction with sulfur selective detection and mixed charge exchange-chemical ionization mass spectrometry. Furthermore, to provide positive identification of selected isomers, suspected but unknown ring systems will be synthesized. Gas chromatographic retention data and mass spectral data will then be compared for positive identification. All compounds synthesized and sulfur rich fractions isolated will be subjected to the Ames test to assay for mutagenicity.
Keywords: shale oil; coal liquids; polycyclic aromatic hydrocarbons; organic sulfur compounds; mutagenesis; gas chromatography; mass spectroscopy; mutagen screening; separation processes; chemical analysis.

106238 In Situ Oil Shale: Ecology. Ireland, R. (Lawrence Livermore Laboratory, Lawrence, CA). **Project number:** 003022. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This study will determine the potential ecological effect of in situ oil shale retorts (ISOS) in the Piceance Basin where new oil shale technologies are being tested and commercialization is imminent. In the context of the biological resources of the Pinyon-juniper, sagebrush, shrub associations, the aquatic communities and the agricultural land use, five tasks are proposed which will be time-phased over a three-year period: (1) preliminary assessment of potential toxicity; (2) preliminary survey of baselines data; (3) supplementary baselines and preliminary effects study; (4) effects studies and models; and (5) assessment of ecological effects. Tasks 1 and 2 are largely paper studies accomplished in the first year; Task 3 is a field collection to supplement existing baselines data and initial bioassay efforts in the second year; and Tasks 4 and 5 are experimental and data analysis efforts in the final year.
Keywords: oil shales; environmental impacts; in-situ retorting; toxicity; bioassay; colorado; waste water.

106239 Iron-55 Phenomenon. Crecelius. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** 003062. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); nuclear fission(80) **R and D categories:** Environmental transport and conversion of pollutants.

The ultimate impact of the trace elements entering the ocean from the earth's atmosphere depends on the physical-chemical forms relative to those of their counterparts in the ocean water. We have learned over the last several years that certain trace elements and radionuclides enter the ocean in a form which makes them far more available for biological uptake than the stable element counterpart in sea water. This has been particularly well demonstrated in the case of 55Fe. In this current proposal, we would plan to carry out the strategy employed in the 55Fe study: (1) make actual measurements of chemical forms of toxic trace elements entering the ocean from the atmosphere and the rate at which these are converted to the chemical forms naturally present in seawater; (2) determine the fraction of the various trace elements in marine aerosols that is associated with anthropogenic versus natural sources; (3) determine the effect of trace element additions, which are 10 to 100 fold higher at mid latitudes, on their concentrations in marine organisms versus latitude; and (4) determine concentration ratios relative to seawater for those trace elements which become substantially enriched in the various marine trophic levels. Major emphasis in this program will be placed on measurement of those trace elements which are known to be associated with energy production sources, such as Se, As, Sb, Hg, Cd, V, and Cu. The measurements will also include the behavior of important radionuclides, including 55Fe, 65Zn, 60Co, 110Ag, 210Pb, and perhaps 46Sc, 54Mn, 88Y, 99Tc, 106Ru, and 137Cs.
Keywords: iron 55; seas; surfaces; trace amounts; environmental transport; selenium; arsenic; antimony; mercury; cadmium; vanadium; copper; zinc 65; cobalt 60; silver 110; lead 210; scandium 46; manganese 54; yttrium; technetium 99; ruthenium 106; cesium 137; quantity ratio.

106240 Dynamics of Trace Elements. Wallace. (Univ. of California, Los Angeles, CA). **Project number:** 004145. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives of this study are to examine potential effects of coal fly ash on desert environments. The goals are to define levels of ash required to cause either short-term or deferred effects on growth, phenology, reproduction and survival of desert plants, and to relate these levels to those actually existing in the vicinity of coal-burning power plants, and to projected levels following 35 years of plant operation. Six blocks of four 15 x 15 field plots have been established at the Nevada Test Site. Ash from precipitators of Southern California Edison's Mohave Generating Station has been applied to three plots in each block, with target levels of 10, 30, and 100 metric tons/ha after two years of application. Each block contains three treated plots and one control. Annual and perennial plants in treated and control plots will be compared in terms of phenology, growth, reproduction, and survival. Shrub species being evaluated are: creosote bush (Larrea tridentata), bur sage (Ambrosia dumosa), desert tea (Ephedra nevadensis), and box thorn (Lycium andersonii). Comparisons between shrubs in different plots will be based on measurements and observations of tagged shoots.
Keywords: coal; fly ash; deserts; biological effects; plants; plant growth; mortality; reproduction.

106241 Development of a Community Index of Minimum Fluctuation for Early Detection of Sulfur Dioxide Perturbation. Treshow. (Univ. of Utah, Salt Lake City, UT). **Contract:** 008263. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A certain amount of fluctuation in the composition of a plant community from year to year is normal. Flux, or variation, represents the plant community response to differences in the environment, especially annual variation in the temperature and moisture regimes. Because of this normal flux, it is difficult to determine the extent to which community changes are influenced by such abnormal stresses as pollutants. The purpose of the proposed research is to develop a sensitive means of detecting abnormal fluctuations and thereby be able to assess the presence of perturbation in plant communities. If community changes that were caused by some abnormal stress or perturbation could be detected the first year, the changes could provide an early and sensitive index for measuring the impact of air pollutants on these communities. A few years ago, injury to plant foliage readily visible to the experienced eye was considered to be the earliest sign of air pollution effects. Air pollution control technology has now reached a state where such injury is

rare and no longer provides an adequate supplement to chemical methods of air monitoring.
Keywords: sulfur dioxide; detection; plants; variations; air quality; moisture; temperature effects; biological indicators; environmental effects.

106242 Revegetation of Alaskan Coal Mine Spills. Loynachan. (Univ. of Alaska, Fairbanks, AK, 99701). **Project number:** 007515. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Alaska contains large reserves of coal which presumably will be developed as the national need for energy from other than petroleum sources intensifies. In a large-scale mining operation, preplanning is important to avoid deteriorative effects upon the environment. Baseline information is required to develop an adequate and adaptive reclamation program. This research will investigate reclamation of coal mine spoils in the cold-dominated environment of Alaska. Physical and chemical properties of spoil materials will be characterized from the different climatic regions in Alaska which contain coal reserves. Special consideration will be given to natural plant succession, and to seedings to revegetate existing spoil sites. Various species of native and introduced grasses, forbs, and woody plants will be evaluated. The importance of topsoiling, mulching, irrigating, and fertilizing will be evaluated. Field plots will be permanently marked to permit long-term study since the cultural management needed to promote longevity of established stands may be critical in the overall reclamation program. Thus, if native species have distinct advantages in persisting without management after initial establishment, those advantages will become increasingly apparent with time.
Keywords: alaska; coal mines; revegetation; land reclamation; spoil banks; soils; plants; cultivation techniques.

106243 Energy Effects Studies. Lindberg. (Univ. of California, Los Angeles, CA). **Project number:** 003003. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The research program is concerned with site disturbance and adjustment of desert ecosystems such as might occur with solar power generation in desert sites. Supporting basic studies dealing with physiological ecology, and structure and function of desert ecosystems will undoubtedly represent a significant part of the program. The activities under this program will coordinate with existing research activities in ecology.
Keywords: deserts; terrestrial ecosystems; solar power plants; environmental impacts; site selection.

106244 Gasifiers in Industry: Pike County. Cowser, K.E. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 003176. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

An environmental and health monitoring and testing plan to study the low-Btu gasifier installation at Pike County, Kentucky, is being developed for the Assistant Secretary for Environment, Department of Energy. Data and information obtained from this and related projects (one being implemented at the University of Minnesota-Duluth and another to be developed at Land O' Lakes, Minnesota) will permit judgments to be made of the environmental acceptability of these processes, in addition to their technical and economic suitability. Each gasifier project is expected to operate for a period of three years in an uninterrupted mode, and each may use different types of coal. State-of-the-art methods are to be emphasized in monitoring and testing, and the interests and needs of other government agencies, such as EPA and NIOSH, are to be integrated into the program. Process streams, plant effluents, and the working environs will be characterized chemically and physically by on-line and in-plant sample collections, measurements, and monitoring. Data development will be used to guide subsequent bioassays and ecological testing of samples to correlate with possible worker exposures, and to assess the potential health and environmental impacts of this demonstration facility.
Keywords: coal gasification plants; kentucky; monitoring; health hazards; environmental impacts; low btu gas; liquid wastes; sampling; bioassay; gaseous wastes.

106245 Gasifiers in Industry. Cowser, K.E. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 003175. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

An environmental and health monitoring and testing plan to study the low-Btu gaisfier installation at the University of Minnesota-Duluth (UMD) is being developed and implemented for the Assistant Secretary for Environment, Department of Energy. Data and information obtained from this and related projects to be developed at Pike County, Kentucky, and Land O' Lakes, Minnesota, will permit judgements to be made of the environmental acceptability of these processes, in addition to their technical and economic suitability. Each gasifier project is expected to operate for a period of three years in an uninterrupted mode, and each may use different types of coal. State-of-the-art methods are to be emphasized in monitoring and testing, and the interests and needs of other government agencies, such as EPA and NIOSH, are to be integrated into the program. The principal components of the monitoring and testing plan involve on-line studies, in-plant studies, and local area studies to be integrated through multidisciplinary assessments. This proposal includes the requirements for on-line and in-plant sample collection, measurement, and monitoring as they relate to the characterization of process streams, effluents, and the working environment, as well as the characterization of samples for subsequent bioassay and ecological testing. A data management component will provide a computerized data management system for storage and retrieval of data and information, and will include: (1) structure for data base development; (2) procedures to ensure proper identification and recording of data; (3) network to provide user access to the files; and (4) data analyses routines.
Keywords: coal gasification plants; environmental impacts; monitoring; health hazards; minnesota; on-line measurement systems; bioassay; sampling; data processing; data base management; liquid wastes; gaseous wastes.

106246 Synthetic Fuels Data Management for the UMD Gasifier. Cowser, K.E. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 003277. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The environmental and health program for the University of Minnesota-DUluth (UMD) gasification facility outlines a program to provide data and perform assessments on the low-Btu gasification facility which will permit DOE and other federal agencies to judge potential impacts and the acceptability of this coal conversion technology. The three year program entails on-line monitoring, sample collections, and laboratory analyses. The primary objective of this supplementary proposal is to develop and implement the data management requirements for investigators in the UMD program. Additional objectives of this proposal are: (1) to solicit the data management requirements of persons indirectly engaged in the UMD program and to implement, when feasible, procedures to enhance the assessment capabilities of the UMD program; (2) to interface with the sampling procedures and the sample management facility and develop archival procedures for the data; and (3) to incorporate the ability to handle data from other gasifier sites within the data management system. The scope of the final objective will include considerations for other technologies and programs within these technologies so that a reasonably flexible system will be implemented.
Keywords: coal gasification plants; minnesota; synthesis; low btu gas; data base management; information needs; data processing; data processing; data analysis; on-line measurement systems; monitoring; environmental impacts; health hazards.

106247 SRC Effluent/Product Characterization. Weimer. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** 003071. **Contract:** 003071. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The solvent refining of coal is a rapidly developing advanced fossil fuel energy technology. As such, it is necessary to assure that all potential environmental and health concerns are evaluated prior to full-scale commercialization of this coal liquefaction process. Samples of SRC-I and SRC-II products, effluents, process streams, and waste materials are being obtained from the solvent refined coal pilot plant facility in Du Pont, Washington. These materials are fractionated and prepared for biological and/or ecological testing. Additional chemical characterization is being performed to identify the biologically active organic compound classes or individual organic constituents present. The coordination between the chemical analyses and the biotesting program assures that the most detailed chemical characterization information is obtained for those SRC research materials of greatest biological concern.
Keywords: src process; solvent-refined coal; synthetic fuels; liquid wastes; gaseous wastes; environmental impacts; src-ii process; pilot plants; washington; sample preparation; chemical analysis; biology; environment; testing; fractionation.

106248 In Situ Coal Gasification: Water/Air. Stuermer. (Lawrence Livermore Lab., Livermore, CA). **Project number:** 002644. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Groundwater quality and air quality source characterization studies of the LLL In Situ Coal Gasification Project in the Powder River Basin at Hoe Creek, Wyoming, will be performed. A complete characterization of the groundwater source term will be performed, and diffusion and transport of trace contaminants in the groundwater plume will be evaluated. Characterization of the particulate, condensable and noncondensable portions of the product gases before flaring will be carried out. Emphasis will be placed on characterizing the trace inorganic and organic constituents in the classes: polycyclic aromatic hydrocarbons, aromatic amines, phenols, organometallic compounds, sulfur species, and heavy and transition metals. Fractionation and characterization of the samples into acidic, basic, neutral, and polycyclic aromatic fractions for bioassay studies will also be performed. This project will be coordinated with, and will complement, the AFE- and ECT-funded efforts on the In Situ Coal Gasification Project.
Keywords: in-situ gasification; ground water; water quality; trace amounts; elements; organic compounds; chemical analysis; particles; polycyclic aromatic hydrocarbons; aromatics; amines; phenols; organometallic compounds; bioassay; wyoming; environmental transport; environmental impacts; aerosols; water; water pollution; surface air; air pollution.

106249 Tracer Analytics. Dietz, R. (Brookhaven National Lab., Upton, NY). **Project number:** 003226. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

This task is comprised of two principal efforts: (1) the development and utilization of atmospheric tracer compounds for dispersion and long-range transport studies; and (2) the development and validation of unique instrumentation for applications in tracer studies and determination of energy-related atmospheric and source-emission pollutants. For the sub-task of atmospheric tracer developments, efforts are directed at the testing and validation of state-of-the-art samplers and analytical procedures for the family of perfluorocarbon tracers (PFTS), the search for new PFTS with lower ambient background levels, the preparation of the respective gas standards, participation in interlaboratory comparison and validation test programs, assistance to other laboratories in DOE-supported field tracer studies, and finally implementation of an effort in BNL-directed tracer programs for vaildation of short- and long-range dispersion and transport models, as applied to energy-related pollution problems. The sub-task of instrumentation development is directed towards the development and improvement of new and existing analytical instrumentation for the determination of meteorological gas tracers (PFTS), the development and commercialization of new atmospheric sampling and concentration procedures for application to the determination of PFTS and energy-related pollutants, the application of chemical conversion principles for the novel development of sensitive techniques for the determination of trace atmospheric constituents, and the development and validation of new gas-standard sources in support of the above efforts.
Keywords: tracer techniques; atmospheric chemistry; environmental transport; measuring methods; design; air pollution monitors; coordinated research programs; fluorinated aliphatic hydrocarbons; fluorinated aromatic hydrocarbons.

106250 Oil Shale Fugitive Air Emissions. Schmel. (Battelle Pacific Northwest Lab., Richland, WA, 99352). **Project number:** 003053. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The development of a major oil shale industry can have significant effects on air quality. Impacts of oil shale development on the atmosphere include releases from mining, transportation, materials handling, crushing, grinding, sizing, retorting, combustion products, methane and hydrocarbon releases from retort water, leachates of retort shale, and spent shale disposal sites. Extensive direct measurements of airborne concentrations and releases will be made to validate fugitive release estimates and predictive atmospheric transport models. The objectives are to determine a data base for the release of airborne particulates and gases during oil shale mining, processing and final disposition of retort wastes and to develop predictive atmospheric transport models.
Keywords: oil shale industry; environmental impacts; air quality; flow models; aerosols; particles; exhaust gases; oil shale mining; oil shale processing plants; spent shales; waste disposal; forecasting; data acquisition.

106251 Atmospheric Diffusion in Complex Terrain. Orgill. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Project number:** 003056. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this research is to develop models and analysis methodology for estimating the dispersion and transport of pollutant particles and gases in complex terrain. Its particular application is to energy resource development sites, but the finding will also be applicable to effluents from any source in similar terrain. The study includes reviews of past model and field work, critique of numerical and physical models for complex terrain, and the collection of field data to provide input and confirmation of the model prediction. The long range objective is to provide methods to predict transport and diffusion from effluent sources located in complex terrain such as cliffs, hills, valleys, gaps, etc.
Keywords: earth atmosphere; environmental transport; topography; dispersions; particles; air pollution; gases; mathematical models; aerosols.

106252 Pollution in Atmosphere. Novakov, C. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 002524. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this project is to assess the role of catalytic (gas-particle) oxidation of sulfur dioxide to sulfate with respect to competing homogeneous reactions, especially photochemical. A more immediate objective is to provide an experimental rating of various catalytically active particulate materials with respect to their ability to oxidize sulfur dioxide in the plume and in the atmosphere. The catalytic activity of particles consisting of soot, vanadium oxides, and iron and manganese oxide will be determined as a function of particle size, particle concentration (mass and number), temperature, and absolute and relative humidity. The particles to be used in this study will be produced in well-defined flames so that the results obtained will be directly applicable to the interpretation of data obtained in studies involving power plant plumes.
Keywords: earth atmosphere; sulfur dioxide; oxidation; sulfates; atmospheric chemistry; catalytic effects; soot; vanadium oxides; iron; manganese oxides; plumes; photochemical reactions.

106253 H-Coal. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 003469. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Major use of coal liquefaction products for boiler fuels, fuel oil, and chemical feedstocks is expected, with a projected energy production of several quads in the next two decades. The H-coal process is one of several methods under intensive technological study, and operation of the pilot plant, to begin immediately, will provide engineering data for scale-up. Concomitant with these anticipated engineering advances and the emphasis on commercialization is the need to ensure the environmental acceptability of the process. Information to be gathered during operation of the H-coal pilot plant can aid in answering questions of an engineering, economic, and environmental nature for an expanding coal-liquefaction technology. In recognition of the potential widespread deployment of this technology, the Oak Ridge National Laboratory (ORNL) was requested by the Assistant Secretary for Environment (ASEV), Department of Energy (DOE), to develop for consideration comprehensive environmental and health plans to study the pilot plant. Emphasis is to be placed on those aspects of the operation that are applicable to a commercial-size facility. Pilot plant operation is expected to continue for a period of about two years. Three different coal types will be tested including Kentucky No. 9, Eastern Illinois No. 6, and a Western Wyodak. The latter two coals will be subjected to two modes of operation (to produce a synthetic crude and a fuel oil). Although state-of-the-art methods are to be emphasized in monitoring and testing, application of several new testing and surveillance protocols is likely during the study period.
Keywords: h-coal process; synthetic fuels; boiler fuel; fuel oils; chemical feedstocks; pilot plants; commercialization; coal liquefaction; environmental impacts; monitoring.

106254 *Hydrodynamic and Chemical Modeling of Heavy Metals* in Ashpond Leachates. Theis, T. (Notre Dame, IN). **Project number:** 008261. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

A description of the theory and methods of modeling heavy metals and other inorganic components in ash pond leachates is

presented. The model could also be applied to other types of wastes such as SO2 scrubber liquors, residues from coal conversion facilities, aqueous nuclear wastes, various blow down discharges, and other wastes from outside the electric power industry. Initially, the case of two-dimensional steady state flow with no adsorption of soluble complexes will be treated. More advanced considerations, such as the non-steady state, can be treated at a later time. The model differs from previous efforts at groundwater modeling in the degree of complexity of the chemical reaction component. Soluble complex formation, adsorption onto soil particles and precipitation are all considered thus giving the model a broad applicative base. Users envisioned ranged from power companies and their consultants, and local and federal environmental regulatory agencies. It can be used as a management, investigative, or research tool. The morphology of the model consists of a finite element approach to hydrodynamic flow and transport in conjunction with an equilibrium description of the chemistry. Solutions of the problem involving direct coupling of the transport and chemical equations and an indirect iterative approach are outlined. Calibration and testing will be achieved beginning with a one-dimensional laboratory soil column and progressing to field evaluations including sites under study in connection with this and previous research efforts. In addition to its usefulness in assessing the migration and degree of pollutional containment in a disposal system, the model is seen as a logical step in the progression and refinement of groundwater modeling.
Keywords: leachates; ponds; mathematical models; hydrodynamics; metals; wastes; sulfur dioxide; scrubbers; ground water; chemical reactions; soils; adsorption; flow models; environmental transport; trace amounts; hydrology.

106255 Migration of Petroleum Products Accidentally Introduced into the Subsurface Through Spills. Pinder. (Princeton Univ., Princeton, NJ). **Project number:** 007509. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This research program is designed to investigate the migration and evolution of hydrocarbons introduced accidently into the groundwater system. Particular emphasis will be placed on the development and evaluation of selected remedial pumping schemes designed to remove contaminating hydrocarbons. The vehicle for this research will be a simulator based on the numerical solution of the partial differential equations describing three-phase flow in porous media. The simulator will utilize the Galerkin method of approximation in conjunction with either isoparametric quadrilateral or isoparametric Hermitian elements.
Keywords: oil spills; environmental transport; ground water; contamination; decontamination; simulation; hydrocarbons.

106256 Analytical Development Studies. Welford, G. (DOE, Environmental Measurements Lab., 376 Hudson St., New York, NY, 10014). **Project number:** 001778. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objectives of this program are to develop methods of analysis for selected trace elements, anions, organic and gaseous pollutants in environmental and biological materials; and to determine the reliability of the selected method for the specific pollutant with variations in major and minor constituents. Individual pollutants will be investigated based on potential toxicity to man, reported levels of environmental contamination, and reported reliability of existing methods and measurements.
Keywords: elements; trace amounts; anions; organic compounds; gases; measuring methods; accuracy.

106257 Dry Geothermal Hot Rock. Miera, F. (Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 002153. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Environmental effects assessment.

Environmental studies at the LASL Dry Geothermal Energy Extraction Project encompass the following major objectives: (1) establishment of biotic and abiotic inventories of the ecosystem at the site; (2) identification and quantification of key ecosystem components; (3) environmental consequences of site effluents; and (4) determination of impact severity upon the animal and plant communities. Specifically, in FY 1979 this project will be in a monitoring posture as all major sampling programs will have been developed and implemented in the field. Seasonal readings from permanent transects will be continued and the existing data set reexamined in an attempt to extrapolate the environmental impacts of a 10-fold increase of the demonstration project. These projections will emphasize the use of natural species for ecological compatibility and perhaps a reshaping of the landscape into more aesthetically pleasing natural contours. Energy shortages will probably cause extensive development of geothermal energy reservoirs by the mid-1980s. Results of this investigation will lead to refined procedures for mitigation of ecological impacts due to these activities. Many questions as to the bioenvironmental consequences of such installations may be answered and, if so, comparisons may be made between the environmental impacts of this and other energy-producing systems. Results of this study include biotic inventories of the LASL test site, with identification of several key species upon which future studies will concentrate. An active weather station has been established and computer software support written to analyze these data. Sampling programs have been established to measure seasonally several population parameters for plants, large mammals, and birds. An ongoing program to measure water quality in the vicinity exists, and additional sampling stations have been placed in the drainage next to the facility.
Keywords: hot-dry-rock systems; environmental impacts; ecosystems; energy demand; computer codes; baseline ecology; water quality; plants; birds; mammals; sampling; landscaping.

106258 Geothermal Studies (Geysers). Shinn, J. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** 003232. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Environmental effects assessment.

The objectives of this proposed research are to conduct research studies to evaluate the environmental impacts of geothermal energy development on geology, hydrology, and ecology. Major field studies will be conducted in two important geothermal areas in California: The Geysers-Calistoga Area and the Imperial Valley. Key issues include: (1) slope stability, subsidence and seismicity; (2) surface water, groundwater, and geothermal reservoir interrelationships; (3) biogeochemical cycling of geothermal effluents, e.g., boron, ammonia, arsenic, mercury, in the soil, water, sediment, and vegetation, and in terrestrial and aquatic organisms; and (4) effects and toxicities of geothermal effluents on terrestrial and aquatic ecosystems. Extensive baseline and effects information have been established by the Imperial Valley Environmental Project (IVEP). Expertise gained in the IVEP will be applied to new research areas at The Geysers-Calistoga Area. Field projects will be established in the first year.
Keywords: geysers geothermal field; imperial valley; environmental impacts; resource development; stability; seismicity; boron; ammonia; arsenic; toxicity; geothermal fluids.

106259 Transuranic Chemical Species in Ground Water. Robertson. (Battelle Pacific Northwest Lab., Richland, WA, 99352). **Project number:** 003378. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Ground water transport of the transuranics is a little understood problem of immediate concern to DOE. At several radioactive waste burial sites and at most major nuclear installations in the U.S. some form of ground water contamination has occurred. There is an urgent need for research studies designed to elucidate both the physicochemical species and the rates and mechanisms of ground water transport of long-lived radionuclides. A unique opportunity exists at the Hanford 81301-N crib trench to study, under natural conditions, the physicochemical processes which control the mobility of radioactivity in ground waters. At this site, low-to-intermediate level radioactivity (including transuranics) contained in Hanford N-reactor coolant waters is continually discharged into a seepage trench located on a bluff overlooking the Columbia River. The effluent water percolates by gravity through a soil bank and emerges to form seepage springs located along the bank of the Columbia River. The objectives of this research program are to utilize this contaminated ground water system as a natural laboratory for (1) identifying what specific physicochemical forms of the radionuclides are migrating, (2) determining the rates and mechanisms of ground water transport of these radionuclides, and (3) identifying mechanisms which immobilize the species of radionuclides that are migrating in ground waters. These studies will help to provide a sound basis for understanding the mechanisms of ground water transport of radionuclides.
Keywords: ground water; transuranium elements; contamination; radionuclide migration; environmental transport; radioactive waste disposal; ground disposal; hanford reservation; low-level radioactive wastes; intermediate-level radioactive wastes.

106260 Retention and Fate of Inhaled PAH. Mitchell, C.E. (Lovelace Foundation for Medical Education and Research, Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002671. **Supported by:** Department of

Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

There is potential for formation and release of polycyclic aromatic hydrocarbons (PAH) from most coal combustion and conversion technologies. They are potentially present in both fugitive and stack emissions from these technologies and are a potential inhalation hazard to man. PAH are known carcinogens. Thus, it is essential that additional work be conducted to characterize the manner in which PAH are handled following inhalation. PAH may be present in the atmosphere as vapors, condensation aerosols, and/or adsorbed onto fine particulates. PAH aerosols of these various types will be generated and used for inhalation exposures of experimental animals. Emphasis will be placed on determining the retention and metabolism of these compounds in the lung following the exposure and translocation to other tissues. Radiolabeled PAH will be prepared and used in this regard. The interaction of PAH and PAH metabolites with cellular macromolecules such as DNA will also be studied. These characteristics of PAH following inhalation will then be correlated with the development of neoplasms in the lungs and other tissues of experimental animals.
Keywords: polycyclic aromatic hydrocarbons; coal; combustion products; retention; lungs; inhalation; coal liquefaction; coal gasification; health hazards; coal industry; air pollution; aerosols; vapors; dna; carcinogenesis.

106261 Coal Carcinogenesis. Herschman. (Univ. of California, Los Angeles, CA). **Project number:** 002785. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Co-carginogens (or promoters) are compounds which are not themselves carcinogenic but enhance carcinogenic activity. They both (1) lower the threshold for active carcinogens, and (2) cause expression of latent (stored or unexpressed) carcinogen damage, and lead to tumor formation. We believe their identification in the environment, and particularly in the products of alternative energy generation technologies, is as important, if not more so, than the identification of carcinogens. A simple cell culture technique has recently been developed to identify co-carcinogens and study their mode of action. We plan to (1) verify this result, (2) develop a screening methodology based on the assay, (3) analyze suspected co-carcinogens and adapt the assay to energy technology by-products, and (4) begin molecular studies of the mechanism of action of promoters.
Keywords: coal; carcinogenesis; animal cells; biological pathways; carcinogens; synergism; cell cultures; mutagen screening; promoters.

106262 Genetic Basis of Mutagenesis/Carcinogenesis. Lalley, P.A. (Oak Ridge National Lab., Biology Division, Oak Ridge, TN, 37830). **Project number:** 003152. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Cancer in humans, caused by exposure to coal derived chemicals, is characterized by variable periods of latency which are not yet understood. It is necessary that the interactions and biochemical effects of environmental carcinogens on cellular macromolecules where the mutagenic and/or carcinogenic potential is expressed are understood. Which nucleic acid molecules are modified by the carcinogen, the sites of attack, and whether these nucleic acid perturbations continue in the resultant malignantly transformed cells will be determined. Initial studies on hamster embryo fibroblasts will be extended to human cell culture. An examination of the chemical perturbation of the main cofactors directing translational fidelity for protein synthesis (tRNA,rRNA) is necessary to define their role in cellular homeostasis and determine where and how malignant transformation by environmental carcinogens interrupt the homeostatic equilibrium. The results will establish whether studies on cell cultures give the same results as related studies in whole animals and thus help verify the validity of the cell culture model and support the extrapolation to man. In addition, if specific nucleotide sites are susceptible to the chemical perturbation, this may lead to the design of protective agents.
Keywords: mutagenesis; carcinogenesis; nucleic acids; fibroblasts; cell cultures; animal cells; proteins; biosynthesis; transfer rna; rna; homeostasis; nucleotides; chemical bonds; coal.

106263 Coal Liquefaction: Mammalian Cell Mutagenesis. Hsic, A.W. (Oak Ridge National Lab., Biology Div., Oak Ridge, TN, 37830). **Project number:** 000237. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(90); nuclear fission(10) **R and D categories:** Biological effects of pollutants in experimental systems.

The foremost objective is to screen, and where possible to quantitate, the cytotoxicity and mutagenicity of effluents and crude products from the coal related synthetic fuels, mostly in the form of already identified chemical constituents, or fuel subfractions separated by analytical methods, and, where feasible, the unfractionated synthetic fuel itself. Other objectives are: (1) to study quantitative specified locus mutagenesis by chemicals and radiation, and by the interaction of chemicals and radiation; and (2) to develop a mammalian cell system suitable for simultaneous quantitative analyses of malignant transformation and gene mutations as a means to establish, ultimately, the possible role of somatic mutation in cancer.
Keywords: mutagen screening; cell cultures; coal liquids; synthetic fuels; synthetic fuels; hamsters; oncogenic transformations.

106264 Skin and Pulmonary Carcinogenesis. O'Connor, T. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL). **Project number:** 001540. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This program has three segments concerned with: (1) enzymatic metabolism of chemical carcinogens; (2) the mechanism of skin carcinogenesis and the factors that determine susceptibility for cancer induction and co-carcinogenic effects; and (3) the critical examination of the use of mouse lung tumors as a test system for the assessment of environmental pollutants for tumorigenic potential. The three segments are interrelated and are concerned with two tissues that are continuously exposed to environmental factors, namely, lung and skin. The studies examine the enzymatic production of the ultimate carcinogen, the relationship of specific DNA damage to subsequent cancer production, and the factors that influence the expression of the cancer-producing changes. An understanding of the factors that may influence susceptibility, such as age, proliferative activity, hydroxylase activity, and infection, are of importance for the assessment of risk and are studied in the rodent lung. Because of the problems in extrapolation of animal data to estimates of risk in man we are attempting to carry out some studies on human skin.
Keywords: carcinogens; metabolism; skin; lungs; mice; man; response modifying factors; risk assessment; neoplasms; mutagen screening; enzymes; biosynthesis.

106265 Development of In Vitro Assay Systems for Oncogenesis. Elkind, M.M. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** 001298. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(70); conservation(30) **R and D categories:** Biological effects of pollutants in experimental systems.

These studies are directed at the use of induced functional changes, e.g., mutation and transformation, in addition to cell killing in order to detect energy related products of potential concern to humans. The use of currently available cell systems for this purpose will also permit basic stuides relative to mechanism. In addition to transformation indexes based upon changes in growth patterns, growth requirements, and cell or colonial morphology, changes in enzymatic and antigenic properties will be sought as appropriate. Similar approaches will be attempted with cultured cells derived from animals phylogenetically more closely related to humans. These, plus efforts to develop animal test systems for cultured cells derived from human tumors as well as for human cells transformed in culture, will aid in the formation of extrapolations of risk estimates from animals to man due to nuclear and non-nuclear technologies.
Keywords: cell cultures; mutagen screening; oncogenic transformations; carcinogens; growth; mice; morphology; chemical properties.

106266 Experimental Radiation-Induced and Chemical-Induced Carcinogenesis. Shella, C.J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001846. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the intent of the present research to study, in a quantitative fashion, the relationship of pollutant chemicals, or model compounds of pollutant chemicals, to mammary neoplasia induction in female rats. The synergistic, additive or inhibitory interaction of these compounds, the effect of route of entry into the body, the influence of hormonal manipulation, and diet will be studied in this model system in an effort to assess the potential impact of energy pollutants upon breast cancer in the human female.
Keywords: pollution; carcinogenesis; mammary glands; rats; synergism; biological models; environmental exposure pathway.

106267 Toxicology of Coal Combustion Effluents. Norris, W. (Argonne National Lab., 9700 S. Cass Ave., Argonne, Il, 60439). **Project number:** 002452. **Supported by:** Department of Energy, Washington,

DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To identify and evaluate the toxicologic problems resulting from the combustion of coal by advanced technologies, a toxicant delivery system will be developed at Argonne National Laboratory (ANL). This system will simulate, as well as possible, the chemical milieu to which human populations are exposed under ambient conditions. An atmospheric pressure, laboratory scale FBC apparatus will be constructed as part of the toxicant delivery system. The design of the FBC apparatus will be integrated with the designs of the other components of the toxicant delivery system to provide flexibility for varying pollutant concentrations, as well as for injecting extraneous pollutants (such as those derived from exhaust of gasoline engines). These extraneous pollutants may prove to be of significance to the chemical interactions that coal-derived effluents undergo in the atmosphere.
Keywords: coal; combustion products; laboratory equipment; toxicity; delivery; simulators; air pollution; design.

106268 Isolation and Identification of PAH from Complex Mixtures. Lipsky, S. (Yale Univ., New Haven, CT). **Project number:** 007145. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are to develop method for the isolation and identification of polycyclic aromatic hydrocarbons found in complex mixtures and to determine their possible toxicity by means of a host mediated bioassay system. High efficiency glass capillary gas chromatographic columns operating in conjunction with mass spectrometry will be utilized to separate and identify the individual components of complex mixtures of polycyclic hydrocarbons derived during a coal conversion process. The chromatographic effluent will be directly or indirectly led into a vehicle which exposes one or more bioassay systems to several individually resolved components on a time basis as they emerge from the chromatographic column. Attempts will be made to correlate chemical structure with biological function, i.e., signs of mutagenicity as determined by the bioassay techniques.
Keywords: polycyclic aromatic hydrocarbons; chromatography; mass spectroscopy; reaction intermediates; structural chemical analysis; toxicity; bioassay.

106269 Working Conference on the Toxicology and Occupational Health Aspects of Converting Fossil Fuels Such as Coal, Oil Shale and Tar Sands. Wands, R. (National Academy of Sciences, 2101 Constitution Ave. NW, Washington, DC, 20418). **Project number:** 007365. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Materials used for construction, fuels, munitions, and equipment, or generated by the consumption or deterioration of such supplies, pose problems which must be answered quickly and correctly for the effective operation of naval equipment and the safety of naval personnel. Other DOD and government agencies must deal with very similar problems for the accomplishment of their missions and the safety of personnel and the general public as well. It is the purpose of this Clearinghouse for Toxicological Information to provide access to what is known about substances with a potential toxic hazard, to establish standards for safe operations, and to guide the design and improvement of technological devices on demand. Storage facilities for past and current information on a wide range of elements compounds specified by the sponsoring agencies as being of concern in their operations are provided. A staff capable of making quick and accurate surveys of the literature, as well as in-depth studies and recommendations as required, is maintained. The advice and assistance of the Committee on Toxicology of the National Safety Council is provided.
Keywords: meetings; toxicity; health hazards; fossil fuels; energy conversion; coal; oil shales; oil sands; coal industry; oil shale industry; information systems; occupational safety; working conditions; chemical effluents.

106270 DOE Funding for President's Commission on Coal Industry. (President's Commission on Coal, Washington, DC). **Project number:** 008239. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: us doe; coal industry; government policies; financing.

106271 Pollutant Transport in Complex Terrain. Dickerson. (Lawrence Livermore Lab., Livermore, CA). **Project number:** 003027. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to improve the modeling capability available for simulating pollutant transport in complex terrain. New ideas and techniques showing practical applicability will be extracted from the atmospheric research efforts at Lawrence Livermore Laboratory and other installations and modified to provide an interconnected consistent set of numerical models able to simulate complicated atmospheric transport and diffusion of multiple materials emitted from multiple sources in very complex terrain. The atmospheric transport and diffusion model development will be focused to provide, within three years, new verified computational capabilities suitable for assisting in the resolution of some of the key air quality issues confronting the development of new energy resource areas and for augmenting the atmospheric release advisory capability modeling repertoire. To insure the applicability of the model developments, close interaction will be maintained with the ARAC Project and with air quality assessments projects such as those planned for The Geysers geothermal region.
Keywords: environmental transport; mathematical models; topography; diffusion; air quality.

106272 Plume Transport and Diffusion. Schuster, K. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 003008. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); geothermal(40) **R and D categories:** Environmental transport and conversion of pollutants.

This program is intended to study the detailed transport and diffusion of particulate plumes. Applications to be studied are plume behavior in simple and complex terrains in relation to pollution plumes from fossil fuel-burning power plants, in situ oil shale production, and geothermal energy production. A data base will be acquired to aid in the construction and verification of a predictive model of plume behavior. Applications to predictive real-time simulations in case of accidental releases from nuclear facilities will also be studied. The experimental techniques will be based on remote laser radar (lidar) detection of fluorescent aerosols. The identification of candidate aerosols and high-volume dispersion methods will be completed early in the period. The lidar system, in a ground-based configuration, subsequently will be constructed and utilized in field tests of small-scale (1- to 10-km) simulations. The ultimate utility of the system, for situations involving very long-range transport, will be in an airborne configuration, which will be initiated at the end of the period.
Keywords: plumes; particles; environmental transport; diffusion; aerosols; topography; fossil-fuel power plants; in-situ retorting; oil shales; geothermal energy; simulation; nuclear facilities; fission product release; accidents; optical radar; fluorescence; mathematical models.

106273 Impact Assessment of Oil Spills on Marine and Estuarial Bird Populations. Ainley, D.G. (Point Reyes Bird Observatory, Box 321, Bolinas, CA, 94924). **Project number:** 008244. **Contract:** 79-EV10254. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this program is a model which would define the extent to which spilled oil, by directly killing birds, may reduce the size of populations in the Gulf of the Farallons and its adjacent California estuaries. The model would predict potential changes in mortality rates caused by major oil spills. Species vulnerability to oil spills of different magnitudes at different localities will be assessed. Also to be examined is the ability of various habitats within the study area to support different species and those species whose populations might be significantly depleted in the event of oil contamination.
Keywords: oil spills; environmental impacts; birds; population dynamics; aquatic organisms; california; estuaries; petroleum; toxicity.

106274 Theory of Population Dynamics in Stochastic Spatially Varying Environments. Roughgarde, J. (Stanford Univ., Stanford, CA, 94305). **Project number:** 007244. **Contract:** EV-10108. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Marine intertidal communities and organisms are being manipulated and numerical modelling techniques applied to explore the influence of competition and dispersal on patchiness and to achieve a more useful mathematical formalization of the concepts of r and K selected species. The objective is quantitative description of the distribution of organisms in time and space as influenced by interacting deterministic and random variables. Ultimately discrimination of normal from perturbed distributions should be possible.

Keywords: population dynamics; aquatic organisms; water quality.

106275 Development of a Center for Biosystematic Resources. Edwards, S.R. (Univ. of Kansas, Association of Systematics Collections, Museum of Natural History, Lawrence, KS, 66045). **Project number:** 008079. **Contract:** 79-EV-10258. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives, through the development of a Center for Biosystematics Resources (CBR), are to facilitate access to the biological expertise represented in the academic/museum community and to provide a centralized source of information governing federal and state regulations regarding the acquisition and use of biological specimens. These services have been available through the Association of Systematics Collections on an ad hoc basis during the past year. However, with the establishment of the CBR, it will be possible to ensure that each of these important services can be provided efficiently and on a regular basis to national laboratory impact statement staff and other users. The heart of the center is a series of computer assisted data bases that have been developed during the past two years. These contain data on biologists and their areas of expertise, biological collections, annotated federal regulations, federal and state controlled species lists, and mailing lists. These data bases are constantly being revised and updated. With the development of the CBR, a diversity of related services will be available to persons engaged in biologically oriented projects. For example, for persons involved in environmental assessment, the center can: (1) locate qualified biologists to perform specific services; (2) determine the specific legal/permit requirements that a biologist must follow; (3) provide a list of species designated as endangered, threatened or otherwise controlled by federal and state governments; and (4) if necessary, subcontract the management of a project through the center.
Keywords: information centers; national government; state government; regulations; data base management; environmental impact statements; taxonomy; biology; terrestrial ecosystems; data acquisition; recommendations.

106276 Thermal Regulation of Functional Groups in Running Water Ecosystems. Cummins, K. (Oregon State Univ., Corvallis, OR, 97331). **Project number:** 008054. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project is for support to conduct experiments relating temperature and food quality to the growth of lotic macroinvertebrates representing different functional groups and to integrate these findings into the current general model of stream ecosystem structure and function. The proposed experiments involve two areas: further characterization of stream macroinvertebrate functional groups and interactions of temperature and food quality in controlling the growth rates of selected representatives of the macroinvertebrate functional groups.
Keywords: invertebrates; food; temperature dependence; water quality; animal growth; mathematical models; aquatic ecosystems; thermal effluents; benthos.

106277 Physiological Stress of Acidification on Fishes and Its Manifestations. Gerking, S.D. (Arizona State Univ., Dept. of Zoology, Tempe, AZ, 85282). **Project number:** 006866. **Contract:** 79-EV02498. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The research will address four general questions: (1) how sensitive are fish to acid (four responses will be used to answer this question: reproductive performance, growth rate, normal activity, and lethal range); (2) what is the physiological mechanism responsible for the adverse effects of hydrogen ions; (3) what are the symptoms of acid stress; and (4) can such symptoms be used to forecast potential danger to fish exposed to acid environments.
Keywords: fishes; tolerance; water quality; ph value; biological stress; environmental effects; habitat; reproduction; physiology.

106278 Investigation into the Usefulness of Multivariate Diffusion Processes in the Study of Home Range: Inference on the Stein-Uhlenbeck Process. Dunn, J. (Univ. of Arkansas, Fayetteville, AR, 72701). **Project number:** 007171. **Contract:** 79-EV01547. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A statistical analysis of radio telemetry data generated by the rovings of wild species poses special problems which biologists generally have failed to confront. The most serious of these are the complications arising from the lack of independence among the successive observations. Any model which is proposed as a basis for inference should place high priority on answering this problem. The substance of this proposal is to draw on the general class of continuous state stochastic models known as diffusion processes in an attempt to represent the wanderings of an animal in his home range. The multivariate Ornstein-Uhlenbeck Process is the starting point. Strong emphasis is placed on the problems of sampling and inference as compared to the development of formalistic probability theory. Close contact is maintained with biologists who are involved with radio telemetry work at a variety of institutions as a source of actual data.
Keywords: wild animals; habitat; biological models; stochastic processes.

106279 Control of Productivity and Population Characteristics in Aquatic Communities. Edmondson, W.T. (Univ. of Washington, Seattle, WA). **Project number:** 006414. **Contract:** 79-EV70023. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The proposed work will focus on three inter-related problems that can be specially well studied in a series of lakes selected for their suitability. One concerns the special features of saline lakes that have been diluted with fresh water resulting in remarkable changes in the biota. Two major aspects of the field work have been finished and the work for the coming year will include preparing the final analysis. These are the study of population changes and dynamics of the zooplankton and the study of the function of the red coloration of certain copepods. The second problem has to do with the effect of meromixis on nutrient conditions and the consequent effects on phytoplankton and zooplankton. Hall Lake, which lost its meromixis for more than a decade, has re-established it. At the time the lake mixed, the zooplankton was eliminated. A rather simple plankton community has been re-established, and the seasonal changes in reproduction, mortality, and abundance will be studied. The third problem has to do with the effect of predation in regulating species composition of zooplankton populations in Hall Lake. Work on the specific selective effects of the predator chaoborus will be finished during the coming year.
Keywords: aquatic ecosystems; lakes; salinity; phytoplankton; zooplankton; seasonal variations; mixing; fresh water; seawater; population dynamics; productivity; biological effects; nutrients.

106280 Biogeochemical Studies of Technetium in Marine and Estuarine Ecosystems. Beasley. (Oregon State Univ., Corvallis, OR, 97331). **Project number:** 008134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Technetium-99 is a fission product radionuclide produced in high yield in the thermal fission of both 235-U and 239-Pu. As such, it is present in rather high concentrations in existing fission product waste storage solutions, and will be produced in significant quantities in plutonium fast breeder reactors. It is proposed to conduct laboratory and field experiments on the behavior of technetium in marine and estuarine ecosystems to acquire basic information on the fate of this element once introduced into the environment. Studies will include food chain transfer dynamics (phytoplankton--zooplankton--macrozooplankton--fish) as well as uptake, loss and distribution in various tissues of marine organisms of commercial importance to man (shrimp, shellfish, benthic fishes). The importance of zooplankton metabolic activity (fecal pellet and moult production) as a mechanism for the vertical transport of the element from the surface layers of the ocean to depth will be investigated. Finally, geochemical data will be obtained on the behavior of the element in seawater, sediments, and at freshwater-saline water interfaces.
Keywords: fission products; radioactive wastes; breeder reactors; technetium 99; estuaries; aquatic ecosystems; food chains; phytoplankton; zooplankton; fishes; uptake; tissues; biochemical reaction kinetics; radionuclide migration; seawater; sediments.

106281 99-Tc in the Environment. Harris, W.F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 003156. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Technetium-99 has recently been identified as being a potentially limiting isotope for the operations of some nuclear facilities. Environmental assessments of technetium-99 have assumed a plant/soil concentration ratio of 0.25. Review of the literature suggests that this ratio may be a 100- to 1000-fold underestimate. If this underestimate is true, the releases of technetium-99 from uranium enrichment facilities potentially may exceed 40 CFR 90 standards. We propose to evaluate the issue by measuring technetium-99 in soil and vegeta-

tion near the K-25 and Paduca facilities and an appropriate control site and by conducting field plot studies to measure the residence time of technetium-99 in soil and its availability to the food chain leading to man.
Keywords: technetium 99; orgdp; paducah plant; soils; plants; ecological concentration.

106282 Integrates Study of the Behavior of Transuranic Elements in the Marine Environment. Choppin, G. (Florida State Univ., Tallahassee, FL, 32306). **Project number:** 008133. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Although the radiochemistry of transuranic elements has been widely studied in the laboratory and numerous measurements made of their distribution in natural environments, insufficient knowledge is presently available to construct reliable predictive models of their potential behavior in the oceans. A new approach is proposed in which a researcher familiar with the chemistry of transuranic elements (Choppin) will work closely with a researcher familiar with marine chemistry (Morse). This approach will yield radiochemical data directly applicable to understanding the distribution and speciation of transuranic elements in the marine environment. Our basic plan is to start with a limited number of common sediment components (e.g., humic and fulvic acids and calcium carbonate) and determine what factors determine the partitioning of transuranic elements among these components. We will then proceed to build up a comprehensive set of data by studying other common sediment components (e.g., clays). From these data a predictive capability for the behavior of transuranic elements in the marine environment should evolve.
Keywords: transuranium elements; seas; spatial distribution; mathematical models; water chemistry; humic acids; fulvic acids; sediments; environmental transport; radionuclide migration; radiochemistry.

106283 Radioecological Investigations of Uranium Mill Tailings Systems. Whicker, F.W. (Colorado State Univ., Dept. of Radiology and Radiation Biology, Ft. Collins, CO, 80521). **Project number:** 008284. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This proposal describes a comprehensive research program on radioecological investigations of uranium mill tailings systems. It is largely justified on the basis of state and federal regulations pertaining to radiological impacts of uranium mill effluents upon biota and humans, and the general lack of scientific information necessary to accurately evaluate such impacts. The overall program is comprised of studies on the ecological behavior of the major radionuclides associated with uranium production (U, Th, Ra, Rn, Pb, Po), the influence of biota upon the integrity of mill tailings and earth used as cover for tailings, and the biological impacts of uranium production operations and mill tailings materials. We propose to conduct scientific studies on radionuclides in biota adjacent to existing facilities, radionuclides from tailings systems, biotic activity and stability of decommissioned tailings systems, biological impacts of a developing uranium production site, and biological effects of fugitive mill tailings. Because of proximity and present and future importance in national production of uranium, study sites in the Wyoming basins will be emphasized in the program. Studies will focus principally upon terrestrial sites representative of shrub-steppe ecosystems at active and inactive production areas. The investigations will provide information pertinent to siting, operation, and decommissioning of uranium production facilities.
Keywords: radioecology; mill tailings; uranium; thorium; radon; radium; lead; polonium; radionuclide migration; wyoming; feed materials plants; environmental impacts; environmental transport.

106284 International Symposium on the Behavior of Tritium in the Environment. Mendelsohn. (Lawrence Livermore Lab., Livermore, CA). **Project number:** 004156. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Funding was provided under this project for the IAFA International Symposium on Tritium in the Environment which was held in San Francisco on October 16--20, 1978.
Keywords: meetings; tritium; environmental impacts.

06285 Development of Natural Matrix Radioactivity Standards. Hutchinson. (Washington, DC). **Project number:** 007840. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

NBS proposes to obtain four, ton-lot quantities of contaminated sediments or soils, representing differing matrix chemistries. These would be from the Columbia River, Enewetak Atoll, Perch L., and Rocky Flats. Later on, they would add biological materials (vegetation and organisms). The monies are to be used for: (1) collecting the material (labor and travel); (2) packaging in drums and shipping it to a sterilization facility and subsequently to NBS; (3) sterilization to sequestor biological degradation (probably by gamma radiation so as to not alter the chemistry); and (4) freeze drying. After this preliminary treatment, the material would be milled, seived, and blended by NBS to assure homogeneity. Then it would be carefully analyzed by NBS, with a double check by two or three other laboratories, and a certificate issued as to its radiation composition and contents. From then on samples would be made available at cost to radioanalytical labs as a natural matrix radioactivity standard. Its primary use would be as a check for quality control in all kinds of environmental radiation monitoring operations (federal, state, local, and private).
Keywords: standards; sediments; soils; columbia river basin; eniwetok; rocky flats plant; sample preparation; chemical analysis; radioisotopes; matrices; radioactivity.

106286 Nucleic Acids and Protein Synthesizing Mechanisms of Mitochondria. (Univ. of Pennsylvania, Philadelphia, PA, 19104). **Project number:** 006271. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

An investigation on the nucleic acids and protein synthesizing mechanisms will be conducted. Tetrahymena mitochondrial contain unique linear duplex DNA with a duplication-inversion and 80-S ribosomes consisting of two 55-S subunits with two ribosomal RNAs (21 S and 14 S). These ribosomal rRNAs are coded in the mt DNA; and multiple ECOR fragments (R1, R2, R3, R4, and R7) form stable hybrids with each rRNA species, suggesting either (1) the mtDNA has a multiplicity of rRNA cistrons, or (2) rRNA is transcribed from multiple discontinuous sites in the DNA. The dual transcriptional origin of mitochondrial tRNAs has been found; many physical/chemical criteria including two dimensional acrylamide gel electrophoresis demonstrate that the one tRNA class is coded for by the mtDNA, and the other transcribed by the nuclear DNA. Comparative studies of the corresponding tRNA synthetases in mitochondria and cytoplasm have resulted in a hypothesis that the tRNA synthetase for nuclear DNA-originated tRNA serves as a transport protein of tRNA across the mitochondrial membranes. To clarify and further elaborate these problems, continued investigations are proposed to elucidate the properties, biosynthesis, and genetic origins of (1) mitochondrial DNA, (2) ribosomal RNAs, (3) transfer RNA, and (4) tRNA synthetase.
Keywords: nucleic acids; proteins; biosynthesis; mitochondria; dna; transfer rna; ribosomes.

106287 Diesel: Physical/Chemical Characteristics. Royer, R.E. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003320. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The physical characteristics of diesel emission particles will be investigated and the mixture of chemical compounds associated with the particles characterized. The physical characteristics to be investigated include size, morphology, equivalent spherical diameter, surface area and pore size, and distribution. These properties relate to particle deposition and to adsorption of gases and organic compounds. Adsorption of toxic gases and biologically active organics will also be measured directly. Compounds adsorbed to the particles will be analyzed by class and, in addition, individual biologically active compounds will be identified. The work will concentrate on identifying and measuring pysical properties and chemicals which are most closely associated with possible health effects. The degree to which the physicochemical properties can vary from one sample to another will be determined and evaluated in relation to engine type, fuel composition, and operating parameters. This work will be correlated with, and guided by, the results of biological studies conducted under other projects.
Keywords: diesel engines; exhaust gases; particles; physical properties; adsorption; chemical analysis; health hazards.

106288 Diesel: Biological Characterization. Brooks, A.L. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003321. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The biological activity of extracts from particulates in diesel exhaust will be determined using short-term tests conducted both in

vitro and in vivo. At the gene level, alterations will be measured using Ames bacterial tests and mammalian cells in culture. Chromosome changes both in vitro and in vivo will be evaluated by determining the frequency of chromosome aberrations and sister chromatid exchanges. Cell transformation will be measured in vitro and related to whole animal carcinogenesis from diesel exhaust. The effect of engine type, operating conditions, fuel type and emission control system on the amount and kind of biologically active materials released into the environment will be investigated. The short-term tests will also aid in directing the fractionation of mutagenic compounds from diesel exhaust. Acute and chronic inhalation studies conducted a part of the genetic toxicology evaluation of diesel will provide a link between measurements of mutagenesis made in vitro and damage produced in the whole animal. Inhalation studies help define the movement, metabolism, target organ, and activity of these pollutants. Such information is essential to developing valid health risk assessments for man.
Keywords: diesel engines; exhaust gases; biological effects; health hazards; inhalation; particles; aerosols; hydrocarbons; toxicity; risk assessment; lungs; physiology.

106289 Diesel: Chronic Exposure. Mauderly, J. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003318. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary mode of human exposure to diesel exhaust materials is expected to be chronic inhalation for varying times ranging to life span. Little is presently known about the health effects of diesel exhaust and data are needed on late-occurring effects for assessment of the health impact of increased diesel use. Animals will be exposed by inhalation to graded concentrations of diluted exhaust from a production light-duty vehicle diesel engine for their life span. Life-span shortening, incidence and nature of neoplastic and non-neoplastic disease, respiratory and mucociliary clearance function, lung connective tissue, and qualitative and quantitative morphometry will be evaluated serially throughout the exposures. The engine, exposure, and analytical systems are currently under development and techniques for evaluating endpoints are presently in use. Subsequent studies may address subjects with existing chronic lung disorders, animal species comparisons, gasoline-diesel comparisons or variations in emissions induced by operating conditions or new control technology.
Keywords: diesel engines; health hazards; chronic exposure; man; inhalation; exhaust gases; neoplasms; life span; morphological changes; lungs; physiology.

106290 Diesel: Inhalation Dose Estimates. Wolff, R.K. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003319. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study will determine the levels of diesel particulates that reach tissues, their residence time, and their biological availability. Diesel exhaust particulates are in the 0.1 to 0.3 micro-micron size range for which there is virtually no solid data on deposition or retention. Total and regional deposition of labeled surrogate diesel aerosols will be measured in both animals and man. External gamma camera imaging will be used for dogs and man, and sacrifice and tissue counting for rats. The deposition, translocation, and long-term retention of radiolabeled diesel particulates will be evaluated using whole-body counting and tissue counting. Fluorescence and GC-MS techniques will be developed to quantitate levels of specific hydrocarbons in tissues. These results and in vitro tests will determine the degree of dissociation of the organics from the particulates. This data will provide a vital link between animal dose response data and human health risk assessment.
Keywords: diesel engines; exhaust gases; particles; aerosols; health hazards; biological effects; synergism; animals; man; dogs; rats; risk assessment; hydrocarbons; toxicity.

106291 Role of Environmental Aromatic Hydrocarbons in Mutagenesis and Carcinogenesis. Cavalieri. (Sloan-Kettering Inst. for Cancer Research, New York, NY). **Project number:** 008242. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This proposal is concerned with mutagenesis and carcinogenesis induced by aromatic polycyclic hydrocarbons which are environmental pollutants. The experiments described will show whether, and how, DNA adducts formed from the proximate carcinogens produce mutations. Our study offers a new approach: we will use the mammalian virus SV40, with its DNA modified in vitro by treatment with the proximate hydrocarbon carcinogen. The modified and characterized SV40 DNA vector will then be studied in infected cells, from which we will learn the molecular nature (base change, insertion, deletion) and location of mutations caused by the hydrocarbon adducts. Our studies will elucidate the role of DNA repair in mutagenesis. We will study both pre- and post-replicative repair and will determine whether the repair process itself is error-prone. A close correlation between mutagenesis and carcinogenesis will be made possible by examining the extent of mutagenesis of SV40 in the same cells in which transformation by the hydrocarbons will be studied. This last approach will also provide a basis for the screening of potential carcinogens.
Keywords: mutagenesis; carcinogenesis; biological models; polycyclic aromatic hydrocarbons; toxicity; dna; biological repair; in vitro; viruses; animal cells.

106292 Coordination of Environmental Mutagenesis. Hollaender, A. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 003435. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fusion(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

This is a service contract to organize, conduct and publish DOE and interagency workshops and conferences on environmental mutagenesis.
Keywords: mutagenesis; education; meetings; health hazards; energy source development; energy consumption; energy.

106293 Metabolism and Fate of Inhaled Hydrocarbons. Mitchell, C. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002671. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

There is potential for formation and release of polycyclic aromatic hydrocarbons (PAH) from most coal combustion and conversion technologies. They are potentially present in both fugitive and stack emissions from these technologies and are a potential inhalation hazard to man. PAH are known carcinogens. Thus, it is essential that additional work be conducted to characterize the manner in which PAH are handled following inhalation. PAH may be present in the atmosphere as vapors, condensation aerosols, and/or adsorbed onto fine particulates. In this study, PAH aerosols of these various types will be generated and used for inhalation exposures of experimental animals. Emphasis will be placed on determining the retention and metabolism of these compounds in the lung following the exposure and translocation to other tissues. Radiolabeled PAH will be prepared and used in this regard. The interaction of PAH and PAH metabolites with cellular macromolecules such as DNA will also be studied. These characteristics of PAH following inhalation will then be correlated with the development of neoplasms in the lungs and other tissues of experimental animals.
Keywords: metabolism; inhalation; polycyclic aromatic hydrocarbons; coal industry; combustion products; energy conversion; technology assessment; man; retention; lungs; neoplasms; aerosols; health hazards; animals.

106294 Repair of Genetic Damage. Misara, N.C. (Univ. of South Carolina, Columbia, SC, 29208). **Project number:** 007967. **Contract:** 7967. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Neurospora, a haploid eukaryotic fungus, is an ideal organism with which to study the biochemical genetics of repair mechanisms. Its genetics and biochemistry are well investigated. This project will attempt to isolate mutants which are defective for repair specific nucleases. Biochemical and genetic characterization of the mutants will follow as well as studies on the effects of radiation and chemical mutagens and carcinogens upon these mutants. The methodology to study the effects of carcinogens upon neurospora is already known.
Keywords: genetic radiation effects; biological repair; neurospora; biochemistry; nucleases; chemical effluents; mutagenesis; biological models.

106295 Diesel Particulate Emissions. (Bartlesville Energy Technology Center, Bartlesville, OK). **Project number:** 003400. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

Health hazards and characteristics of particulate matter discharged from diesel engines will be studied in a laboratory equipped to simulate actual-use conditions including the important effects of patterned variations in speed and load. Ambient temperature effects also are reproduced in a climate-controlled chassis dynamometer. All emissions, including particulates along with fuel

economy, are measured and these performance characteristics are related to fuel properties, to duty cycle, and to system design parameters. These system design parameters include the highly-critical variables, or design options, in or for exhaust emission control.
Keywords: diesel engines; exhaust gases; air pollution control; temperature effects; health hazards; fuel economy; data acquisition; nitrogen oxides; carbon monoxide; sulfur dioxide; hydrocarbons; particles; aerosols.

106296 Effects of Atmospheric H2S on Vegetation. Thompson. (Univ. of California, Los Angeles, CA). **Project number:** 007506. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The present proposal would study the effects of actual levels of H2S on important crop plants which are grown near a developed geothermal energy field (The Geysers). Field exposures would be simulated by programming data obtained from this area into an automatic, timed dispensing system on a diurnal basis so that changes in levels caused by wind patterns, temperature, etc., would be duplicated. A second objective would be to increase the above ambient levels by a factor of three and conduct a similar parallel study to find out what a three-fold increase in H2S levels would do to agricultural and native species. A third objective would be to compare the long-term toxic effects of H2S and SO2 on selected plant species so that the amount of injury to vegetation could be predicted downwind. During the second year, the study with grapes, pears, and walnuts would be continued. In addition the growth stimulating effect of H2S at low levels would be studied intensively to find out what environmental factors enhance this effect. Plant sulfur nutritional status, relative humidity, and light regimens will be studied to find out which of these factors influence the effects of H2S most. Attempts will be made to maximize the growth stimulating effect of use commercially by floriculturists, vegetable producers, or other greenhouse operators. Plant fractionations will be done to separate cellular components to find out where sulfur from H2S accumulates. With this information integrated with published knowledge, projections may be made of the way in which H2S accumulates and causes effects in plants.
Keywords: hydrogen sulfides; atmospheric chemistry; plants; sensitivity; metabolism; toxicity; geothermal energy; environmental effects; grapes; pears; seeds; nutrition; biochemical reaction kinetics.

106297 Photochemical and Thermal Reactions of Combustion-Related Particulate Organic Matter: a Combined Chemical and Microbiological Approach. Pitts, J.N. (Univ. of California, Los Angeles, CA). **Project number:** 008095. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A three-year combined chemical and microbiological research program is proposed to investigate in detail the products, kinetics, and reaction mechanisms of the thermal and photo-chemical reactions of polycyclic aromatic hydrocarbons, present in combustion-related particulate matter, with the criteria gaseous pollutants and other reactive species present in photochemical smog. In this research, benzo(a)pyrene, benz(a)anthracene, benz(a)acridine, and perylene, representative PAH and N-PAH, will be deposited on various types of filter and particulate substrates, and exposed to O-3, NO-2, SO-2, PAN, singlet oxygen, and OH radicals: (1) under a wide range of laboratory conditions; (2) in simulated atmospheres; and (3) ultimately to ambient smog. Thus, variables to be investigated in PAH and N-PAH exposure experiments conducted under laboratory conditions will include light intensity and spectral distribution, temperature, and exposure time, as well as nature of the substrate. In all cases detailed chemical characterization and microbiological assay of the mutagenicity of the reaction products will be performed. In the second and third years fly ash and soot particles containing traces of PAH and N-PAH will be generated and these aerosols will be exposed in large environmental chambers under simulated atmospheric conditions to the gaseous pollutants cited above. Finally, actual particulate matter from different emission sources, e.g., from coal fired power plants, also will be exposed to individual gaseous pollutants, as well as to ambient photochemical smog. Their potential to form direct mutagens will be assessed and, hopefully, the compounds responsible identified.
Keywords: photochemical reactions; thermodynamic properties; polycyclic aromatic hydrocarbons; microorganisms; benzopyrene; benzanthracene; acridines; perylene; ozone; nitrogen dioxide; sulfur dioxide; mutagenesis; atmospheric chemistry; bioassay.

106298 Petroleum Effects on Neural Systems in Marine Organisms. Case. (Univ. of California, Los Angeles, CA). **Project number:** 007833. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim is to determine the effects of identified components of petroleum on neural systems in order to provide a basis for understanding how petroleum in the marine environment affects the activities of marine organisms. Primary emphasis will be upon systems found in marine organisms in which the actions of petroleum components can be studied in terms of their relatively direct effects upon cell membranes. Examples of the three types of neuronal membranes - sensory, synaptic, and conductile - will be studied. We will use two types of sensory or environmentally excitable membranes: the chemosensory receptors of crustaceans such as the crab, Cancer antennarius, and the lobster, Panulirus interruptus, and the mechanically excitable cell membrane of the dinoflagellate, Pyrocystis fusiformis. Effects on electrically excitable axonal membranes will be studied using a Panulirus giant fiber preparation and effects on transmitter-excitable synaptic membranes will be studied using identified central neurons of the marine mollusk, Aplysia. Further, since neuroplasmic transport is of importance in maintenance of both dendrites and axonal membranes, a simple test will be conducted on the effect of petroleum fractions on axonal transport. For comparison with excitable system, effects on membrane potential, measured with voltage dependent fluorescent dyes, will be conducted on erythrocytes. These investigations are designed so as to determine both chronic and acute effects in experimental situations in which exposure to petroleum is limited to the membrane system under study and in which the dosage and composition of the petroleum elements under test are precisely known.
Keywords: aquatic organisms; petroleum; neurology; behavior; receptors; aquatic ecosystems; nerve cells; biological effects; crustaceans; molluscs; erythrocytes; membrane transport; physiology.

106299 Models of Carbon Flow in Tropical Ecosystems with Emphasis on Their Role in the Global Carbon Cycle. Lugo, A.E. (Inst. of Tropical Forestry, Box AQ, Rio Piedras, PR, 00928). **Project number:** 007981. **Contract:** 79-EV06047. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this proposal are: (1) to survey and compile the available literature and unpublished reports dealing with carbon storage and carbon flow in tropical ecosystems; (2) to categorize the data by life zone association and stages of succession; (3) to assemble available evidence on the impact of human activities on the carbon flow of different lifezones; (4) to stimulate these data with an existing ecosystem model in order to extrapolate trends in the available data and to elucidate the significance of particular transfer mechanisms and feedbacks; and (5) to make recommendations for priority research needs relative to the role of tropical ecosystems in the exchange of carbon with the earth's atmosphere.
Keywords: carbon cycle; global aspects; mineral cycling; data compilation; earth atmosphere; mathematical models.

106300 Environmental Transport and Effects of Coal Conversion. Gehrs, C.W. (Oak Ridge National Lab., Bldg. 1505, Oak Ridge, TN, 37830). **Project number:** 001693. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this research is to develop the data necessary for assessing the environmental implications of the various coal conversion technologies, thus allowing development of technologies most amenable to man and his environment. Data must be generated in a timely fashion to attain this objective. Toxicity testing of whole effluents, fractions, and subfractions will be conducted to quickly determine the most active materials for research in long effects and transport studies. Concommitantly, model compounds will be used in studies designed to elucidate degradation metabolism, transformation, fate, bioaccumulation, availability, and potential toxic interactions. Data necessary to allow the orderly development of environmentally safe coal conversion technologies, with the siting of specific plants and technology type used (e.g., hydrocarbonization, solvent refined) done with an input of environmental data will be developed.
Keywords: environmental transport; environmental effects; coal gasification; coal liquefaction; data acquisition; toxicity; waste water; metabolism.

106301 Interagency Working Group on Data Collection Systems. Lockes, O.D. (National Aeronautics and Space Administration, 400 Maryland Ave., Washington, DC, 20546). **Project number:** 008078. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.
Keywords: data acquisition systems; research programs.

106302 Prenatal Effect of Pollutants. Andrew. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Contract:** 002714. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will examine behavioral, physiological, and biochemical parameters which may be sensitive indicators for demonstrating and quantitating of postnatal effects of perinatal exposure. Suspected toxic non-nuclear pollutants, such as heavy metals, polycyclic hydrocarbons, heterocyclic compounds and their biotransformation products are discussed. The parameters studied would include neuromuscular and overt behavioral development, hepatorenal function, general measures such as survival, growth, immunocompetence and the ability to respond to imposed stress, all selected for their presumed sensitivity in assessment of deficits in fetal and neonatal maturation. Other parameters for evaluating developmental toxicity of various organ systems, including hematologic integrity, fertility, pulmonary function, tumor susceptibility, and learning ability will also be studied.
Keywords: teratogenesis; prenatal irradiation; perinatal irradiation; behavior; physiology; biological indicators; biochemistry; biological radiation effects.

106303 Biochemical Indicators of Macrophage Involvement in Pulmonary Damage from Coal Conversion. Werb, Z. (Univ. of California, Lab. of Radiobiology, Davis, CA). **Project number:** 002791. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

As the first line of hot defense in inflammation, the pulmonary macrophage may come into contact with airborne pollutants produced by coal-conversion processes. Ingestion of particles by the macrophages may induce secretion of enzymes active in extracellular degradation of lung connective tissue. These macrophage proteinases may promote fibroblast groth and collagen synthesis and, as the effector cell in cell-mediated immunity, the activated macrophage may be responsible for immunological reactions in the chronic inflammatory lesion. The purpose of this project will be to identify and characterize proteins that may be used as indicators of macrophage involvement in lung damage. Mouse macrophage elastase will be purified and characterized because this enzyme may be central in producing irreversible connective tissue damage. Proteins produced by activated macrophages will be analyzed using radiochemical, immunological, and genetic approaches.
Keywords: biological indicators; coal industry; macrophages; health hazards; ingestion; lungs; immunology; bioassay; physiology; inflammation.

106304 Industrial Low Btu Gasifier: Inhalation Toxicology. Hobbs, C.H. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003207. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In this project a collaborative effort with Oak Ridge National Laboratory (ORNL) will be established to characterize potential airborne effluents from a low Btu gasifier being constructed at the University of Minnesota-Duluth (UMD) under the DOE Gasifiers in Industry Program as to their potential health effects. ORNL has proposed an extensive program to evaluate the potential environmental and health effects from this gasifier. In this program, the specialized equipment and expertise available in aerosol sampling and inhalation toxicology will be utilized to supplement and extend ORNL's efforts in a collaborative fashion. The Inhalation Toxicology Research Institute's role will be to make several field trips to UMD for aerosol collection and characterization from the process and exhaust stream of the gasifier. Chemical characterization of the collected particles will be done collaboratively with ORNL. The results from these studies along with data from in vitro screening tests for toxicity and mutagenicity will be used to select the materials with the highest potential for inhalation hazard to man. These materials will be selected for inhalation toxicology studies in experimental animals (rodents). Some acute inhalation toxicity studies will be done but primary emphasis will be on life span studies to determine the carcinogenic potential.
Keywords: low btu gas; chemical effluents; toxicity; health hazards; environmental effects; aerosols; sampling; inhalation; rodents; life span; carcinogenesis.

106305 Coal Liquids Carcinogenicity Screening Tests. Calkin, W.H. (E.I. Du Pont de Nemours and Co., Aiken, SC). **Project number:** 007582. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The project addresses the potential health effects associated with end use of synthetic liquids produced in 8 different processes under development by DOE. The research is specifically concerned with the crude product, products refined for chemical feedstock as a substitute for natural petroleum and residues after refining. The crude materials and fractions derived therefrom are evaluated for mutagenic and carcinogenic and toxicity by use of a battery of short-term cellular tests and animal bioassay for acute and subacute toxicological effects.
Keywords: mutagen screening; carcinogens; carcinogenesis; petroleum; synthetic fuels; coal industry; bioassay; toxicity.

106306 Inhalation Toxicity of Organometals. Weisman. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003206. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In the coal conversion processes currently being used or developed for energy production, organometallics may be produced. The objectives of this project are to identify organometallics in the exhaust stream of coal conversion processes and to investigate the potential toxicity of the organometallics found. Initial work will concentrate on the sampling and analysis of both vapor-phase and particulate organometallics in low Btu gasification. Other energy technologies may be investigated at a later time. Mutagenicity tests will be undertaken for some compounds isolated. Rats will be exposed via inhalation to various organometallics characteristic of those found in the effluent. Short term studies to determine fate in the body will be conducted followed by life span health effects studies. Pathological examinations will be conducted following single and repeated subchronic exposures. An assessment of the health hazard of effluent metals based on the actual chemical forms in which they occur will be made.
Keywords: toxicity; inhalation; metals; organic compounds; coal gasification; coal liquefaction; health hazards; rats; life span; chemical effluents; air pollution.

106307 Outer Atoll Survey. Doyle, J.F. (EG and G, P.O. Box 1912, Las Vegas, NV, 89101). **Project number:** 600215. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The Northern Marshall Islands Survey includes both photographic and aerial radiation coverage over eleven atolls and two islands which are suspected of having received radioactive fallout from the nuclear weapons testing program conducted in the Pacific from 1946 to 1958. The atolls and islands are: Ailinginae Atoll, Ailuk Atoll, Bikar Atoll, Bikini Atoll, Jemo Island, Likiep Atoll, Mejit Island, Rongelap Atoll, Rongerik Atoll, Taka Atoll, Ujeland Atoll, Utirir Atoll, and Wotho Atoll. Enewetak Atoll, the only other atoll known to have received fallout, was surveyed in 1972 and again in 1977. Radiation surveys were carried out by means of two helicopters which flew multiple missions from a naval ship stationed near the atolls. EG and G supplied the scientific flight crews and technical support personnel to operate and maintain the radiation measuring and position measuring equipment. After completion of the field portion of the project in November 1978, EG and G produced a preliminary report on the radiological condition of the surveyed areas. Following this, a more complete final report will be written. With the completion of the final report in FY 1980, the project will come to an end.
Keywords: marshall islands; radiation monitoring; aerial monitoring; nuclear weapons; radiation doses.

106308 Northern Marshall Islands Survey. Robison, W. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** 600220. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Vegetation, soil, water, marine, and animal samples collected during 1978 as part of the Northern Marshall Islands multi-atoll survey will be processed and analyzed for 137Cs, 90Sr, 239Pu, 240Pu, 241Am, and 241Pu. With these data we will evaluate the radiological consequences of current habitation and potential resettlement of the atolls. Samples will be dried, ashed, and analyzed for gamma-emitting radionuclides by high resolution gamma ray spectroscopy. We will determine Pu, Sr, and Am concentrations by wet chemistry procedures. The data will be incorporated into a large scale Marshall Islands data bank ready for use in the dose-assessment program, Continuing Marshall Islands Radiological Dose Assessment.
Keywords: marshall islands; cesium 137; strontium 90; plutonium 239; plutonium 240; plutonium 241; americium 241; radiochemical analysis; radioactivity; radioecological concentration.

106309 Enewetak Radiological Survey and Monitoring. Ray, R. (Nevada Operations Office, P.O. Box 14100, Las Vegas, NV, 89114). **Project number:** 600169. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

As a part of the overall effort to clean up and rehabilitate the islands of the Enewetak Atoll, the DOE has been tasked to provide radiological support to the DOD/DNA operation. DOE responsibilities include: (1) establish guidelines for radiological cleanup; (2) provide advice to the DNA in radiological safety and other radiation related matters; (3) conduct radiological surveys, data processing, and analysis; (4) provide on-island radiochemistry lab support; (5) provide on-island instrument maintenance and calibration; (6) classify soil radioactivity levels; and (7) document the radiological condition of the atoll upon completion of the clean-up phase of the project. Tasks 2 through 7 have been delegated to the Nevada Operations Office.
Keywords: eniwetok; decontamination; radiochemistry; radiation protection; human populations; biological radiation effects; delayed radiation effects; plutonium 239; nuclear weapons; radiation monitoring.

106310 Marshall Islands Radiological Safety Program. Greenhouse, N.A. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 600003. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

A comprehensive radiological safety program will be maintained for the inhabitants of atolls in the Northern Marshall Islands contaminated as a result of the U.S. Pacific testing programs. The following items and services will be provided: (1) environmental and personnel monitoring to provide data for BNL dose assessments and determination of radiological trends; (2) individual and population dosimetry based on actual measurements which will be used to modify dose commitment predictive models so that they accurately reflect future trends; (3) suggestions based on field experience to mitigate doses via the more critical pathways; and (4) a flexible resource of radiological expertise to independently review radiation protection programs associated with rehabilitation efforts in the Northern Marshalls and for related health physics interests of OES in the Pacific Basin. Program activities for the coming fiscal year will emphasize the following: (1) in vivo counting of Bikini and Enewetak residents; (2) urine bioassay to define radionuclide excretion patterns from individuals and to estimate 90Sr and transuranic nuclide burdens; (3) definition of the annual contributions to dose via the inhalation pathway at Bikini, Rongelap, and Utirik (special emphasis placed on continuous air sampling for wind-mediated resuspension of radionuclides in local soils and on special measurements to define aerosol contributions resulting from human activity); and (4) development of radiological dose predictive models which involve both human and environmental monitoring data.
Keywords: marshall islands; radiation protection; human populations; nuclear weapons; radiation monitoring; personnel dosimetry; biological pathways; environmental exposure pathway; urine; radiochemical analysis; strontium 90; transuranium elements; body burden; radionuclide kinetics; radiation doses; radionuclide migration.

106311 Marshall Islands Dose Assessment. Robison, W. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** 600146. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Assessments will be made to evaluate the radiological consequences of resettling atolls in the Northern Marshall Islands. Doses will be calculated for each exposure pathway, alternative living patterns, and various atolls using the extensive sampling surveys and continuing research programs. Special attention will be given to Bikini and Enewetak Atolls. Data from the surveys, plus resorts of continuing research programs on updated dietary information and alternative living patterns will be used in conjunction with the latest dose models to calculate bone and whole body doses via ingestion and inhalation. Doses from all pathways, including external exposure, will be summed to determine the predicted maximum annual dose rates and the integrated 30, 50, and 70 year doses to populations resettling the atolls.
Keywords: marshall islands; radioactivity; radiation doses; decontamination; diet; bikini; eniwetok; human populations.

106312 Biochemistry of SO2 in Plants. Filner, P. (Michigan State Univ., East Lansing, MI, 48823). **Project number:** 002191. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Increases in SO2 pollution are expected to accompany the anticipated increased dependence on coal for energy. This task is directly concerned with the consequences, for crops and other plants, of this added environmental stress. It seeks to determine how SO2 damages plants, and how plants resist the effects of SO2. The stages of the task's research are: (1) determine susceptibility of crop plant cultivars in order to obtain cultivars with differing sensitivity to H2SO3- (SO2 dissolved in H20); (2) design and construct apparatus for exposing plants to SO2 of known concentrations, while continuously monitoring SO2 absorption, volatile S emissions, and stomatal behavior; (3) determine which cultivars achieve resistance physically by closing stomates and which achieve resistance biochemically, i.e., they absorb SO2 but are minimally affected; (4) feed radioactive SO2 to biochemically resistant and sensitive cultivars and determine whether there are detectable differences in SO2 metabolism; and (5) analyze the biochemical differences detected and construct a hypothesis for the resistance mechanism.
Keywords: sulfur dioxide; toxicity; plants; metabolism; coal industry; sensitivity.

106313 Effect of SO2 on Light Modulation of Plant Metabolism. Anderson, L.E. (Univ. of Illinois, Urbana, IL, 61801). **Project number:** 007970. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of the experiments proposed here is: (1) to examine a wide number of plants with respect to the effect of sulfite on the light modulation system, with particular emphasis being placed on economically important species; (2) to identify the component of the light modulation system which is affected by sulfite; (3) to demonstrate that this component is irreversibly de-natured by sulfite in vitro and by SO2 in vivo; and (4) to determine whether the light modulation system is involved in stomatal opening. The experiments outlined will also contribute to understanding of the process of light modulation of enzyme activity in green plants.
Keywords: sulfur dioxide; plants; metabolism; biological effects; photosynthesis; biological models.

106314 Nature and Mechanism of Induction of Mutation. (Washington State Univ., Pullman, WA). **Project number:** 006306. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this contract proposal is to elucidate the mechanism of azide mutagenesis in barley. Azide, a respiration inhibitor used in many agricultural and industrial processes, is a potent mutagen in barley and bacteria. Preliminary investigations with barley and studies with bacterial systems indicate that azide is unique in its mechanism of action and the nature of mutations it induces, possibly transversion-type base substitutions. Research proposed on this contract will investigate in barley: (1) azide's mechanism of action through studies of the relationship of its mutagenicity to DNA synthesis, metabolism, radical formation, and chromosome aberrations; and (2) the nature of mutations it induces by DNA hybridization techniques and genetic fine structure analyses of mutants affecting pollen grain structure and function.
Keywords: mutations; barley; mutagenesis; biological models; bacteria; azides.

106315 Polamares Assistance. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 003473. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The determination of transport/movement of transuranic elements over time (these were released into the environment in the 1966 weapons accident in Spain) is of great importance to the evaluation and assessment of the impact of this accident on man and his environment. A resurvey of appropriate areas of Polamares requires provision of field and laboratory instruments. LASL has been requested to construct/purchase this equipment. Funds are to support time spent on the equipment, preparation of training manuals, and travel to Spain for installation of equipment and training of personnel.
Keywords: transuranium elements; environmental impacts; radionuclide migration; spain; radiation accidents; radiation monitoring.

106316 Diesel: Health Risk Assessment. Cuddihy, F.G. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 003317. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: oil and gas(100) **R and D categories:** Health effects assessments.

This task is directed toward providing a series of integrated assessments of the human health risks associated with various scenarios for the utilization of diesel engines in light-duty vehicles. The integrated assessment will have three major contributing assessments. The first is a human exposure assessment to predict human exposures. It will be made using data on emission levels, the physical and chemical characteristics of the emissions (especially particles), their dispersal under various traffic patterns (e.g., metropolitan street canyons, urban freeways, open country roads), diesel production scenarios and demographic statistics. The second is a human dose assessment which will predict tissue levels of particle constituents, especially hydrocarbons, resulting from the exposure levels derived in the exposure assessment. This will be done using the physical and chemical characteristics of emissions, knowledge of particle deposition and clearance in man and laboratory animals, and data on the dissociation of hydrocarbons from particles gained from in vivo and in vitro studies. The third assessment will predict human health effects for various levels of exposure. It will utilize the results of human epidemiologic studies, studies of animals exposed in controlled environments, and short-term assays. The integrated assessment will seek to establish the relationships between source, exposure environment, dose to people, and health effects for the total population. Where possible, comparisons will be made to other transportation technologies that result in potential health risks to man. The assessments will be performed in an iterative manner with a view to providing improved estimates of risks as additional input data become available from the on-going parallel research effort.
Keywords: diesel engines; health hazards; exhaust gases; petroleum industry; hydrocarbons; aerosols; particles; risk assessment; man; roads; epidemiology.

106317 Human Studies of Environmental Pollutants. Morrow, P. (Univ. of Rochester, Rochester, NY, 14627). **Project number:** 003134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Clinical studies in humans.

The failure of SO2 per se to meet the epidemiologic and toxicologic requirements for certain air pollution episodes and experimental evaluations led to the view that it was the interaction of SO2 with particulate matter which accounted for its special toxicity. Although this concept has not been disregarded, observation that oxidant--SO2 mixtures were synergistic, led to the generally held view that particulate sulfates dervied from gas-phase reactions involving SO2 were the etiological factors of concern. The two investigative approaches which appear most likely to provide meaningful health effects data are the epidemiologic and the carefully controlled, short-term human studies. In the latter regard, we believe that studies encompassing many hours of occupational threshold limit value of 1 mg/cubic m (0.25 ppM as H2SO4) and 0.01 mg/cubic m, the latter being approximately the lowest level to which adverse effects have been associated. Accordingly, we propose to develop an environmental chamber, wherein regular physiologic testing is possible, in order to investigate both normal and asthmatic subjects over exposure periods of days.
Keywords: sulfur dioxide; epidemiology; toxicity; air pollution; health hazards; respiratory system diseases; physiology.

106318 Health Effects of Battery Storage Systems. Sharma, E.H.R. (Argonne National Lab., Argonne, IL). **Project number:** 002855. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Health effects assessments.

The principal objective of this program is to achieve an understanding of health effects and of potential public health and occupational health impacts hazards associated with battery storage technologies. The program includes two tasks. The primary purpose of Task A is to perform an assessment that will define the needs for health-effects research in (nonhuman) biological systems and that will present a research plan for resolving health related issues. The primary purpose of Task B is to launch experimental initiatives on several key issues already identifiable as relevant to health risks associated with battery energy storage technologies. In the forefront of these is the need for quantitative approaches toward the appraisal of the physiological and neurophysiological states of malaise, of behavioral dysfunction, and of general morbidity that appear to be serious and insidious concommitants of metal poisoning, and that are often missing tiers in the standard multi-tier approaches to conventional toxicology. Particular attention will be given to the refinement of classical toxicological methods and to the development of relevant new ones. The animal studies are relevant to human problems with respiration, with hypertension, and with damage to the central nervous system and to integrated behavior. Metals of choice initially are lithium, cadmium, and lead.
Keywords: health hazards; animals; electric batteries; lead-acid batteries; toxicity; energy storage; energy storage systems.

106319 Office to Coordinate Information and Technological Transfer in Environmental Mutagenesis and Carcinogenesis. Hollaender, A. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 003435. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Health effects assessments.

Three types of workshops for the training of individuals in academia and industry to detect environmental mutagens, carcinogens, and teratogens have been developed. There is an urgent need to have personnel available who are able to evaluate the environment, especially in connection with the development of new energy sources. Such training courses have been developed in cooperation with universities and research institutions. One program is designed for management personnel consisting of 2 and 1/2 days of lectures. An intermediate program is designed for individuals who manage laboratories and are in charge of the staff doing the work. A training course for technicians actually conducting tests has been initiated to insure such training courses planned. This office cooperates with the DOE and other government agencies, advising them in regard to problems in the environment, especially of general significance, in close cooperation with the Division of Biology and Environment (DOE), as well as other government groups. This office also helps to organize symposia on the use of genetic engineering, especially in plant sciences and microbiology.
Keywords: mutagenesis; carcinogenesis; technology transfer; education; management; information needs.

106320 Molecular Aspects of Radiation Genetics. Billen, D. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 001476. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.
Keywords: genetic radiation effects; molecular structure; ionizing radiations.

106321 Study of the Molecular Basis for Radiation Mutagenesis. Wang, S.Y. (Johns Hopkins Univ., Baltimore, MD, 21218). **Project number:** 006223. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Ionizing radiation produces genetic effects in biological systems. Since genetic effects are usually the result of modifications of DNA or sometimes of RNA, interest is being centered on the chemical and physical nature of radiation-induced lesions to nucleic acids and their components. These investigations have revealed the enormous complexity of chemical events and the possible degradation of nucleic acids by strand breakage. Therefore, work in the ionization radiation of nucleic acids has proceeded along a dual course. On the one hand, molecular changes have been characterized for a number of primary radiation products. On the other hand, strand breakage has been investigated intensively as a direct primary event. Both of these aspects were emphasized in our research last year.
Keywords: mutagenesis; radioinduction; genetic effects; ionizing radiations; nucleic acids; radiation injuries; chromosomal aberrations; strand breaks.

106322 Magnetic Studies of Radiation Damage. Box, H.C. (Health Research, Inc., Buffalo, NY). **Project number:** 006199. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project has been a study to identify the primary radicals formed in nucleic acids after exposure to ionizing radiation. The technique is to make ESR measurements on crystals at low temperature. An inherent limitation of the study is that only radicals can be measured but this past year 13C NMR spectroscopy in conjunction with 13C enrichment procedures has been developed as a means for identifying the final radiation products. Thus, the capability of studying the full range of reactions that nucleic acids and other compounds can undergo from the initial generation of radicals to the final stable end products is now possible. Also alkoxy radicals have been studied which are believed to be important radiation products coming from the sugar moriety of DNA. Finally techniques have been applied to studying oxidation-reduction processes in a model of photosynthesis viz. an octahedral complex of iron.
Keywords: radiation injuries; radicals; nucleic acids; radiolysis; dna; alkoxy radicals; photosynthesis; ionizing radiations.

106323 DNA: Polynuclear Hydrocarbon Interactions. Geaciwtov, P. (Univ. of New York, New York, NY). **Project number:** 007967. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Coal will constitute a significant source of energy in the coming decades. The increased use of coal will give rise to an increasing pollution of urban atmospheres. Polycyclic aromatic carcinogens constitute an important class of pollutants which are present in soot particles derived from coal combustion. The long term biological effects of these compounds constitutes an important health hazard and it is proposed to study the interaction of these compounds with DNA in aqueous systems. The use of the excited states of the aromatic carcinogens as probes of their microenvironment in DNA complexes (both covalent and non-covalent adducts) is proposed. Of particular interest is the structure of these polycyclic carcinogen-DNA adducts and how they affect the properties of the nucleic acid.
Keywords: dna; air pollution; coal; polycyclic aromatic hydrocarbons; carcinogens; soot; combustion products; biochemical reaction kinetics.

106324 Cooling System Pathogens. Fliermans, C.B. (E.I. Du Pont de Nemours and Co., Savannah River Lab., Aiken, SC). **Project number:** 003186. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the microbial pathogen study in southeastern cooling systems is to determine the impact of fossil and nuclear fueled electrical generating facilities on the population density, distribution, survival, and in situ physiology of a variety of human pathogens in waters downstream from the cooling system. Previous research in a 20-year cooling reservoir, Par Pond, has demonstrated that the survival and growth of specific pathogenic microorganisms are enhanced by cooling system operation. Planned studies will focus on defining the types of microbial pathogens associated with southeastern cooling systems and the adaptation of specific bacterial, fungal and protozoan pathogens to in situ conditions. Studies will include selection of specific study sites, identification of the pathogenic microbial populations and sensitivity of bacterial isolates to selected antibiotics. The study will provide guidance for the proper use of waters associated with power plant cooling systems in the southeast.
Keywords: cooling systems; microorganisms; water pollution; health hazards; population density; survival curves; spatial distribution; physiology; bacteria; fungi; protozoa.

106325 R-Biophysical Chemistry. Klein. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 003274. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This program utilizes a variety of biophysical techniques, including magnetic resonance, optical, x-ray spectroscopy, theoretical modeling, and chemical synthesis to study fundamental processes of membranes, cells, nucleic acids, proteins, and nerves. The results are applicable to problems of solar energy, nitrogen fixation, carcinogenesis, drug-membrane interactions, DNA replication, and damaging effects of pollutants produced from fossil fuel combustion and from nuclear energy production. The storage and utilization of energy by biological systems, together with the nature and changes in information content of such systems, are the principal concerns of this research. Emphasis is placed on: (1) the role of biological structure on the process of energy transduction in photosynthesis; (2) the way in which nucleic acid structure and organization influences its role as a repository and transmitter of cellular information; (3) the role of membranes in energy tranduction; and (4) specific steric requirements related to the action of enzymes and other controlling factors in cellular regulation. This project consists of the following tasks: (1) the pathway of nitrogen and mechanism of nitrogen fixation; (2) the mechanism of water splitting and oxygen evolution in photosynthesis; (3) magnetic resonance spectroscopy; (4) computer based data acquisition and analysis; and (5) structures of nucleic acids.
Keywords: photosynthesis; biophysics; nucleic acids; structural chemical analysis; biological pathways; cell membranes; enzymes; nitrogen fixation; magnetic resonance; data acquisition; data analysis; x-ray spectroscopy.

106326 Hormones and Bone Metabolism. Brand. (Univ. of Rochester, Rochester, NY, 14627). **Project number:** 002872. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Since the early days of research on deposition of radionuclides it has been clear that the skeleton is a major site of accumulation of heavy metals which enter the body. With increasing attention now being given to possible hazards posed by environmental pollutants, of which an important class is the heavy metals, the skeleton must again be considered a focal point for two reasons in particular. First, as a site of deposition and concentration, whole-body retention may be increased and extended in time by skeletal accumulation thus providing a reservoir of a toxic heavy metal and possibly prolonging the exposure of other organ systems by slow release back into the circulation. Secondly, there is the potential of toxicity to the cells of bone exposed to higher local concentrations of these substances. The work in this laboratory has contributed to understanding some of the basic features of ion and substrate transport and protein synthesis in a mixed population of bone cells. Since these cell functions are likely to be sensitive to the introduction of heavy-metal pollutants and if, indeed, these substances have adverse effects at low levels, we can provide a useful experimental model to evaluate the possible hazards to the skeleton.
Keywords: hormones; skeleton; metabolism; metals; biological accumulation; bone cells; biological models; toxicity.

106327 Human Studies of Environmental Pollutants. (Univ. of Rochester, Rochester, NY, 14627). **Project number:** 003134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Clinical studies in humans.

The failure of SO2 per se to meet the epidemiologic and toxicologic requirements for certain air pollution episodes and experimental evaluations led to the view that it was the interactions of SO2 with particulate matter which accounted for its special toxicity. Although this concept has not been disregarded, the observation that oxidant--SO2 mixtures were synergistic, led to the generally held view that particulate sulfates derived from gas-phase reactions involving SO2 were the etiological factors of concern. The two investigative approaches which appear most likely to provide meaningful health effects data are the epidemiologic and the carefully controlled, short-term human studies. In the latter regard, we believe that studies encompassing many hours of exposure are needed in order to assess atmospheric levels between the occupational threshold limit value of 1 mg/cubic m (0.25 ppM as H2SO4) and 0.01 mg/cubic m, the latter being approximately the lowest level to which adverse effects have been associated. Accordingly, we propose to develop an environmental chamber, wherein regular physiologic testing is possible, in order to investigate both normal and asthmatic subjects over exposure periods of days.
Keywords: man; sulfur dioxide; toxicity; air pollution; atmospheric chemistry; epidemiology; asthma; respiratory system diseases.

106328 Social State Radioimmunoassay in Cocarcinogenesis. Kennel, S.J. (Oak Ridge National Lab., Biology Division, Oak Ridge, TN, 37830). **Project number:** 003148. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The focus of this project is the development of solid state radioimmunoassays that will be useful in screening of clones of cells for transformed phenotypes. Altered gene regulation, characteristic of transformation, causes expression of proteins unique to tumor cells. Conventional analysis of cell proteins from individual clones in carcinogen treated cultures is expensive and laborious. Protein quantitation by radioimmunoassay can be automated using solid state secondary antibodies. This automation allows analysis of large numbers of cell clones for proteins associated with transformation, providing quantitation of the frequency of altered gene expresion. Specifically, radioimmunoassays for leukemia virus protein will be used to perfect the solid state technology. Frequencies of viral gene expression will be measured in cell populations treated with chemical carcinogens. Subsequently, assays for plasminogen activator and tumor specific antigens will be used to study transformation of epithelial cultures. The cell system of rat tracheal epithelium shows promise in this study since many tumors from these cell populations bear cross reactive antigens potentially useful for screening purposes. Exploiting advantages for screening clones using solid state radioimmunoassays provides an objective approach to evaluating the involvement of chemical by-products of energy production in altering gene expression.
Keywords: tumor cells; mutagen screening; radioimmunoassay; mutagenesis; biological models; leukemia viruses; carcinogens.

106329 Mechanisms of Action of Heavy Metals and Asbestos on Cultured Animal Cells. Rubin, H. (Univ. of California, Berkeley, CA, 94720). **Project number:** 008251. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to correlate the changes in surface bound and intracellular cation concentrations produced by lead, mercury, cadmium, nickel, and asbestos with changes produced in the rates of cellular metabolism and proliferation. We plan to expose cultured animal cells to toxic and to subtoxic stimulatory levels of these environmental pollutants in the presence and absence of physiologically important cation competitors and cation complexing anions. In order to obtain information regarding the mechanisms of the frequently observed cation antagonisms, various combinations and concentrations of heavy metal cations will be used under varying conditions of medium pH and anion composition. Because of the present great concern for the possible carcinogenicity of the various agents, both acute (up to 2 days) and chronic (weeks) exposures will be studied and comparisons made with control and virally transformed cells. Under all environmental conditions employed, measurements will be made of the rates of intermediary metabolism, macromolecular synthesis, cell proliferation, and levels of membrane bound and intracellular heavy metals, Na+, K+, Mg2+, and Ca2+, and measurements will also be made of intracellular ion distributions in various organelles, and binding of cations to isolated membrane preparations in order to obtain information regarding intracellular compartmentation and membrane cation binding properties.

Keywords: metals; asbestos; animal cells; cell cultures; lead; mercury; cadmium; nickel; cell proliferation; metabolism; toxicity; carcinogenesis; biological models; cations; anions.

106330 Methanol Metabolism: Ecological Effects. Benson, A.A. (Univ. of California, San Diego, CA, 92037). **Project number:** 007451. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This proposal is to study the metabolism of methanol in selected terrestrial and marine plants. The study is on the utilization of methanol, not its production. Comparisons would be of the absolute and relative rates of incorporation of methanol, ethanol, and carbon dioxide, both alone and together. Studies of methanol by yeast and bacteria show that it is incorporated into the C-1 of the sugar allulose-6-phosphate; a similar incorporation will be sought in whole plants, chloroplasts, and plant mitochondria. However, by using techniques such as thin layer chromatography, gas-liquid chromatography, and the combination of gas chromatography with mass spectrometry, it should be possible to detect and characterize new or unexpected products of methanol metabolism.

Keywords: methanol; metabolism; plants; ethanol; carbon dioxide; synergism; yeasts; bacteria; health hazards.

106331 Environmental Damage in Human Lymphocytes. Norman, A. (Univ. of California, Los Angeles, CA, 90032). **Project number:** 006146. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to measure environmental damage in human peripheral blood lymphocytes. For this purpose we have assembled a multiparameter cell sorter that is capable of measuring volume, fluorescence intensity, and fluorescence polarization and sorting cells in accordance with preset values of these parameters. We will investigate the usefulness of the kinetics of fluorescein uptake and leakage, and of fluorescein fluorescence polarization as measures of membrane changes induced by mutagens, specific antigens, and other agents. We propose to continue our studies of DNA damage and repair in lymphocytes using immunological assays, unscheduled DNA synthesis, and chromosome aberrations as measures of damage. We propose to develop methods based on surface membrane features to differentiate and separate lymphocyte subpopulations with the cell sorter.

Keywords: human populations; lymphocytes; fluorescein; biochemical reaction kinetics; uptake; chemical effluents; toxicity.

106332 Flow Systems Development. Van Dilla, M.A. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** 000256. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This project provides flow-systems-technology support to several environmental toxicology programs in the division. Rapid measurement of sperm DNA content and morphology may permit both mutagen screening and monitoring for occupational exposure. However, mammalian sperm are flat and have a high index of refraction, making them difficult to measure accurately in our flow systems, which have orthogonal axes of flow, illumination, and detection. We are exploring epi-illumination and hydrodynamic control of sperm-head orientation to overcome this problem. The other efforts of this project are directed at engineering improvements of the present flow-systems laboratory. Cell-sorting capability has been improved by design of a special sorted-cell-collection chamber for efficient microscopic analysis. In addition, precise control over sorted droplet trajectory has been achieved, and the addition of a high power argon laser has made possible important experiments on chromosomes. Multiporometer-data acquisition and display have been facilitated by improved linkage of flow systems to the Division's MODCOMP computer. Hardware methods of signal ratioing and three-dimensional display of two-parameter-data are being implemented. Stabilization of flow-system operation and high speed operation will be investigated. Improved excitation and fluorescence collection and conversion from hard-wired to computer-based pulse-height analyzers are planned.

Keywords: mutagen screening; spermatozoa; toxicity; dna; bioassay.

106333 Heavy Metal and Noxious Gas Emissions. Robinson. (Battelle Pacific Northwest Labs., Richland, WA, 99352). **Contract:** 003075. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

Although geothermally produced power is considered to be a comparatively clean source of energy, significant releases to the environment of undesirable by-products do occur. The high temperature magmatic processes which create hydrothermal provinces also result in the accumulation of noxious gases and liquids containing high concentrations of heavy metals. During the tapping and utilization of hydrothermal reservoirs for power production, elevated levels of these naturally-produced contaminants can be mobilized to the surrounding environment. Volatile metals, notably Hg, B, As, Sb, Se, and Te, which are associated with hydrothermal mineral deposits, are emitted to the environment during the release of geothermal steam and heated vapors. For example, tens of kilograms of Hg may be released each year to the atmosphere in steam and vapor emanating from a single venting well-head in geothermal areas. These elements, plus others such as Cu, Zn, Cd, Pb, Ag, Ni, Mn, Cr, and F are present at elevated concentrations in thermal waters due in part to increased solubilization of mineral phases by the subterranean, superheated water. Toxic concentrations of a number of these metals exist in some thermal waters. Gaseous contaminants include H2S, radon, ammonia, and carbon dioxide. Measurement of pertinent species at or near geothermal sources will be made in coordinated programs of field experiments to study air and water quality problems at selected geothermal sites, such as The Geysers, CA, and Valles Caldera, NM.

Keywords: metals; geothermal energy; chemical effluents; air pollution; gaseous wastes; metals; mercury; boron; arsenic; antimony; selenium; tellurium; copper; zinc; cadmium; lead; silver; nickel; manganese; chromium; fluorine; thermal pollution; hydrogen sulfides.

106334 Long Term Effects of High LET Radiation. Alpen, E.L. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 000475. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The major goals of the project are to assess the potential chronic adverse effects of exposure of mammalian systems to ionizing radiation of high linear energy transfer (LET). Late functional changes and tumorigenesis of the acute and late effects of heavy ion radiation will be compared with x-rays and beta-rays on skin of the Sprague Dawley rat. Studies on lung enzymes and morphometric evaluation of late fibrotic alterations will be made. Spinal cord injury and associated tumorigenesis will be studied in the rat. Further functional studies will include spermatogenesis effects and the proliferative capacity of the crypt cells of the intestine.

Keywords: let; delayed radiation effects; animals; radiosensitivity; tumor cells; carcinogenesis.

106335 External Radiation Toxicity: Neutron and Gamma-Ray Toxicity Studies. Thompson, J.F. (Argonne National Lab., Div. of Biological and Medical Research, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 000101. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$1,415,000.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The focus of this program is on late effects of neutron and gamma radiation in experimental animals and the assessment of risk. The principal research activities are life-span experiments designed to define the responses to single, fractionated, or duration-of-life exposures to doses of neutron and gamma radiation, measured by

analysis of life tables for cancer and to other non-cancerous diseases. From these dose responses, models can be formulated for prediction of radiation hazards to man, particularly at low radiation doses. **Keywords:** ionizing radiations; delayed radiation effects; low dose irradiation; life span; dose-response relationships; carcinogenesis; risk assessment.

106336 Carcinogenesis: Modulation and Mechanisms. Reilly, C.A. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000102. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$508,000.
Related energy source: Coal(90); nuclear fission(10) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is divided into two segments: Liver co-carcinogenesis or enhancement of chemical carcinogenesis by various compounds which are not necessarily carcinogens will be studied. The experimental approach is to examine the responses of the liver to carcinogenic stimuli and to agents that modulate the carcinogenic effects. Concurrently comparisons are made of the relative effects of those agents on molecular processes concerned with the replication and expression of genetic information. Studies will be conducted on the molecular events of the neoplastic transformation in liver and co-carcinogenic effects of hormones on cancer induction. In the latter case, the study concerns not only the effect of hormones on the incidence of either chemically- or radiation-induced tumors in tissues other than liver, but also the effect on the potential for metastasis. **Keywords:** liver; pollution; carcinogenesis; synergism; dose-response relationships; biological effects; dna replication; carcinogens; oncogenic transformations; biochemical reaction kinetics; hormones; metastases.

106337 Experimental Radiation Pathology and Oncology. Reilly, C.A. (Argonne National Lab., Div. of Biological and Medical Research, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 000103. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$535,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The program goal is to provide basic data for use in evaluating the hazard to man from exposure to ionizing radiation, bone-seeking radionuclides in particular. Three approaches have been used: (1) radionuclides are tested in a number of species in order to obtain dose-response information on life span and tumor incidence in relation to differences in both radiation and animal characteristics; (2) bone-cancer induction is examined when the physical, biological, and temporal parameters of dosage are altered in order to answer questions related to total dose, dose-rate, latent period, and animal sensitivity; and (3) the role of oncogenic viruses in bone-cancer induction by radiation is investigated, an approach that has yielded three murine bone-tumor viruses, two murine reticular-tissue viruses, strong evidence for a human sarcoma agent, and the hypothesis that radiation triggers oncogenesis by activating endogenous viral genetic information. Experiments now receiving special attention are the effects on life span and tumor incidence in beagles exposed to 90SR in different injection schedules and at different ages, and in mice exposed to CP-5 fission neutrons and gamma rays.
Keywords: bone seekers; biological radiation effects; carcinogenesis; dose-response relationships; life span; oncogenic viruses; biological functions; oncogenic transformations; bone tissues.

106338 Mammalian Genetics. Grahn, D. (Argonne National Lab., Div. of Biological and Medical Research, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 000107. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The nuclear fuel cycle for present light water reactors (LWR) and the proposed liquid metal cooled fast breeder reactors (LMFBR) contains significant quantities of plutonium and other alpha-emitting transuranic elements. These radionuclides could be released to the environment in small quantities whence they can be inhaled or ingested by man with the consequence of small burdens subsequently being deposited in the gonads. The potential genetic hazard will be evaluated by appropriate gonadal uptake, retention, and microdistribution studies with monomeric and polymeric solutions of 239Pu given intravenously. Short term genetic evaluation will include examination of the dominant lethal mutation rate, sperm morphology, and testis weight; chromosome loss may also be examined. Radiation quality comparisons will be made with gamma radiation, fission neutrons, and plutonium alpha particles to derive basic RBE values, to examine the proposition that RBE's may increase with decreasing dose of high LET radiation, and to place Pu induced genetic damage into an immediate perspective with that produced by more conventional radiations.
Keywords: plutonium 239; transuranium elements; inhalation; toxicity; inhalation; injection; genetic radiation effects.

106339 Coal Gasification Mutagenic Activity Hydrocarbons. Kubitschek, H.E. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000108. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$285,000.
Related energy source: Coal(40); oil and gas(60) **R and D categories:** Biological effects of pollutants in experimental systems.

Energy-related pollutants produce DNA lesions leading to cell death or mutation. This program is concerned with the production of DNA lesions by environmental agents, their mechanisms of action, and their relationship and interaction with other noxious agents. Studies are carried out with bacteria because well-defined mutant bacterial strains are available for mutational analyses, because these systems have the only complete genetic maps, and because more is known about mutation in these systems than in any other organism. Mammalian cells also are used, because these have mutagen sensitivities that are more similar to those in man. Recent evidence suggests that one of the processes by which DNA lesions are repaired in cells, SOS inducible repair, may be the major mutagenic mechanism and account for the bulk of mutations produced by strong mutagens. This mutational pathway, therefore, is expected to be one of the most hazardous to man. For this reason we plan to examine environmental and energy-related mutagens for their ability to stimulate the SOS repair mutational pathway.
Keywords: coal gasification; dna; cell killing; mutations; bacteria; biological repair; biological pathways; mutagenesis; hydrocarbons.

106340 Radiation Toxicity in Dogs. Fritz, T.E. (Argonne National Lab., Div. of Biological and Medical Research, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 000109. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$1,210,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of these studies is to determine the detailed responses of beagle dogs subjected to continuous (22 hr/day) irradiation from a 60Co gamma-ray source. The effects of three major factors associated with the irradiation procedures are being explored: (a) the daily irradiation dose rate, (b) the accumulated total exposure in radiation, and (c) the influence of age at the time irradiation is initiated on the effects observed. The work compares the responses of young-adult beagles kept in the gamma-ray field until they die with those of similar dogs that have accumulated predetermined total exposures. In addition, the developing beagle fetus is being irradiated continuously throughout its gestation period. Considerable effort has already been directed toward defining the responses at rates ranging from 5 to 35 r/day where there were systematic, consistent, highly dose-rate-dependent, responses limited primarily to the hematopoietic and reproductive organs. Studies most recently initiated are those at lower exposure rates (0.4, 1.0, and 2.5 r/day) where animals will respond more slowly, and others concerned with mechanisms of radiation-induced responses previously defined at higher exposure rates.
Keywords: beagles; biological radiation effects; gamma radiation; cobalt 60; age dependence; dose-response relationships.

106341 Carbon-14 Assays in the Stratosphere. Fields, P.R. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000510. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

Nuclear detonations have greatly increased atmospheric 14C above prebomb cosmic-ray background concentration with > 99% of total 14C in the form of CO2. Measurements of the excess 14C content of CO2 samples collected on molecular sieve material at several altitudes in the stratosphere thus provide NOAA with an ideal tracer for studies of the circulation, mixing, and diffusion of carbon dioxide in the atmosphere. The sieve material is loaded into a separate collection apparatus and carried to altitude on many of the scheduled balloon flights made by the Environmental Measurements Laboratory. On completion of the flight, the sieve material is transferred to canisters and shipped to ANL for separations, purification, and 14C assays. Since the adsorption properties of molecular sieves are considerably different at low pressures and temperatures, we are undertaking a study of the sieve characteristics for other atmospheric constituents (e.g., fluorocarbons and oxides of nitrogen) at simulated collection altitudes. These data will provide a basis for the modification and/or redesign of the CO2 collection apparatus to extend its application to the efficient collection of a number of other important molecular constituents of the stratosphere in a single mission.

Keywords: stratosphere; carbon 14 compounds; tracer techniques; carbon dioxide; ecological concentration; earth atmosphere; nitrogen oxides; organic fluorine compounds.

106342 Environmental Research Park. Edgington, D.N. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000909. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purpose of the program is to develop a National Environmental Research Park (NERP) for the midwest. A NERP is a secure outdoor laboratory where research may be carried out to achieve national environmental goals. Because Argonne has only small land holdings of at best limited ecological interest, it will eventually be necessary to acquire title or long-term access to lands which are representative of important midwestern ecosystems. Sites thus obtained will include experimental areas for manipulative research, and selected impacted and control areas to permit comparisons of stresses and unstressed ecosystems. Since this region borders on the upper Great Lakes and includes many of their watersheds, active consideration is being given to including portions of these critically important freshwater impoundments in the NERP. Concurrently, this program will determine a history of pollutant inputs at other NERP sites by careful characterization of sediment cores taken from representative ponds and lakes.
Keywords: environment; ecosystems; research programs; biological stress; midwest region; fresh water; nature reserves.

106343 Transuranic Elements in Natural Waters. Wahlgren. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 001293. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$115,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this program is to define the physiochemical properties of transuranium elements in natural waters, so that a reliable prediction of their fate and transport may be made if further environmental inputs occur. Combinations of ultrafiltration and ion-exchange technique will be used to determine the chemical speciation of the transuranic elements in the water column. The nature of the complex formation and distribution coefficients relative to various extraction technique will be used to define association of these elements with the different solids in particulates and sediments. It is anticipated that as a result of this research it will be possible to better predict the chemical form, association, transport and fate of transuranic elements released to the environment.
Keywords: plutonium; biogeochemistry; great lakes; radioactivity; physical properties; americium; radionuclide migration; water; transuranium elements; chemical properties.

106344 Coastal and Offshore Siting. Hicks, B.B. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 001294. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$170,000.
Related energy source: Coal(30); oil and gas(20); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to provide the basic information required for the assessment of the impact upon coastal inhabitants of releases to the atmosphere of pollutants from nuclear and fossil fuel power plants located on coastal and off-shore sites, and to develop improved precedures for calculating atmospheric disperison and deposition rates appropriate to marine locations. Experimental investigations of dispersion, using zero-lift balloons are supported by measurements of atmospheric turbulence and statistical studies of the properties of the lower atmosphere. Fluxes of gaseous and particulate pollutants are measured directly by the micrometeorological eddy-correlation technique. The influence of atmospheric stability on disperison coefficients in coastal regimes has been evaluated. Guidelines for estimating the fluxes of airborne pollutants to the Great Lakes have been developed.
Keywords: human populations; health hazards; public health; nuclear power plants; fossil-fuel power plants; offshore sites; environmental transport; radioactivity; chemical effluents; deposition; earth atmosphere; air pollution; stability; forecasting; mathematical models.

106345 Lethality and Repair Mammalian Cells. Elkind, M.M. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 001297. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$110,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Various chemicals and radiations on the one hand constitute environmental pollutants, and on the other are used in the treatment of disease, particularly cancer. Pollutants can give rise to metabolic, teratogenic, mutagenic, and oncogenic changes but in order for each of these end effects to be expressed, cell viability must be maintained. This project is aimed at elucidating the mechanisms whereby mammalian cells are killed in the sense of division suppression. Chemical and radiation effects on cell growth, division, and macromolecular systhesis will be followed, in addition to variations in survival response correlated with the aging of a cell in its growth cycle. Damage-repair processes, expressed at the level of cell function (e.g., survival, growth, metabolic activity, etc.), will be assessed. When two or more cytotoxic agents are used, we will distinguish between independent versus interactive effects and when the latter are observed, between additivity, synergism, and protection. Changes in DNA will be followed by sedimentation and/or column separation techniques, and correlations will be sought between such changes and the demonstrable or putative alterations in cell function. To correlate DNA changes with critical events in the life cycle of a cell, synchronous cell populations will be employed.
Keywords: animal cells; biological repair; chemical effluents; radioactive effluents; metabolism; synergism; biochemical reaction kinetics; biological radiation effects; mutagenesis; biological models; man; hamsters.

106346 Plutonium Behavior in the Miami River Watershed. Larsen, R.P. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 001344. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$300,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this study is to assess the behavior and mobility of plutonium in a watershed that has experienced plutonium deposition over a period of years from a processing facility sited close to the Miami River. This is a field-based aquatic and terrestrial program. Samples of water, soils, sediments and biota will be collected as required and analyzed for their Pu-238/Pu-239 content and for other important parameters necessary for the interpretation of the data. The program will determine the sources and sinks of plutonium in the watershed, examine mechanisms of resuspension and mobility in water and soil, and assess the role of biological uptake and cycling in transport to man via the food chain.
Keywords: plutonium 238; watersheds; deposition; plutonium 239; water; soils; sediments; aquatic ecosystems; terrestrial ecosystems; radionuclide migration; contamination; food chains; distribution; radioactive effluents; plants; uptake; radionuclide kinetics; fuel reprocessing plants.

106347 Atmospheric Effects of Cooling Ponds. Hicks, B.B. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 001450. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$110,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

Significant atmospheric perturbations are caused by the heat and moisture released from industrial cooling ponds. Investigative procedures developed by this Section for the study of air-water interchange of heat, water vapor and momentum have been applied to the particularly demanding case of a relatively small cooling pond, in order to improve methods for predicting the thermal performance characteristics of specific installations. The resulting formulations of exchange processes are now being used in studies of potential atmospheric effects. Methods of predicting steam fog and rime ice have been developed for both daily occurrences and seasonal averages. The effects of a cooling pond on the structure and circulation of the atmosphere downwind have been simulated by the use of a second-moment closure scheme; predictions of the numerical model have been shown to agree qualitatively with observations. To conclude this program this fiscal year, documentation of the research efforts will be completed.
Keywords: air pollution; atmospheric chemistry; cooling ponds; environmental impacts; thermal effluents.

106348 Development of Improved Monitoring Equipment for On-Line Detection and Characterization of Airborne Plutonium Aerosols (AP). Yule, T.J. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 001762. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The primary objective is the development of improved on-line monitors for aerosols containing thorium, uranium and the transuranics. A secondary objective is the development of techniques for determining the characteristics of these aerosols. Im-

proved sensitivity and reliability are achieved by utilizing virtual impactors to separate the small-sized background alpha emitters from the aerosols to be monitored. New techniques are being developed for determining the activity and particle-size distribution of the alpha-emitting aerosols that incorporate the use of solid-state track recorders. A prototype virtual impactor solid-state detector monitor was designed, constructed and tested. As part of the design effort, the aerosol collection characteristics of virtual impactors as a function of arbitrary operating parameters were determined. The monitor was calibrated in the laboratory using test aerosols. Several monitors were built and will be field tested. The development of a dedicated electronics system is in progress. The use of track recorders to determine the amount of fissionable material in individual particles was demonstrated.
Keywords: radioactive aerosols; lungs; plutonium; air pollution monitors; radiation detectors; air pollution; plutonium isotopes; nuclear fuels; fuel cycle; radiation monitoring; particle size; background radiation; particle kinematics; radioecological concentration; specifications; thorium; uranium; transuranium elements; fabrication; operation.

106349 Land Reclamation Program. Carter, R.P. (Argonne National Laboratory, Argonne, IL, 60439). **Project number:** 002199. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$979,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Land Reclamation Program addresses coordinated, applied, and basic research into the physical and ecological problems of land reclamation and rehabilitating mined coal land to productive end uses. The purpose of the program is to conduct research and development projects focused on near- or long-term reclamation problems in all major U.S. coal resource regions, including Alaska, and to coordinate, evaluate, and disseminate the results of related studies conducted at other research institutions. The activities of the Land Reclamation Laboratory program will involve close cooperation with industry and focus on establishing a comprehensive field and laboratory effort. Research demonstration sites are addressed. The research is implemented through close cooperation with related efforts at academic institutions and other agencies. The major effort focuses on the complete coal extraction/reclamation cycle where necessary to develop solutions to ameliorating the environmental impacts of coal development. The activities of the Land Reclamation Laboratory are divided into four key areas: (1) Program Development and Coordination--Identification of Key Problems and Issues, Current Research, and Technology Transfer; (2) Field and Laboratory Research in Problem Areas--Geophysical and Geochemical Studies, Ecosystems Studies; (3) Model Development and Generic Statements; and (4) Data System Development and Economics and Land Use Planning.
Keywords: coal mining; surface mining; land reclamation; research programs; technology transfer; economics; land use; acid mine drainage; dusts; metals; soils; ground water; surface waters; ecosystems; planning.

106350 Molecular Perturbations in Man Produced by Energy Pollutants. Anderson, N.G. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002454. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$576,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The human genome contains an estimated 25,000 structural genes. Separations and analysis systems capable of dealing with this complexity are being developed under the ANL molecular anatomy program and include high resolution zonal centrifuge systems, miniature centrifugal fast analyzers, rapid recycling affinity chromatography, and the iso-dalt two dimensional electrophoresis system, which has a theoretical resolution of approximately 20,000 proteins or protein subunits. The objective is to describe the molecular anatomy of human cells and tissues, to decipher the program of human differentiation, and to determine how cell composition changes during development and disease. In human cancer present evidence suggests derepression of genes normally active in early development. Understanding how this may occur requires a detailed knowledge of the program of human development. Basic questions asked relate to the organization of genomic expression - are genes turned on and off in sets; can we discover the gene products in each set; and is there an obligatory sequence to the expression of sets. Against the background of the information being obtained, the nature of the proteins (gene products) which cells leak into the circulation and into urine in response to injury by energy-related pollutants may be determined and the site of injury determined.
Keywords: energy source development; biological effects; environmental impacts; genetic effects; animal cells; biochemistry.

106351 Analytical Instrument Development for Organic Environmental Contaminants. Cafasso, F.A. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002769. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This program will develop instrumentation for the rapid analysis of organic compounds. Initially, a gas chromatograph/mass spectrometer system will be upgraded beyond current state-of-the-art and automated for rapid sample through-put and data quality. To date, the components have been acquired or designed, interfacing has been initiated, and appropriate laboratory space prepared for installation.
Keywords: air pollution monitors; water pollution monitors; performance testing; organic compounds; monitoring; mass spectrometers; gas chromatography.

106352 Trace Element Cycling Processes. Allen, H.E. (Illinois Institute of Technology, Dept. of Environmental Engineering, Chicago, IL, 60616). **Project number:** 002522. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(25); nuclear fission(75) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This program provides the basic knowledge needed to assess the impact of the biogeochemical transformations of energy-related pollutants in aquatic ecosystems. The Great Lakes provide a unique environment to study because of their large size, the presence of a significant fraction of the population of the U.S. living in their basin, and differing lake morphologies. Specific problems to be evaluated include source terms, long-term build up of pollutants in the water column, chemical speciation, biota- and sediment-water interactions, and eventual fate or removal from the system. Studies of radionuclides, both natural and from nuclear testing, provide information not only to predict the effects of further accidental releases of radioactivity from the nuclear industry, but also on the behavior of other pollutants and the rates of biogeochemical processes. Other studies examine biogeochemical cycling of inorganic and organic pollutants likely to arise from the increased combustion of fossil fuels. Most of the field sampling work is conducted in Lake Michigan, but in order to verify hypotheses and models, studies are conducted in the other lakes when necessary.
Keywords: trace amounts; mineral cycling; great lakes; water pollution; baseline ecology; environmental impacts; environmental transport; biological models.

106353 Oxygen Isotope Ratio Studies of Sulfur Dioxide and Sulfates in the Environment. Cafasso, F.A. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 001749. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$45,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the program is to determine whether oxygen isotopic analysis can be used to differentiate between the competing mechanisms of sulfate formation in the atmosphere. Samples of ambient sulfur dioxide, sulfates, water vapor, and precipitation water are being analyzed for 18-O and 16-O ratios. Given the same reactants, the oxygen isotope ratio in the product sulfate varies, depending upon the mechanism of sulfate formation. Results of the work to date have shown that there is a pronounced seasonal variation in the oxygen isotopy of ambient water vapor, precipitation water, and sulfates dissolved in precipitation water, but not so in the sulfate in the ambient aerosol. The results strongly indicate that the sulfates dissolved in precipitation and the aerosol sulfates are predominantly formed by the same mechanism.
Keywords: oxygen 16; oxygen 18; sulfates; sulfur dioxide; water vapor; atmospheric precipitations; chemical reaction kinetics; isotope ratio; aerosols; earth atmosphere; photochemical reactions.

106354 Tu Cycling of Wind Scale Wastes. Larsen, R.P. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002521. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop an understanding of processes that govern the physical, chemical and biological behavior of plutonium, americium and other transuranic elements under oceanic conditions associated with waste disposal. The water, sediments and biota of the Irish Sea will be sampled and analyzed where the UK discharges wastes from their nuclear fuel reprocessing plant. Initial emphasis is on the characterization of chemical form, molecular weight, charge and oxidation state of the transuranics in the environ-

ment. Subsequently, biogeochemical processes will be studied. It is anticipated that the results of this research will provide a better understanding of the behavior of plutonium and americium in the marine environment.
Keywords: plutonium; americium; transuranium elements; chemical analysis; sampling; seas; sediments; aquatic organisms; contamination; chemical properties; biogeochemistry; fuel reprocessing plants; environmental effects; water pollution; oceanography; radioisotopes; radioactive waste disposal; marine disposal; radioecological concentration.

106355 Effects of Energy Derived Pollutants. Stoner, R.D. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 000009. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Health effects assessments.

This research combines several studies on energy-related effects on immunologic systems. The protection normally conferred on individuals by active immunization with antigens and vaccines and by passive immunization with specific immunoglobulins may be abolished after whole-body exposure to sub-lethal doses of ionizing radiation. A great void exists in the literature concerning the effects of energy derived pollutants on immune reactions in mammals; thus basic studies are needed to explore the biologic effects of exposure to pollutants on immune mechanisms. The objectives of this research are directed to the following seven interdependent areas of immunologic study: (1) alteration of antibody responses induced by agents resulting from the production of nuclear and non-nuclear energy materials, (2) effects of these agents on active and passive anaphylactic shock, (3) alteration of in vitro antigen-antibody reactions, (4) capacity of these agents to combine with normal host proteins to act as haptenes and induce auto-immune responses, (5) effects of pollutants on the incidence and time of onset of lymphocytic leukemia in mice, (6) pollutant effects on the genetic control of antibody responses, and (7) cellular proliferation in regional and peripheral lymphoid tissues during antibody responses to antigen alone and to complexes of antigen and specific antibody.
Keywords: immunology; immunoglobulins; ionizing radiations; animal cells; mice; antigen-antibody reactions; lymphocytes; leukemia; chemical effluents; toxicity.

106356 Radiation Instrument Development. Radeka, V. (Brookhaven National Laboratory, 20 N. Technology Street, Upton, NY, 11973). **Project number:** 000041. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$215,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

This project deals with the development of basic measurement technology in the field of nuclear analytic instrumentation, techniques and methods. Advanced measurement capabilities are investigated in the areas of detection of all types of radiation and subsequent signal processing. Particular emphasis is placed on position-sensitive detectors for charged particles, neutrons, x-rays, and ultraviolet photons. Adequate engineering development is carried out on useful ideas to assure data quality and integrity in applied systems. Investigations are underway in the areas of gas and semiconductor detectors, scintillation counters, photomultipliers and microchannel plate electron multipliers with a view toward developing new position-sensitive detectors and improving the accuracy of energy, timing and position information in all types of detectors. Advanced signal processing is necessary to realize the full performance of all types of detectors. Activity in this area includes research on the physics of noise sources, low noise amplifying devices and the theory of optimum filtering. Readout systems for position-sensitive detectors are again emphasized. Examples of currently active efforts include the following: (a) investigations into dense gas and liquid ionization media in multiwire proportional detectors, and in ionization chambers for position and energy measurements; (b) methods to reduce the processing time of readout systems in large two-dimensional position-sensitive detectors; and (c) research into the avalanche formation process and signal formation in drift and multiwire proportional detectors.
Keywords: neutron detection; x-ray detection; charged particle detection; position sensitive detectors; data processing; signals; noise; readout systems; multiwire proportional chambers; multiwire ionization chambers; drift chambers.

106357 Atmospheric Diagnostics. Newman, L. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 000493. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$295,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

To study the generation, transport, transformation, and removal processes of pollutant species in the atmosphere requires the development of fundamentally new analytical methods as well as implementation of existing methods for measuring the identities and amounts of these pollutants. The Atmospheric Diagnostics program is designed to develop and implement analytical methodologies for studying the chemical and physical properties of airborne gaseous and aerosol constituents and their evolution under the dynamically changing meteorological conditions of the ambient atmosphere. Constituents include gaseous species (sulfur and nitrogen oxides, ozone, ammonia, nitric acid, hydrocarbons) as well as particulate sulfur, nitrogen, and trace-metal compounds classified by particle size. Areas of interest include urban and power-plant plumes and their impact on rural areas, ambient-aerosol composition (as a function of particle size) and its seasonal, diurnal, and regional variability, and vertical pollutant-composition profiles as they affect long-range transport phenomena. The overall goal of this program is to develop and/or implement the best methods for determination of specific atmospheric pollutants using continuous or integrated sampling techniques. Major emphasis is in the analytical methodologies for determination of ambient levels of specific oxygenated sulfur and nitrogen compounds (sulfate, sulfuric acid, nitrate, etc.). These determinations combined with ammonia, strong acid, and size-distribution measurements will lead to better understanding of transformation processes controlling aerosol sulfate and nitrate levels.
Keywords: aerosol monitoring; diffusion; aerosols; physical properties; meteorology; air pollution; measuring methods; particle size; sampling; sulfur dioxide; nitrogen oxides; ozone; iron; vanadium; inorganic acids; organic acids; quantitative chemical analysis; qualitative chemical analysis; earth atmosphere; chemical effluents; ammonia; chemical properties; environmental transport.

106358 Coastal Meteorology. Raynor, G.S. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000547. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$225,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

This study is designed to obtain an understanding of meteorological processes in the coastal region that affect siting, operation, and safety of power-producing and related facilities located either offshore or near a coastline. The study involves climatological investigations, tracer experiments, wake-effects studies, mesoscale and micrometeorological observations, theoretical studies, and modeling programs. A major goal of the program is to develop a reliable system for describing diffusion conditions affecting releases from coastal or offshore sites and to predict them from measurable meteorological and surface parameters such as general synoptic situation, type of flow (sea-breeze or gradient), wind and temperature structure, sea-surface roughness, and coastal terrain. Meeting this goal involves an understanding of conditions in the transition region where over-ocean flow is modified by passage over land as well as over the water. Results of this program will include techniques for the prediction of over-ocean and coastal wind and temperature fields which not only transport and diffuse pollutants but are involved in air-sea interactions and oceanic processes. They will also include a rating of sites along the U.S. East and Gulf coasts in terms of onshore wind frequency, diffusion capacity, and severe weather prevalence.
Keywords: thermal power plants; site selection; shores; meteorology; diffusion; mathematical models; plumes; water; chemical effluents; air pollution; environmental transport.

106359 Oceanographic Data Acquisition and Monitoring System Development. Dimmler, D.G. (Brookhaven National Lab., 20 N. Technology Street, Upton, NY, 11973). **Project number:** 000920. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$112,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

This project is concerned with the development of new methods and techniques in systems for large scale, continuous, automated, real-time remote sensing and monitoring of environmental conditions at many locations dispersed over large geographical areas. Special attention is directed toward: (1) assuring the accuracy of data by development or appropriate data verification techniques and instrumentation for filtering, sampling, integration, and averaging of parameters from sensors; (2) techniques and instrumentation for data communications systems which are suitable for transmission of remotely sensed data from, and commands to, remotely located stations; and (3) application of computer techniques for the purpose of automatic, real-time data acquisition, control of remote equipment and sensors, as well as improved data verification in real-time. Techniques for verification and ordering of collected data in real-time are considered to be of crucial importance to improve on the data credibility as compared with that obtained from existing non-

real-time techniques as well as to reduce the often excessive operating costs associated with traditional manual and semi-automated systems. Real-time, automated remote sensing, data acquisition and monitoring instrumentation systems which satisfy these basic requirements for high quality correlated synoptic data from remotely located stations are essential for large area regional environmental and biological studies related to airborne emission, health and safety monitoring, and physical atmospheric or oceanographic measurements which provide the basis for predictive modeling studies. Essential requirements for such systems are: (1) conservation of power and communication bandwidth for the remote sensing data acquisition and monitoring stations; (2) operation of command-response telemetry; and (3) communication capability between geographically dispersed remote stations and a central command and data acquisition station.
Keywords: oceanography; data acquisition; automation; monitoring; telemetry; communications; ecosystems.

106360 Environmental Park. Hendrey, G. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 000992. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Environmental effects assessment.

Programs relating to the environment have been carried out at Brookhaven National Laboratory (BNL) since its inception thirty years ago. Studies in meteorology, in the movement of surface and ground water, and in terrestrial ecology were instituted to establish base-lines against which potential impacts of BNL could be measured and control strategies developed. This interest in problems of the environment has continued and with the recent development of public concern about effects of energy-related activities. Studies have served as foci for greatly-expanded efforts in the atmospheric, marine, land and freshwater environmental sciences.
Keywords: nature reserves; terrestrial ecosystems; environment; meteorology; surface waters; ground water; environmental impacts; bnl; baseline ecology; energy; aquatic ecosystems; biological models.

106361 Radiation and Chemical Damage. Setlow, R.B. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 001285. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$195,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The responses of cells to the deleterious agents in the environment that arise from nuclear, fossil and synthetic fuel technologies are governed by the fact that DNA is not only the most vulnerable but also the most important cellular target. Thus cellular responses depend on the radiation and chemically induced changes in DNA and how cells cope with these changes. Our goal is to understand the repair systems in a number of different animals, how they mitigate deleterious effects, and if such systems are inhibited by pollutants from fuel technologies. We analyze, at the molecular level, the characteristics of the repair steps that take place both before and after DNA replication in bacteria and mammalian cells. We attempt to correlate biological, enzymological, chemical and physical data on bacterial and various types of mammalian cells so as to identify quantitatively the changes in DNA that have serious biological consequences, and how physical and chemical agents affect the repair systems themselves.
Keywords: dna; biological radiation effects; biological effects; biological repair; coal industry; petroleum industry; natural gas industry; nuclear energy; chemical effluents; animal cells; carcinogenesis.

106362 Coastal Oceanography Ship Charter. Whitledge. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001538. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Research vessels are required for multidisciplinary studies of coastal oceanography at Brookhaven National Laboratory (BNL). This research includes projects on Ecosystems Analysis, Primary Productivity and Utilization, Food Chain Dynamics, Larval Fish, Coastal Transport and Diffusion, and Mid-Atlantic Bight Coordination. The closely associated Coastal Meteorology and Instrumentation Development programs also require vessel support. Vessel requirements are based on the nature, location, and timing of scientific work to be conducted. Shelf and shelf break biological-process cruises involve the investigation of biological, chemical, and physical phenomena and require cooperative effort among scientists representing the several disciplines. The resulting need for a large scientific complement together with a stable oceanographic platform during adverse conditions generally leads to the requirement for one or more large vessels. The well-equipped major vessels of the University National Oceanographic Laboratory System (UNOLS) meet these requirements and have been very effectively utilized. In addition, cooperative use of National Oceanic and Atmospheric Administration (NOAA) vessels has proved to be feasible and advantageous to both agencies.
Keywords: oceanography; aquatic ecosystems; food chains; fishes; environmental transport; meteorology; coastal waters; sampling; ships; water pollution.

106363 Ambient Aerosols Determination. Marlow, W.H. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001814. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$110,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Aerosols are a principal agent by which air pollution has its impact on man, animals, plants, and the atmosphere. Little is known about their origin, evolution (either physical or chemical), atmospheric interactions, or eventual removal processes. The efforts under this program are concerned with the development of both instrumentation for field studies of the atmospheric aerosol and methods for the analysis and interpretation of these measurements. The planning and design of this instrumentation as well as its utilization in field studies is done with the cooperation of other Atmospheric Sciences groups. The analytical work relates to instrumental methods and measurement methods, while the interpretive work draws largely upon fundamental chemical physics.
Keywords: aerosols; particle size; measuring methods; environmental transport; earth atmosphere; measuring instruments; chemical reaction kinetics; diffusion; removal; photochemistry; mathematical models.

106364 Experimental Radiation-Induced and Chemical-Induced. Shellabarger, C.J. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001846. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$260,000.
Related energy source: Coal(70); nuclear fission(30) **R and D categories:** Health effects assessments.

It is commonly stated that 50 to 90 percent of human cancer may be the result of environmental factors and that of this environmental cancer a large portion may be the result of pollutant chemicals from energy production and use. Breast cancer in the human female usually has been ingored as an environmental cancer. There are at least two lines of evidence that support the concept that human breast cancer may be an environmental cancer. First, the increased incidence of breast cancer in Japanese women may be correlated with increasing industrialization and westernization of Japanese life-style. Secondly, chemicals thought to be model compounds for pollutant chemicals and/or chemical pollutants themselves may induce mammary neoplasia (and cancer) in the rat, where the rat mammary tumor system is used as a model for the human breast cancer situation. It is the intent of the present research to study, in a quantitative fashion, the relationship of pollutant chemicals, or model compounds of pollutant chemicals, to mammary neoplasia induction in female rats. The synergistic, additive or inhibitory interaction of these compounds, the effect of route of entry into the body, the influence of hormonal manipulation, and diet will be studied in this model system in an effort to assess the potential impact of energy pollutants upon breast cancer in the human female.
Keywords: carcinogenesis; biological models; chemical effluents; radioactive effluents.

106365 Multi-Spectral, Multi-Pollutant Specific, Simultaneous, Real Time Measurement System. Schwartz, S.E. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001842. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant measurements technology.

The objectives of this program are the development and novel utilization of state-of-the-art spectroscopic techniques that allow for real-time, simultaneous measurement of a variety of atmospheric pollutants resulting from energy production that are present in gaseous, aerosol, and particulate phases such as sulfuric acid, sulfate salts, OH and oxi-organic radicals, NH3, SO2, NO/NOx, O3, and aliphatic and aromatic hydrocarbons. The development and application of real-time instrumentation for in-situ characterization and determination of critical species will dramatically advance understanding of the homogeneous and heterogeneous chemical transformations of these energy-related pollutants as well as their transport. Three spectroscopic systems that would allow for ultrasensitive simultaneous measurement of a number of different pollutants and which require no pre-measurement treatment of the samples are: an intracavity laser Raman system, an opto-acoustic system at CO2 laser wavelengths, and a uv resonance fluorescence. The laser

Raman and opto-acoustic systems are currently being breadboarded. Theoretical calculations and preliminary tests indicate a practical sensitivity limit of 0.1 ppB pollutant concentration for both systems. It is anticipated that laboratory prototype systems will be completed this fiscal period and that sufficient measurements will be taken so that the design criteria for fieldable instruments may be ascertained.
Keywords: ultraviolet radiation; resonance scattering; acoustic monitoring; particles; sulfuric acid; sulfates; ammonia; sulfur dioxide; ozone; hydrocarbons; aromatics; nitrogen oxides; real time systems; air pollution monitors; chemical effluents; aerosols; gaseous wastes; performance testing; monitoring; spectroscopy; raman spectra.

106366 Mid-Atlantic Bight Coordination. Manowitz, C. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 002546. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The DOE-funded oceanographic programs in the northeast include a diverse array of facilities, talents, and research objectives, and are located at geographically-dispersed laboratories and universities. The environments under study range from the open ocean, continental slope and shelf, estuaries, bays, and coastal lagoons to the intertidal zone, with particular strength in the study of estuarine and shelf ecosystems. The expertise and current research of the investigators include physical, chemical, and geological oceanography, several specialities within biological oceanography, and ecosystems analysis, with emphasis on the shelf and estuarine systems. In order to maximize the usable output from these programs, a high degree of coordination and communication among the investigators and with other federally-funded programs in the northeast is desirable. Using three types of meetings as primary mechanisms, Brookhaven National Laboratory (BNL) proposes to encourage better information exchange and liaison among the northeast DOE contractors. These meetings will include: (1) annual program-review meetings among this entire group of contractors; (2) meetings and/or experiments for the intercomparison of methods and instruments; and (3) meetings on single topics of timely nature. Reports from these meetings will be made available to DOE for the periodic reevaluation of program goals, deficiencies, and accomplishments.
Keywords: oceanography; research programs; seas; continental slope; aquatic ecosystems; us doe; information systems; technology transfer; data; communications; baseline ecology; data analysis; systems analysis.

106367 Approach to the Molecular Basis of Teratogenesis. Slater, D.W. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 002557. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: Coal(100) **R and D categories:** Health effects assessments.

The goal of the proposed research is the development of flexible, rapid and economical assay systems for the determination of teratologic risk generated by environmental insult using embryonic material possessing a propensity of meaningful extrapolation to other embryonic forms including human as well as the ability to provide adequate quantities of such material prerequisite to the identification of primary molecular lesions causal to teratogenesis. Teratogenesis is viewed as aberrant genetic expression resulting from the inactivation or derangement of cellular surveillance mechanisms normally operative in monitoring differentiation. Given its pivotal role in cell metabolism, RNA is considered to be the molecular species of choice for use as a sensitive diagnostic probe to assess the molecular etiology of teratogenesis. It is further proposed that the possible contribution of maternal activation and detoxification can be evaluated ex utero. Physiological and phylogenetic considerations as well as explicit characteristics of import for selecting an embryonic system compatible with the envisaged experimental approach are reviewed. Based on these prerequisites the use of two embryonic indicator systems is recommended, namely, sea urchin embryos and clonal lines of embryonal cells derived from mouse teratocarcinomas.
Keywords: teratogenesis; biological models; cell differentiation; rna; animals; plants; mice; aquatic organisms; genetic effects.

106368 Determination of Mutagenic Carbolines Formed on Pyrolysis of Fossil Fuels and a Study of Their Biological Effects. Shaw, E.N.; Lacks, S. (Brookhaven National Lab., Biology Department, Upton, NY, 11973). **Project number:** 001805. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

A new class of mutagens and carcinogens has recently been detected in Japan that originates from the pyrolysis of proteins and is found in charred food products and in smoke. The active materials are different from the currently studied polycyclic hydrocarbons since they contain nitrogen. One group of materials arises from the tryptophane of protein and consists of two classes of carbolines: Type A--mutagenic and carcinogenic; and Type B--non-mutagenic but comutagenic (that is, enhances the mutagenic activity of other mutagens). The presence of additional active, nitrogen-containing materials is indicated by preliminary work. Since fossil fuels are derived from organic material, the presence of these mutagens and carcinogens represents a potential health hazard associated with coal technology that must be evaluated. In particular, these materials may be the basis for the observation that the mutagenicity of unfractionated smoke or tar is considerably greater than can be accounted for by the content of benzpyrene alone. In addition, new waste technology involving the combustion of garbage as a conservation effort may also result in the release of carbolines as a by-product pollutant. The proposed work seeks to provide a method for the determination of carbolines and related nitrogenous products of combustion in several chromatographic systems. Isolated pure carbolines will be assayed for mutagenic and comutagenic activity in the expectation that more detailed information on the health effects due to fossil fuel combustion will be obtained.
Keywords: fossil fuels; pyrolysis; biological effects; combustion products; organic nitrogen compounds; coal; mutagenesis; health hazards; proteins; toxicity.

106369 Cell Damage Metals. Mel, H.C. (University of California, Donner Laboratory, Berkeley, CA, 94720). **Project number:** 000111. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: Coal(90); nuclear fission(10) **R and D categories:** Biological effects of pollutants in experimental systems.

The object of this project is to relate biophysical properties and responses of cellular and cell-membrane systems to their biomedical features (normal and abnormal differentiation and development, and pathology) and to agent responses. Focus is on both single cells and cell populations. Extensive experience has been gained in measurement and interpretation of cell electrical, hydrodynamic, rheological and cytological properties, including development of new methodology, with special emphasis on the processes of hematopoiesis. Individual cells and cell populations are studied by staflo sedimentation (for size, sedimentation rate and density); by microelectrophoresis and staflo electrophoresis (for charge); by resistive pulse spectroscopy (for size, shape, and deformability) by live-cell and dead-cell cytology (for morphology, vital characteristics and staining properties, and by transplantation and culture (for growth properties). Theoretical studies are concerned with modeling evolutionary and stability properties of decision-making networks such as may underlie (stem) cell differentiation.
Keywords: metals; toxicity; blood formation; biochemical reaction kinetics; measuring methods; cytology.

106370 Scanning Electron Microscopy. Hayes, T.L. (Lawrence Berkeley Lab., 108 Donner Lab., Berkeley, CA, 94720). **Project number:** 000226. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The object of this study is to determine the possible lung macrophage cell exposure levels due to the uptake of the very high matrix and minor element concentrations found to exist in specific single fly ash particles. These high single cell exposures will be correlated to possible carcinogenic effects due to transformation in the cell itself or to loss of protective capabilities which depend on the integrity of these cells. Similar studies will be carried out with respect to damage to plant material due to the heterogeneity of elemental distribution among pollutant particles and the resultant elevated single cell exposure to high level single particle element concentrations. An SEM-x-ray system modified for rapid (TV rate) three color element mapping, beam stop and digital scan will be the principal instrument used and test objects will be obtained from lung tissue of experimental animals (mostly rodents) and pelargonium leaf samples exposed to standard fly ash. Potential for single cell damage leading to long term effects such as cancer could be clearly higher when elements are concentrated on a few high level particles rather than being spread uniformly among all particles.
Keywords: scanning electron microscopy; lungs; macrophages; fly ash; carcinogenesis; particles; plants; rats; sample preparation.

106371 Molecular Mechanisms of Cell Effect of Heavy Ions. Tobias, C.A. (Lawrence Berkeley Laboratory, Building 10, Room 202, Berkeley, CA, 94720). **Project number:** 000305. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$155,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The biological effects of heavy charged particle radiation are being evaluated at the cellular and molecular levels. Basic radiobiological parameters such as relative biological effectiveness (RBE)

and oxygen enhancement ratio (OER) are being determined for densely ionizing radiation using a variety of cultured mammalian cell lines, including human kidney cells and mouse and hamster fibroblasts. During the 1970's, suitable accelerator facilities have been vailable to allow these studies to be carried out with charged articles having atomic numbers in the range Z = 1 to Z = 36, and nergies ranging from 4 MeV/N to 2.8 GeV/N. Areas of research under active investigation include the following: cellular studies are being made on the oxygen effect, repair of radiation damage, heavy-ion microscopy of irradiated cells, the neural membrane response to heavy-ion beams, the effects of chemical modifiers (including radioprotectors and hypoxic cell sensitizers), and radiation enhancement of viral transformation; molecular studies relate radiation-induced DNA strand breakage to cell lethality.
Keywords: carcinogenesis; biological models; oxygen enhancement ratio; animal cells; man; mice; hamsters; fibroblasts; kidneys; radiation injuries; biological repair; radioprotective substances; radiosensitivity effects; dna; strand breaks; cell cultures; heavy ions; ion beams.

106372 Metabolism of Tranuranic Elements. Durbin, P.W. (Lawrence Berkeley Laboratory, Division of Biology and Medicine, Berkeley, CA, 94720). **Project number:** 000314. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$115,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Safety standards for internally deposited radionuclides are based on the best available radiation dose-biological response relationships and an appropriate metabolic model from which radiation doses to tissues are calculated. In order to improve the metabolic models now used to set permissible intakes the absorption, tissue deposition, and excretion of 90Sr, Am, and Pu are being studied in macacca, a genus of old world monkeys. A total of 29 rhesus monkeys (M. mulatta) were injected with 90Sr and observed for 1 yr or longer. Excreta and blood samples are analyzed periodically from 8 monkeys injected from 10 to 18 years ago. Five adult macaques (one each male and female M. mulatta and M. fasicularis and one female M. arctoides) were injected with 0.3mu ci/kg of 238Pu(IV) citrate and sacrificed at 1 wk. Analyses of gross and microscopic tissue distributions are underway. Comparable groups of monkeys will be injected with 238Pu and followed for 1.5 or 5 yr. Three adult New Zealand rabbits were injected with a mixture of 237Pu and 238Pu whole-body counting of the 100 keV gamma rays of 237Pu and collection and analysis of blood and excreta are being used to study the early behavior of Pu in this herbivorous animal.
Keywords: transuranium elements; metabolism; radionuclide kinetics; macacus; americium 241; plutonium 237; strontium 90; plutonium 239.

106373 Detector Materials, Detectors, Instruments. Goulding, F.S. (Lawrence Berkeley Laboratory, Department of Instrument Techniques, 1 Cyclotron Road, Building 29, Room 101, Berkeley, CA, 94720). **Project number:** 000708. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$171,000.
Related energy source: nuclear fission(50); nuclear fusion(50) **R and D categories:** Pollutant measurements technology.

The project objective is to develop both the basic technology of radiation detectors and materials and the associated measurement techniques required for a broad range of radiation measurements. The methods employed are: (1) research and development in purification and crystal growth of germanium; (2) basic research of impurities, point and line defects in germanium; (3) development of new detector geometries, contacts, and protective surface coatings; and (4) development of new types of detectors for environmental measurements. The results expected are: (1) reliable techniques leading to a guaranteed supply of high-purity germanium from industry; and (2) new environmental contaminant detectors increased radiation resistance of detector materials. The results obtained to date are: (1) successful development of zone-refinement/purification and crystal growth of high-purity germanium; (2) analysis of all residual impurities and their sources; and (3) development of a large number of detector systems for medical and environmental measurements involving x- and gamma-rays and charged particles.
Keywords: performance testing; design; fabrication; high-purity ge detectors.

106374 Development of Physical Methods Trace Contaminants. Leskovar, B. (University of California, Lawrence Berkeley Laboratory, Department of Instrument Techniques, 1 Cyclotron Road, Building 29, Room 101, Berkeley, CA, 94720). **Project number:** 001307. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: Coal(40); oil and gas(40); oil shale(20) **R and D categories:** Pollutant measurements technology.

The objectives of this project are: (1) to develop new techniques for the measurements of gaseous trace contaminants; (2) to develop complete instruments using these techniques in order to make them available to the scientific community; and (3) to cooperate with environment or health programs which apply the instruments. The techniques are investigated and developed by teams of physicists, chemists, and engineers who are expert in the fields of physical and chemical processes. The developments are then designed into complete instruments by engineering teams. The techniques are selected for development on the basis of their potential for solving problems in monitoring environmental or health hazards. This technique supplements gas chromatography, mass spectroscopy, and various laser methods in the identification and/or monitoring of trace-gas pollutants in the atmosphere. It makes possible fast, highly specific, and sensitive measurements in the laboratory and ultimately in the field.
Keywords: air pollution monitors; design; air pollution; measuring methods; engineering; gaseous wastes; trace amounts; earth atmosphere; computers.

106375 Physical Methods of Analysis. Jaklevic, J.M. (Lawrence Berkeley Laboratory, No. 1 Cyclotron Road, Building 29, Room 101, Berkeley, CA, 94720). **Project number:** 001308. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$210,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objectives of this program are to develop and apply physical methods to the measurement of environment pollutants likely to cause health and other deleterious effects. Physical methods offer much greater potential for large-scale high-speed detection and analysis. The program is based initially on the application of x-ray methods to elemental analysis. In addition to the development of energy dispersive techniques for elemental analysis, the application of powder diffraction and high resolution emission spectroscopic methods for chemical characterization have been studied. The use of extended x-ray absorption spectra for the characterization of atmospheric aerosols has been demonstrated and will be used to study chemical transformations of atmospheric aerosols. The programs in air sampling methods and x-ray absorption fine structure are by now well established and will continue to be areas of fruitful research. At least two new experiments are proposed as a part of a synchrotron radiation program and will be carried out as accelerator time is available over the next several months.
Keywords: aerosols; x-ray fluorescence analysis; air pollution; emission spectroscopy; powders; diffraction methods; monitoring; particles.

106376 Tritium in Mammalian Cells. Burki, H.J. (Lawrence Berkeley Laboratory, 365 Donner Laboratory, Berkeley, CA, 94720). **Project number:** 001447. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

One major objective of this study is to gain information on the basic mechanisms which lead to the inactivation or the mutagenesis of several types of mammalian cells including normal and transformed human cells in vitro. The other major objective is to provide a quantitative framework for evaluating the hazardous effects of tritium disintegrations and related types of DNA damaging agents in different parts of the mammalian nucleus. During this grant period our goals were: to study the effects of 3H, 14C, and 125I decays in synchronous Chinese hamster cells; to study chromosomal aberrations and other chromosomal effects of these and other agents such as BUDR; to observe the effects of storage conditions and toxicity effects on the toxicity of tritium decay; and to start general tritium mutagenesis studies in yeast and mammalian cells. These investigations make use of the method of molecular suicide which offers a quite novel fashion of testing the effects of the agents above especially tritium in the DNA. The results provide a conservative framework to estimate the risks to human populations from environmental tritium, a by product of fission and proposed fusion power generation.
Keywords: animal cells; tritium; mutagenesis; biological models; man; hamsters; yeasts; toxicity; chromosomal aberrations; budr.

106377 Survey of Environmental Instrumentation. Hunt, M.S. (University of California, Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 001598. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$147,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(10); geothermal(10) **R and D categories:** Pollutant measurements technology.

Concurrent with our need to develop new energy technologies and optimize existing conversion processes has been the under-

standing that it is essential to analyze and control the effect of these developments on our environment. To adequately characterize these pollutants and their impacts, highly sophisticated techniques and instruments have been developed. To aid monitoring and analytical laboratories in choosing among the techniques and instruments available for measuring and characterizing the pollution associated with energy related processes and their effects, a survey of instruments used for analysis and monitoring of environmental pollutants was undertaken. Instrumental methods included are those which analyze air and water quality, radioactive emissions and biomedical impacts. The results of the Survey of Instrumentation for Environmental Monitoring are currently in four volumes in six (soon to be seven) loose leaf binders, with more than 5000 copies in circulation. Included in the discussion of each type of pollutant is material describing the forms, sources, effects, and methods of controlling the contaminant and then detailed descriptions of the instrumental techniques for determining its presence and concentration. Information regarding the instrumental techniques includes descriptions of physical and operating techniques of commercially available instruments, comparisons among the currently accepted instrumentation and recommedations concerning developing techniques and instruments.
Keywords: monitoring; water pollution; land pollution; air pollution; air quality; water quality; radiation monitoring; chemical analysis; measuring methods; measuring instruments.

106378 Effects of Pollutants on Somatic Mammalian Cells. Glaser, D.A. (University of California, Department of Molecular Biology, 229 Stanley Hall, Berkeley, CA, 94720). **Project number:** 001860. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$158,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The overall aim of this work will be to detect and characterize quantitatively the carcinogenic, mutagenic and physiologically toxic effects of environmental pollutants on animal cells in tissue culture. At first this is a program for screening the effects of a number of putative deleterious agents including heavy metals, gaseous pollutants and environmental contaminants found in the liquid and solid form. By virtue or our present technological ability to examine millions of independent clones of cells and to measure their response to putative deleterious agents, it should be possible to identify agents that pose a health hazard and at what level of exposure the hazard is first detectable. In the next phase the mechanism by which the cells are damaged will be explored, to establish whether the changes are genetic, physiological through simple toxicity, or through more-or-less stable perturbation of some regulatory system. As the program develops we will probably focus on particular pollutants and try to understand the mechanism of damage in order to be able to propose methods for avoiding the danger and to design effective whole animal experiments to evaluate acceptable levels of contamination if no form of treatment is plausible.
Keywords: animal cells; somatic cells; somatic mutations; metals; toxicity; gaseous wastes; chemical effluents; health hazards; biochemical reaction kinetics; mutagenesis; biological models.

106379 Biological Effects of Magnetic Fields. Tenforde, T.S. (Lawrence Berkeley Laboratory, 1 Cyclotron Road, Building 74, Room 344, Berkeley, CA, 94720). **Project number:** 002189. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$405,000.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

A systematic investigation is being carried out to determine the effects of stationary and alternating magnetic fields on living organisms and man. The major goal of this project is to assess the biological effects of exposure to magnetic fields such as those associated with controlled thermonuclear reactors (CTR) and magnetohydrodynamic systems (MHD) and to acquire quantitative data leading to the establishment of exposure guidelines for CTR and MHD workers and the populace-at-large. The major areas of research within this project include the following: (1) physiological parameters will be measured in experimental animals exposed to magnetic fields, including food intake, urine and fecal discharge, body weight and temperature, respiration, climbing activity, blood and urine composition, plasma growth hormone and corticosterone, visual function and cellular mitotic activity; (2) using a variety of cell culture lines, magnetic field effects on cell growth rate, differentiation, cytokinesis, retinal photoreceptor, electrophysiology, neural regeneration, and the electron transport system will be investigated; (3) magnetic effects on plant cells will be examined by measuring the growth and geotropic response of phycomyces and by measuring the protoplasmic streaming and membrane excitability in nitella; and (4) the influence of magnetic fields on human subjects will be investigated, including effects on the visual system, psychomotor activities, hematopoietic system, endocrine system, and nervous system.
Keywords: magnetic fields; biological effects; magnetohydrodynamics; animal cells; man; thermonuclear power plants; in vivo; in vitro; human populations; dosimetry.

106380 Magnetic Field Dosimetry. Amer, N.M. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 002935. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant measurements technology.

The purpose of this program is to develop a sensitive (fraction of a Gauss) and simple dosimetry technique for occupational exposures to magnetic fields in fusion plants. Our approach will involve the use of ferro-nematic 1 and ferro cholesteric 2 liquid crystals. The physics behind the proposed device is that incorporating non-spherical magnetic grains into the liquid crystal matrix allows the nematic and cholesteric molecular orientation to be coupled to a very weak external magnetic field. The coupling, which is mechanical in nature, is due to the elastic properties of the liquid-crystalline phase. This coupling is what we propose to exploit as the basis for our magnetic dosimeter.
Keywords: thermonuclear power plants; magnetic fields; hazards; monitoring; safety; personnel; dosemeters.

106381 Laser Optoacoustic Spectrometer for CO Detection. Amer, N.M. (Lawrence Berkeley Lab., Building 70, Room 128, Berkeley, CA, 94720). **Project number:** 004037. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$138,000.
Related energy source: Coal(20); oil and gas(60); oil shale(20) **R and D categories:** Pollutant measurements technology.

The purpose of this program is to develop and investigate laser optoacoustic spectroscopy and to develop an ultra-sensitive multiparameter molecular detector for the characterization of trace contaminants, from energy technologies, at the part per billion level. Laser optoacoustic spectroscopy is a refined version of infrared absorption spectroscopy that can be used to measure the concentration of any gas. The only requirement is that the spectral output of the laser light source match one of the absorption bands of the gas to be detected. The laser light is then absorbed by the sample; the sample is thereby heated. By modulating the laser beam, the temperature changes of the sample will cause a time dependent fluctuation of pressure. This can be detected with a microphone placed in the sample cell. The signal from the microphone is then processed to determine the magnitude of the absorption. The techniques we are developing enable the detection of ultra-low concentrations (1 part per billion or better) even in the presence of large concentrations of other constituents. The required sample volume is in the order of a few cubic centimeters, and the measurement time is of the order of seconds.
Keywords: laser spectroscopy; photoacoustic spectrometers; infrared spectrometers; gases; quantity ratio; design; gas analysis.

106382 Radiosensitivity of Oocytes. Dobson, R.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** 000252. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$225,000.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This research, using mainly the mouse and monkey, is directed at (1) identifying effects of very low exposures to tritium (and to other radionuclides and external radiation) during embryonic, fetal, and postnatal development, the most vulnerable parts of the life cycle, and (2) quantifying these effects in sensitive cell populations in terms of residual cell numbers and functions, thus obtaining data necessary for critical comparisons at low-level exposure where hazard evaluation is most needed. Focus is on tritium because of its importance as fuel for nuclear fusion, byproduct of nuclear fission, and environmental contaminant. (In water it has ready access to living systems, passing freely from mother to developing offspring, irradiating, and being incorporated into growing cells). Main attention is on oocytes and neuroblasts because both are highly radiosensitive during development and cell numbers are set by birth or shortly thereafter. Priority is presently placed on dose-response determinations for oocyte destruction in monkeys following chronic low-level 3-HOH exposure. Expected results are: (1) determination of lowest exposure levels significantly affecting important cell populations, (2) measurement of quantitative dose effect relations, and (3) determination of relative effectiveness and related data required at low exposures for reliable hazard evaluations and safety standards.
Keywords: oocytes; radiosensitivity; mice; monkeys; tritium; low dose irradiation; perinatal irradiation; toxicity; biological radiation effects.

106383 Coal Liquefaction-Chromosome Aberrations. Carrano, A.V. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452,

Livermore, CA, 94550). **Project number:** 000273. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$298,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This program will investigate chromosome damage induced in vivo and in vitro following exposure to effluents from coal-conversion technologies. The objective is the valid comparison of cytogenetic damage among species and among tissues within a species and eventual extrapolation from animals to man. Cytogenetic damage will be assessed following acute insult and during protracted chemical exposure. An in vivo rabbit model is being developed that allows assessment of injury in the peripheral blood, bone marrow, and testes of the exposed animals, and through breeding, in the F-1 generation. Cells are analyzed for sister chromatid exchanges, unstable chromosomal aberrations, and the stable heritable aberrations. Cell-culture systems are utilized to clarify mechanisms of lesion production, their specificity of induction, and functional significance. Extrapolations from the model systems to man will be made as relevant human data become available.
Keywords: chromosomal aberrations; coal liquefaction; in vivo; in vitro; biological effects; rabbits; blood; bone marrow; testes; sister chromatid exchanges; cell cultures; gaseous wastes; chemical effluents.

106384 ***Transuranic Marine Studies.*** Noshkin, V.E. (Lawrence Livermore Lab., P.O. Box 808, L-233, Livermore, CA, 94550). **Project number:** 000934. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

This is a continuing study on the distribution of 90Sr, 137Cs, 238Pu, 239Pu, 240Pu, and 241Am in GEOSECS oceanic water columns. Each of these radionuclides has been introduced to the oceans as a result of atmospheric tests of nuclear explosives. In addition to providing baseline data on the concentrations and distributions of these long-lived radiotoxic pollutants in the world's oceans, the radionuclides are valuable tracers for oceanic water movement, for estimating the flux of particulate material, for assessing the sedimentation and removal rates of chemical analogs, and for revealing the net fluxes of atmospherically delivered pollutants to the sea surface. We emphasize plutonium analyses because of our ongoing efforts and interests in the geochemical behavior of this element in other aquatic environments. One additional purpose of this study, therefore, is to ascertain how far one can extrapolate the behavior of fallout plutonium in the world's oceans to other sites, such as coastal or off-shore reactor sites or the Marshall Islands which receive plutonium inputs from other sources.
Keywords: transuranium elements; biological radiation effects; aquatic ecosystems; strontium 90; cesium 137; plutonium 238; plutonium 239; plutonium 240; americium 241; radionuclide migration; oceanography; fallout.

106385 **Emissions - Advanced Combustion.** Ondov, J.M. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** 000937. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$325,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of the program is to determine the physical and chemical properties and atmospheric transformations of emissions from advanced and conventional coal combustion systems used for electric power generation. Pollutants studied include minor and trace elements, sulfur species, radionuclides and trace organic compounds. Atmospheric transport and inhalation—lung deposition models are applied to the empirical data to compare dose impacts of combustion--control system alternatives. The approach is to carry out in situ particle--sizing and collection using in-stack and airborne downwind cascade impactors in conjunction with instrumental aerosol measurement systems. Gases are collected using in-stack and airborne traps. The particles and gases are analyzed for bulk trace element using neutron activation analysis, x-ray fluorescence analysis, and atomic absorption. Particle sizes are determined by electron microscopy. Chemical speciation of sulfur is done by ESCA and chemical techniques. Organic analyses are done by gas chromatography and mass spectrometry techniques.
Keywords: fossil-fuel power plants; air pollution; environmental transport; aerosols; particle size; gaseous wastes; trace amounts; elements; physical properties; chemical properties; sulfur; air pollution control; pollution control equipment; organic compounds; radioisotopes.

106386 **Regional Atmospheric Modeling.** Gresho. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** 000939. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$220,000.
Related energy source: Coal(60); nuclear fission(40) **R and D categories:** Environmental effects assessment.

The objectives are to develop a three-dimensional time dependent atmospheric boundary layer numerical simulation model(s) and to develop a three-dimensional time-dependent reactive plume model for the study of large point sources of reactive pollutants and their effect on the surrounding environment. The boundary layer model(s) will be used to investigate atmospheric behavior on a scale of 40,000 to 90,000 sq km Studies of various numerical techniques are done first with one- and two-dimensional models to ascertain an appropriate numerical method for solving the system of equations. Then further studies are performed using one- and two-dimensional problems that contain more relevant physics. After the model(s) are verified against analytical solutions for certain closed problems, realistic verification studies are conducted using measured atmospheric parameters.
Keywords: earth atmosphere; boundary layers; mathematical models; plumes; point pollutant sources; air pollution; environmental effects; monitoring.

106387 **Atmospheric Release Advisory Capability.** Dickerson, M.H. (Lawrence Livermore Lab., P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** 000940. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$635,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the ARAC service is to provide real time predictions of the effects of atmospheric releases of hazardous materials as rapidly and accurately as possible. When implemented, the ARAC would provide advisories to support DOE and designated sites in handling routine and accidental releases. The technical basis for ARAC includes the present state-of-art of technology (sensing, monitoring, communications, data banking, data quality control), the utilization of existing or recently developed and validated atmospheric transport diffusion models, the use of evaluated dose conversion constants for various modes of exposure, and the availability of an advanced computer center.
Keywords: air pollution; monitoring; data; diffusion; forecasting; environmental effects; earth atmosphere; computer codes; radionuclide migration; environmental transport; technology assessment; aerosol monitoring; radioactive aerosols.

106388 **Radionuclides in Coastal Environment.** Noshkin, V.E. (Lawrence Livermore Lab., P.O. Box 808, L-233, Livermore, CA, 94550). **Project number:** 001309. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$250,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This investigation provides a basis for characterizing the rates and mechanisms of the various physical, chemical and biological processes that control the behavior of nuclear-related pollutants in the coastal environment. Marine samples including water, sediment and biota are collected from specific environments and analyzed for radionuclides by a variety of radiochemical techniques. Transuranics are included among the radionuclides investigated.
Keywords: coastal regions; radioisotopes; transuranium elements; pollution; seawater; sediments; aquatic organisms; contamination; environmental effects; aquatic ecosystems; radioactive effluents; radionuclide migration; plutonium.

106389 ***Marshall Islands - Transuranics.*** Noshkin, V.E. (Lawrence Livermore Lab., P.O. Box 808, L-233, Livermore, CA, 94550). **Project number:** 001508. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$350,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this study are (1) to develop recommendations to minimize the passage of radionuclides (emphasizing the transuranium elements) to human populations; (2) to evaluate the cycling of radionuclides through critical processes essential for the establishment and continuity of life at the atolls; (3) to provide a fundamental base of data from these contaminated environments which will be useful in predicting future transuranic impacts on the aquatic environment from different global sources such as reactors, reprocessing facilities and accidents; (4) to provide data and recommendations to assist cleanup and reconstruction at the atolls; and (5) to recommend and assist in providing usable resources of ground water for future generations of the atoll. Ground water and marine samples are collected and radiochemically analyzed for the transuranics and other specific radionuclides. The data are used to construct models of radionuclide fluxes and transport mechanisms in the environment.

Keywords: biogeochemistry; transuranium elements; radioisotopes; marshall islands; recommendations; human populations; radionuclide migration; data acquisition; ground water; seawater; contamination; functional models; environmental effects; aquatic ecosystems; fishes; plutonium.

106390 Pollutant Effects on Marine Organisms. Harrison, F.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** 001511. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The two classes of pollutants considered are (1) potentially toxic trace metals and (2) radionuclides. For both classes, we are investigating with radiotracer techniques some of the reactions that change physico-chemical properties of pollutants and, in turn, their availability to the biota and their residence time in the water column and bottom sediments. The properties include (a) the chemical species or form, (b) the relative size of complexes formed, (c) the binding to known organic molecules, and (d) the affinity to particles. Our results indicate that the physico-chemical properties can be affected drastically by the presence of dissolved organic matter (aquatic humus). We have been investigating under controlled laboratory conditions the effects of some potentially toxic metals on important organisms indigenous to open coastal areas and selected bays in California. Our results to date with copper indicate that there are large differences in sensitivity with species (abalone, herring, anchovy, mussels) and for a particular species, the sensitivity varies with the stage (embryo, larvae, adult), the size, and the temperature of the water.
Keywords: aquatic organisms; radioisotopes; metals; tracer techniques; toxicity; invertebrates; vertebrates; california.

106391 Marshall Island Radioecology. Robison, W.L. (Lawrence Livermore Lab., P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** 001676. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$765,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

A program of radionuclide measurements in soil, water and biota, radioecological transport modeling, and dose evaluation in the Marshall Islands is designed to fulfill the immediate objectives of (1) meeting present high priority needs for effective rehabilitation of Enewetak Atoll, and (2) supporting the ongoing evaluation at Bikini Atoll. The long-term goals are to identify the key parameters affecting dose to man, to determine the residence time of key radionuclides in the atoll environment, and to provide information required for implementation of resettlement and rehabilitation in both regions. Our program has the following specific objectives: (1) to make measurements that will delineate the rates of uptake, redistribution, and removal of radionuclides in the ecosystem, and to develop or refine the concentration factors for the critical radionuclides, especially for food species; and (2) to develop further understanding of the cycling of radionuclides in the terrestrial foodchains so as to derive guidelines for agricultural practices and agricultural development such that population exposure via terrestrial foods will be minimized.
Keywords: distribution; food; human populations; radiation doses; contamination; soils; water; biological models; dosimetry; radionuclide migration; data; plutonium; environmental impacts; terrestrial ecosystems; biological repair; marshall islands; radioecology; radioisotopes; uptake.

106392 IVEP: Air Quality. Gudiksen, P. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** 002347. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$580,000.
Related energy source: geothermal(100) **R and D categories:** Environmental effects assessment.

One of the potentially important impacts of large-scale development of geothermal resources within the Imperial Valley is degradation of air quality. Nearly all geothermal and development schemes will release noncondensable gases to the atmosphere. The principal constituent of the noncondensable fraction is CO2, but lesser amounts of H2S, H2, CH4, NH3, N2, and Rn are generally present as well. Some of these gases may undergo reactions in the atmosphere; the most notable is the conversion of H2S to SO2 with subsequent possible transformation to H2SO4. To assess this impact, the objectives of the IVEP air quality project are to (1) measure current ambient concentrations of H2S, SO2, O3, CO2 and particulates through the Imperial Valley, (2) measure rate of emissions from the various known geothermal wells, (3) evaluate contributions from other sources such as field lots, fertilizer plants, (4) characterize atmospheric transport properties on a valley-wide base, and (5) develop atmospheric transport models to predict the impact on air quality in the Imperial Valley from geothermal power plants.
Keywords: imperial valley; air quality; geothermal energy; environmental impacts.

106393 Toxicology of Coal Gasification. Hatch, F.T. (Lawrence Livermore Laboratory, Livermore, CA, 94550). **Project number:** 002631. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$138,000.
Related energy source: Coal(100) **R and D categories:** Health effects assessments.

This program establishes an integrated program at Lawrence Livermore Laboratory (LLL) for linkage of a broad-based set of bioassays for potentially toxic constituents directly to the testing of energy effluents from in situ coal gasification and from oil shale retorting development processes. Effluents to be sampled include: ground water, underground tars, product gas condensate, crude oil fractions. Constituents will be chemically fractionated into organic and water-soluble acids, bases, and neutral classes of constituents. Acute toxic effects of the fractions on the assay systems may interfere with detection of genetic injury or other cellular damage. Evaluation and control measures (e.g., dilution) will be applied to cope with these effects. The initial bioassay set consists of: (1) measurement of induced mutation frequencies at multiple drug-resistance loci in cultured mammalian cells and in primary embryonic cells, (2) assays for sister chromatid exchange and chromosomal aberrations, (3) in vivo assays for damage to male and female mammalian germ cells, (4) the induction of lambda bacteriophage in e. coli for revealing the induction of a form of DNA repair that is itself mutagenic, and (5) the widely used Ames salmonella test for reversion of special histidine mutants.
Keywords: in-situ gasification; ground water; tar; gaseous wastes; toxicity; fractionation; bioassay; animal cells; cell cultures; mutation frequency; chromosomal aberrations; in vivo; germ cells; dna; biological repair; mutagen screening; in-situ retorting.

106394 Modeling Climatic Effects of CO2 Increase. Knox, J.B. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** 003028. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The potential for increased atmospheric concentration of carbon dioxide from continued and possibly expanded use of fossil fuels is currently the single most important environmental question facing mankind. It is imperative to reduce the ranges of uncertainty in our ability to predict the amount of carbon dioxide retained in the atmosphere and the effects of increased atmospheric concentrations on our global environment and climate. To assist the DOE Carbon Dioxide Effects Research Program, LLL proposes to use its zonal atmospheric model (ZAM2) and a simplified one-dimensional climate/carbon-reservoir model to study the global climate response to increased atmospheric CO2 concentrations. Although previous studies have shown that the surface temperature will increase, the intent here is to narrow the range of uncertainty by including the effects on the global climate of the hydrologic balance, the verticle structure of the atmosphere, and meridional transport. The LLL family of radioactive and kinetics models will then be used to improve the understanding of long and shortwave radiation with regard to varying atmospheric composition, and to evaluate the temperature feedback effect of increased atmospheric CO2 on stratospheric ozone.
Keywords: carbon dioxide; monitoring; air pollution; climates; earth planet; environmental transport; environmental impacts.

106395 Tumorigenic Risk from Particles in the Lung. Peterson. (Los Alamos Scientific Lab., MS 880, Los Alamos, NM, 87545). **Project number:** 000120. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$750,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The most probable hazard from increased use of plutonium and other transuranium elements is by inhalation of relatively insoluble particles, resulting in nonuniform irradiation of the lung. This project studies such hot-particle effects by a combination of animal experimentation and theoretical modeling using a unique microsphere exposure method which gives controllable dose-distribution patterns in the lung. Zirconium oxide ceramic microspheres with a uniform diameter of 10 micrometer are loaded with the type emitter desired (alpha,beta). Spheres are injected into the jugular vein of each animal and are lodged in the lung capillary bed, providing a stable field of irradiation foci. Varying the number of spheres and type of emitter enables irradiating $< 1\%$ to approximately 100% of the total lung tissue. Histopathological studies on animals that die are directed toward early identification of damage. One objective of this study is to measure directly the relative effectiveness of local and

diffuse irradiation for the production of radiation damage, especially cancers. Another objective is the identification of specific biological mechanisms involved to permit a more realistic modeling of the problems and to increase the credibility of inevitable extrapolations involved in hazards prediction. Localized hot particles containing plutonium-238 and -239, over a large range of specific activities, have shown little tumor incidence when low numbers were injected (< 10,000/animal). There is an apparent increase, however, when larger numbers are used, but these data are statistically uncertain at present. When the entire mass of lung is irradiated using spheres containing promethium-147, there is a significant increase. This difference in tumor induction between diffuse and localized irradiation will continue to be studied on a more mechanistic basis.
Keywords: lungs; radiosensitivity; physiology; alpha particles; beta particles; plutonium 238; microspheres; particle size; neoplasms; radioinduction; plutonium 239; in vivo; promethium 147; toxicity; inhalation; carcinogenesis; biological models.

106396 Photo-Adducts of Carcinogens with Model DNA. Hoard, D.E. (Los Alamos Scientific Laboratory, Group H-9, MS 886, Los Alamos, NM, 87545). **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: oil shale(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The object of this work is to determine if compounds present in the products of oil shale processing react with DNA after metabolic activation or after exposure to near-ultraviolet light and to determine if the products of such reactions are substrates for repair enzymes. We are interested in several aspects of this subject including which metabolic intermediates react with DNA, what sites on DNA are attacked, what the nature of the chemical reaction is, whether all DNA regions are equally susceptible, what the effects of such interactions are on template properties of DNA, what types of damage are recognized by repair enzymes, and how all these effects are modified by the presence of chromatin proteins. The model DNA's of known size and sequence which we have already prepared are providing a useful tool with which to investigate these questions. Several experimental approaches will be utilized including reacting polydeoxyribonucleotides with effluents from oil shale processing (or the chemical known to be present in such effluents) in the presence of enzymatic or ultraviolet activation. Products from these reactions suitably labeled with radioactive markers will then be analyzed in several ways to obtain information pertaining to the types of questions listed above. A variety of unique model DNAs are already on hand in this laboratory, as are many of the necessary enzymes, including DNA and RNA polymerases and a number of DNA repair enzymes. Measurements of the changes produced in the physical properties of double-stranded polydeoxynucleotides by exposure to chemical agents have begun, as have studies on the template properties of such modified polymers.
Keywords: carcinogens; dna; biological models; oil shale industry; health hazards; toxicity; near ultraviolet radiation; biological repair; chemical effluents; polymerases.

106397 Waste Transport in Intermittent Streams. Hakonson, T.E. (Los Alamos Scientific Lab., Box 1663, Los Alamos, NM, 87545). **Project number:** 000687. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$273,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

Water erosion of soils and sediments is a major factor in the transport of waste toxicants generated by the nuclear and fossil fuel industries in the southwest. The objective of this study is to develop empirical relationships between storm runoff and soil particle transport that can be used to predict the downstream transport of waste toxicants in southwest ecosystems. A series in-situ tracer experiments will be conducted in an intermittent stream at Los Alamos to quantify relationships between runoff variables (velocity, peak flow and duration) and sediment transport distances as a function of sediment particle size and time. The relationships which are developed for one intermittent stream at Los Alamos will be tested in other intermittent streams in New Mexico to determine the generic attributes of the prediction model. This study is an integral part of a research program at Los Alamos to understand the environmental processes controlling the distribution of waste materials. The results of this work have application to waste management problems at Los Alamos and in the uranium and coal extraction and utilization regions in the southwest US.
Keywords: soils; sediments; erosion; runoff; environmental transport; particle size; velocity; spoil banks; arid lands; metals; radionuclide migration; mines; tailings; spatial distribution.

106398 *Fine Particle Studies* Related to Health. Etting, H.J. (Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 000712. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$216,000.
Related energy source: oil shale(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives are to determine resuspension parameters and migration of deposited contaminants; to provide well characterized aerosols for inhalation toxicology studies; and to develop aerosols similar to atmospheres encountered with developing energy processes. Parameters that govern the resuspension and migration of deposited contaminants with controlled experiments will be obtained utilizing a wind tunnel. These parameters will include saltation rate in terms of mass and number flux, accelerated wind conditions, and surface roughness. Generation and characterization of aerosols for inhalation toxicity studies of materials related to oil shale processing and field sampling studies at oil shale processing facilities will provide information for planning inhalation toxicity studies.
Keywords: particles; inhalation; toxicity; energy source development; aerosols; suspensions; environmental transport; oil shales; production; spent shales; biological effects; air pollution.

106399 Biogeochemistry of Uranium Mill Wastes. Dreeson, D.R. (Los Alamos Scientific Lab., P.O. Box 1663, MS-522, Los Alamos, NM, 87545). **Project number:** 000926. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of LASL's research on the management of uranium mill tailings is to contribute to the understanding of the transport and environmental fate of contaminants associated with tailings and to the goal of achieving containment of these waste materials. The contaminants of prime interest in this study include Se, Mo, As, V, U, and 226-Ra. Inactive tailings piles in the western US are being studied to delineate the various mechanisms of contaminant transport as well as to quantify some of these mechanisms. Field studies have measured radon-222 flux from inactive sites, determined ground water quality around one pile, investigated the uptake of contaminants by vegetation, and studied the stabilization of inactive sites by establishing native vegetation without using irrigation. Mean flux from three inactive sites was 300 to 500 times the flux from local soils. Radon flux was attenuated by about 30% by a 30 cm clay soil cover while an average 75% attenuation was provided by a 100 cm cover. Elevated concentrations of Na, Mo, and U were found in shallow ground water downgradient from one pile. Significant uptake of As, Se, and 226-Ra was found in vegetation growing on some inactive piles and future studies will further elucidate this transport mechanism. The toxic as well as xeric substrate conditions prevented the establishment of a significant vegetative cover.
Keywords: uranium mines; milling; data; emission; environmental effects; land reclamation; spoil banks; stabilization; uranium; toxicity; terrestrial ecosystems; soil mechanics; soil chemistry; revegetation; technology assessment; radionuclide migration; mill tailings; radioactive waste management; selenium; molybdenum; arsenic; vanadium; radium 226; usa; environmental transport; soils; ground water; radionuclide kinetics; radiation monitoring.

106400 Environmental Research Park. Johnson, L.J. (Los Alamos Scientific Laboratory, P.O. Box 1663, MS400, Los Alamos, NM, 87544). **Project number:** 000927. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The Los Alamos National Environmental Research Park is established as an outdoor laboratory to study the effects of man's technological efforts on natural systems. This facility is available to regional institutions and individuals for environmental research.
Keywords: aquatic ecosystems; terrestrial ecosystems; environmental effects; technology utilization.

106401 Terrain Influence on Low Level Meteorological Transport. Barr, S. (Los Alamos Scientific Laboratory, MS 588, Los Alamos, NM, 87545). **Project number:** 000948. **Contract:** GK-01-02-03-3. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: Coal(35); nuclear fission(35); solar(20); geothermal(10) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to document the major effects of terrain irregularities on the transport, dispersion, and deposition of effluents released to the air. An integrated program will be conducted of field experiments and modeling to identify the important physical mechanisms and incorporate them into an objective generic analysis scheme. Most of the major energy production and related facilities are situated in areas where terrain variations play a vital role in the distributions and effects of airborne effluents.
Keywords: air pollution; environmental transport; mathematical models; energy facilities; site selection; aerosols.

106402 Project Airstream, Field and Measurements Support. Sedzacek, W.A. (Los Alamos Scientific Lab., Chemistry-Nuclear Chemistry Group 11, MS-514, Los Alamos, NM, 87545). **Project number:** 001883. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$38,000.
Related energy source: Coal(25); nuclear fission(50); nuclear fusion(25) **R and D categories:** Pollutant measurements technology.

Los Alamos Scientific Laboratory (LASL) participates in the various facets of OHER's High Altitude Sampling Program (HAPP). In particular, LASL is deeply involved in HAPP aircraft project Airstream. This involvement begins with the logistic preparation for sample and data collection, proceeds through actual sample collection to laboratory analysis of these samples with data evaluation and interpretation. LASL participates in the operational and scientific planning phases of the project followed by an active role in the task accomplishment of all these plans. These roles have produced for the LASL project members an indepth insight into the acquisition, analysis and evaluation of samples and measurement techniques of minor constituents of the troposphere and lower stratosphere.
Keywords: stratosphere; sampling; aerosols; data compilation; data analysis; troposphere.

106403 Plutonium-Induced Mutation Frequency on Mammalian Cells. Barnhart, B.J. (Los Alamos Scientific Lab., Cellular and Molecular Biology Group H-9, MS 886, Los Alamos, NM, 87545). **Project number:** 002438. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$68,000.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Mutants of the mammalian cell line cho have been isolated in this laboratory and will be used to assess the potential mutagenicity of high LET alpha radiation. Both forward and reverse mutations at the HGPRT locus and reverse mutations of glycine-requiring and temperature-sensitive clones will be employed. Following a systematic assessment of x-ray-induced mutations in this mammalian cell system, the mutagenicity of alpha radiation from a plutonium-238 source (5 MeV, 7 rad/sec) will be evaluated. Preliminary results from x-irradiation studies showed reversion frequencies from temperature sensitive (TS) phenotype to wildtype growth of 5- to 20-fold above the spontaneous reversion rate. Alpha irradiation at doses giving survival frequencies equivalent to those at which x-rays were optimally mutagenic resulted in no detectable mutations. Lack of revertants may be due to a characteristic of this particular TS mutation rather than of the radiation. Mutations at specific genetic loci (HGPRT and glycine auxotrophy) will be quantitated.
Keywords: plutonium 238; toxicity; mutation frequency; animal cells; let; alpha particles; x radiation; mutagenesis; genetic radiation effects.

106404 Fission Neutrons and Gamma Rays, Late Effects of Single and Fractionated Doses of. Ullrich, R.L. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000143. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$370,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Because of the continuing and projected increased usage of high LET radiation in the production of energy, in medicine and in industry, studies on the biological effects of high LET radiation are particulary important. Moreover, recent data suggests very high RBE's for neutrons in some animal and human tumors; convex shaped dose response curves, and data suggesting greater life shortening and tumor induction with protracted neutron exposure makes the understanding of the dose and dose rate relationships involved in carcinogenesis after neutron irradiation even more imperative. We are conducting experiments with specific tumor systems designed to examine the dose, dose rate and RBE relationships after neutron irradiation in detail. In these experiments, emphasis is being placed on the study of the RBE-dose relationships and the dose rate relationships and on assessing the ability of the host to respond to, modify, and/or repair the radiocarcinogenic injury induced. It is particularly important that we not only establish in detail the RBE, dose and dose rate relationships for a number of murine tumors, but that we also establish the mechanistic basis for these relationships so that reasonable and reliable extrapolation can be made for human risk estimates.
Keywords: let; neutron beams; health hazards; radiotherapy; dose-response relationships; gamma radiation; fractionated irradiation; biological radiation effects; biological repair; risk assessment; tumor cells; neoplasms; radioinduction; lungs.

106405 Dose Response Relation in Chemical Carcinogenesis. Holland, J.M. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000146. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$345,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Continuous mouse skin carcinogenesis dose response studies are done to assess the relative epidermal carcinogenicity of various commercial materials as well as liquid hydrocarbon mixtures being considered as replacements for natural petroleum. In addition to a determination of the relationship between tumor risk and exposure intensity, we are comparing various in vivo parameters that are likely to modify skin responses to topically applied materials. Quantitative techniques are being developed that will permit comparison of bioavailability, dose to critical target cells, species and strain differences in overall metabolism and possible differences that could modify expression of neoplastic cells such as cell killing or cytostasis.
Keywords: carcinogenesis; mice; skin; dose-response relationships; hydrocarbons; metabolism; health hazards; pathogenesis.

106406 Biometrics: Risk Analysis. Gardiner, D.A. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 000159. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); solar(20) **R and D categories:** Health effects assessments.

This activity comprises collaboration and research by statisticians and mathematicians on research problems in the biomedical and environmental sciences and is related to energy research through risk assessment of chemicals and radiation including the evaluation of coal conversion by-products and power plant effluents. Department members collaborate in areas of research including radiation genetics, carcinogenesis, chemical mutagenesis, radiation-induced disease incidence, cryosurgery, enzyme kinetics, DNA structure, thermal and toxic effects on the environment and health effects of nuclear facilities. The collaboration requires the application and extension of many statistical and mathematical models. Much of the research is motivated by the collaboration indicated above and thus is directed towards specific problems arising from one or more programs. Other research is directed toward problems of general interest or toward the development of new statistical and mathematical techniques which may be applicable to biomedical and environmental research. Three of some of the more important areas of collaboration and research include large-scale experiments using mice to evaluate the somatic effects of dose, dose rate, and type of radiation, a procedure for screening chemicals and mutagenicity utilizing mice to detect heritable translocations, and a mathematical analysis of the cryosurgical technique.
Keywords: statistical models; mathematical models; biological models; chemical effluents; radioactive effluents; risk assessment; genetic radiation effects; carcinogenesis; mutagenesis; enzymes; biochemical reaction kinetics; dna; thermal effluents; health hazards.

106407 Enzyme Regulation. Jacobson, K.B. (Oak Ridge National Lab., Biology Div., P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000169. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$197,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Biologically hazardous by-products result from the production of electricity by nuclear reactors as well as by coal and petroleum. One of the hazards resulting from appearance of such by-products in organisms is mutation. This research will assess the mechanism of expression of mutations and determine how the mutant expression can be counteracted. The biochemical abnormalities associated with the vermilion and purple mutants of Drosophila are partially or fully restored to normal by the presence of a suppressor mutation [su(s)/sup 2/]. The goal of this research is to determine how su(s)/sup 2/ accomplishes the suppression of vermilion and purple. We have recently found that purple causes a decreased amount of sepiapterin synthase and that suppression is accompanied by a change in tyrosine transfer RNA. Vermilion is known to have greatly decreased tryptophan oxygenase activity. This activity is restored by su(s)/sup 2/ and also by dietary means. We shall assess how the activities of these enzymes are regulated and how transfer RNA levels are related to this regulation. This system is unique among higher organisms since it allows a detailed study of the mechanism by which an organism can correct the damage done by mutation. Damage and alteration of DNA causes mutations; a number of means of repairing the DNA are under investigation in other laboratories. This study is addressed to alternate means of correcting mutational damage. Additionally the toxic role of cadmium and zinc is being assessed on Drosophila viability and on the enzymes and tRNA described above.
Keywords: mutagenesis; biological models; drosophila; biological repair; mutations; diet; enzymes; transfer rna; biochemical reaction kinetics; cadmium; zinc; toxicity; tyrosine.

106408 Mammalian Biochemical Genetics. Popp, R.A. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 000173. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$328,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Nuclear reactors or coal-burning steam plants produce radiation or chemical by-products that are mutagenic. The quality and frequency of mutations induced by x-rays at the hemoglobin loci in germinal cells of mice are being studied to provide data on the types of mutations that might have occurred at the 7 specific loci studied by W.L. Russell. Hemoglobins of the mutants are being analyzed chemically to identify point mutations, frameshifts or deletions. The mutational, toxic and physiological side effects of immunosuppressant drugs are being studied to determine whether the inherent mutagenicity of these chemicals might cause the increased incidence of tumors in persons or experimental animals treated over long periods with immunosuppressant drugs. The frequency of HGPRI stem cells in bone marrow is a measure of mutagenicity, and stem cell survival and bone marrow cellularity are measured to assess drug toxicity. Congenic strains of mice are being used to study the influence of specific alleles on the general physiology, immunology, aging, viral infection and pathological diseases of mice.
Keywords: biochemical reaction kinetics; fossil-fuel power plants; nuclear power plants; x radiation; hemoglobin; germ cells; mice; drugs; mutagenesis; toxicity; physiology; health hazards; genetics; genetic radiation effects; genetic effects.

106409 Mammalian Genetics. Russell, L.B. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000174. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$1,310,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This is a large-scale long-term project with mice to provide information directly applicable to the estimation of the human genetic hazards of exposure to ionizing radiation and other mutagens, including chemicals involved in non-nuclear energy production and utilization, particularly from coal technology. The work concentrates on those mutations induced in the reproductive cells of the living animal which are transmitted to subsequent generations of offspring. Since such data are not available in man, estimates of the human risk are necessarily based on the animal data. Gene mutations and chromosomal aberrations are used to determine how the frequency and qualitative nature of the mutations is affected by such factors as the mutagenic response of the various reproductive cell stages, from immature to mature, in both sexes. The relative effectiveness of different types of chemicals and radiation, including internal emissions from tritium, and the effects on mutation frequency of radiation and chemical dose, dose rate, and fractionation are also being investigated. The nature, extent, and persistence of actual anatomical damage expressed in descendants of populations exposed to mutagens is being estimated by an intensive investigation of mutations affecting the skeletal system.
Keywords: mice; comparative evaluations; genetic effects; genetic radiation effects; mutagens; mutagenesis; biological models.

106410 Mammalian Cytogenetics. Preston, R. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000181. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$375,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The mammalian cytogenetics group investigates the mutagenic activity of ionizing radiation and a broad spectrum of chemicals by using chromosome aberrations as the mutagenic endpoint. The studies are done exclusively in mammalian systems with the principle emphasis placed on effects in germ cells, both male and female. Where appropriate, somatic cell systems are utilized to form a basis for extrapolating genetic hazard data from laboratory animal models directly to man. Investigations are also underway that enable us to measure directly the cytogenetic effects of various chemical substances on the early embryo. At this time we are evaluating effects in 1-64 cell embryos and correlating the cytogenetic data to lethal and genetically recoverable events. We are also currently attempting to elucidate the mechanisms of chromosome aberration production. At present we are concentrating on three aspects. Firstly, we are determining the extent of initial damage and the rate and extent of its repair in mammalian cells following radiation or chemical exposure. Using chemicals which sensitize cells to killing by chemical and/or radiation, we are beginning to show a relationship between excision repair and aberration induction. We intend to pursue our studies in human lymphocytes since they are very amenable to aberration studies.
Keywords: mammals; cytology; genetic effects; chromosomal aberrations; biochemical reaction kinetics; animal cells; lymphocytes; man.

106411 Automated Analyses for Biochemical Indicators of Genetic Difference. Scott, C.D. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000182. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$155,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant measurements technology.

Concern over possible genetic effects of chemical mutagens in the environment and in food, of radiation, and of infectious agents is growing. If environmental factors appreciably increase the mutation rate in man, serious long-term consequences may result. Thus, there is a great need for reliable data concerning the relationship between the mutation level in the presence of these agents compared with the level in their absence, i.e., the background level. The problem becomes one of devising methods for obtaining this information. Biochemical characterization offers advantages in that detection of altered protein structure may be accomplished by use of a variety of physical and chemical techniques, either alone or in combination. Once an alteration in gross protein structure is detected, experiments using heat inactivation and/or chemical inhibition or activation may be designed to quickly detect the mutant protein and quantify the rate of its occurrence. This can ultimately result in identifying cause. Variations of the following methods are under development for biochemical screening: automated electrophoresis, high-resolution chromatography employing new support materials, and enzyme assays including fast kinetics on centrifugal analyzers.
Keywords: biological indicators; genetic variability; genetic effects; food; chemical effluents; microorganisms; mutation frequency; mutagen screening; optimization.

106412 Mammalian Gametogenesis. Oakberg, E.F. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000183. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$105,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Relevance of induced mutation rates in mouse oocytes to estimation of genetic hazards in women is being evaluated by study of the basis for dramatic changes in radiation response of the mouse oocyte. The stages where dramatic changes in sensitivity of the growing oocyte to both cell killing and mutation have been identified. Morphological and biochemical study of these stages should provide a critical first step in understanding species differences in oocyte response to radiation and chemicals. Our studies on the testis can provide data on the effects of radiation and chemicals on spermatogonial stem cell numbers and stem cell dynamics. Different stages of the cell cycle have characteristic response both to cell killing and mutation induction, and it therefore is important to understand the effects of various agents on both number and dynamics of stem cells. We have demarcated the dose limits over which treatments can be given without inducing either differential cell survival or changes in the mitotic cycle of spermatogonial stem cells. This increases our confidence in applying data on genetic effects in mouse spermatogonia to estimation of genetic hazards in men.
Keywords: mammals; mice; oocytes; biological radiation effects.

106413 Radiation Immunology. Perkins, E.H. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000190. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$115,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

There is no human information on the role that radiation induced early and/or late immunodepression plays in radiation carcinogenesis and these studies cannot be conducted in man. The murine model provides an immediate and practical approach because most tumors have relatively long induction periods and the life span of the mouse only slightly exceeds 3 years. Furthermore, the significance of radiation-induced immunodepression to radiation-induced carcinogenesis and life shortening, particularly as it relates to chronological age at the time of exposure, has never been assessed. This research will answer these questions, and in addition provide fundamental information on immunopoiesis which has immediate clinical application in immune deficiency conditions and diseases.
Keywords: carcinogenesis; radioinduction; immune reactions; life span; delayed radiation effects; biological models.

106414 Coal Liquefaction: Role of Repair in Carcinogenesis. Regan, J.D. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000287. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Deleterious health effects of a chronic nature (cancer) may be related to unrepaired or misrepaired macromolecular lesions produced by representative class compounds of coal conversion that are carcinogens or precarcinogens. Our major objectives are to define and characterize the various kinds of prereplication and postreplication DNA repair that occur in human cells after treatment with representative carcinogens and metabolites of carcinogens in an effort to understand the relationship between lesions induced in DNA, the alteration by repair enzymes and the ultimate human health consequences of these events. The sequence of DNA repair events, the various modalities of repair, the genetic inhibition of repair due to mutation and the physiological inhibition of repair due to biochemical inhibitors are all characterized on the molecular level. The significance of these studies lies in the ubiquitousness of repair (most organisms including man have several complex repair systems), the belief that mutagens and carcinogenic events may arise only from residual (non-repaired) lesions or that error-prone repair systems may be the major induction mechanisms of the mutagenic or carcinogenic event, and the clear association of repair defects and highly carcinogenic disease states in man (exoderma pigmentosum). **Keywords:** coal liquefaction; health hazards; carcinogenesis; biological models; biological repair; biochemical reaction kinetics; animal cells; cell cultures; human populations.

106415 Fusion Tech: Aquatic Environmental Cycling; Effects of Activation Product Nuclides. Blaylock, B.G. (Oak Ridge National Laboratory, Building 1505, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000604. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$230,000.
Related energy source: nuclear fusion(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this research is to determine for aquatic systems the environmental transport and effects of activation product (AP) nuclides which may be released routinely or accidentally from controlled thermonuclear reactors (CTR). The AP nuclides will be determined by the structural material used in the reactor. The material is not precisely known at this time although some leading candidate materials have been identified. Most AP nuclides are different from fission product nuclides and limited environmental data are available for assessing the hazards to man and the environment. An evaluation of available literature on selected AP nuclides, Al, V, Cr, Mo, Bi, and Nb, will be made in relevance to environmental transport and biogeochemical behavior. Based on the extant data available, field and laboratory experiments using stable element chemistry and radiotracer techniques will be conducted: (1) to determine concentration factors, and trophic transfer factors for AP in typical freshwater environments; (2) to estimate the transfer of AP's from sediments to aquatic biota; and (3) to develop data for AP's in food chains leading to man. Data from these studies will improve the accuracy of dose estimation to man and the assessment of environmental impacts related to CTR's. The results will have direct application to environmental assessments required for the CTR program.
Keywords: thermonuclear reactors; radioactive effluents; aquatic ecosystems; food chains; radionuclide migration; radioactivation; radioisotopes; radioecological concentration; environmental impacts; human populations; environmental exposure pathway; environmental transport; biogeochemistry; sediments.

106416 Transport, Fate and Effects of Energy Technology Effluents. Harris, W.F. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** 00608. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$298,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this study is to investigate biogeochemical cycles of forest ecosystems such that the fate of chemical releases to the environment can be quantitatively related to biotic and abiotic processes influencing: (1) atmospheric deposition; (2) storage within ecosystem components; (3) biological responses to perturbations; and (4) eventual release from the landscape system to groundwater and aquatic ecosystems. Three modes of research are employed: (1) monitoring of atmospheric inputs, stream outputs and concentration levels in biota and soils; (2) detailed research to elucidate mechanisms controlling biogeochemical cycles and how these mechanisms are affected by chemical perturbations; and (3) development of mathematical models of element transport as a means to summarize complex data, to design relevant future research and eventually to apply research results to other landscape systems. This project will continue to provide baseline data on sulfur cycling and fate validated models of water and pollutant transport and experimental data on manipulations of geochemical cycles (sulfur acidified precipitation). The results are relevant to fuel use policy and environmental regulation.
Keywords: biogeochemistry; forests; air pollution; deposition; storage; environmental transport; aquatic ecosystems; chemical effluents; soils; terrestrial ecosystems; sulfur; lead; manganese; nitrogen; cadmium; calcium.

106417 Thermal Effects Studies. Coutant, C.C. (Oak Ridge National Laboratory, Building 1505, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00609. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$310,000.
Related energy source: Coal(50); nuclear fission(30); solar(10); geothermal(10) **R and D categories:** Environmental effects assessment.

The project objectives are to develop biological/ecological information that can be used for predicting impacts of power plant cooling systems on the environment. Biological criteria are to be developed to aid in siting, design and operation of cooling systems. These objectives are met through field research, laboratory experiments and computer simulation. The problem-oriented research has yielded temperature criteria for aquatic organisms that have been used in regulatory activites by EPA, AEC/NRC and state agencies. Future results will emphasize synthesis of results obtained for benthos, fish and microorganisms into community and ecosystem criteria, and extension of power station considerations to cooling systems of new technologies.
Keywords: thermal effluents; power plants; biological effects; biological models; mathematical models; temperature effects; aquatic organisms; fishes; microorganisms; cooling systems; thermal pollution; population dynamics; environmental effects.

106418 Environmental Effects of Effluents of Uranium Enrichment Facilities. Reichle, D.E. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 000681. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Potentially hazardous chemicals discharged during the manufacturing and enrichment of uranium include gaseous effluents (UO2F2, HF, and possibly other combined fluorides) and chromates in drift from several mechanical-draft cooling towers. The integration of field and controlled environment studies is directed to provide information on the atmospheric dispersion, accumulation and weathering of fluorides in plants, and on the responses of vegetation (yield) to low, intermittent fluoride exposures. Additional objectives of UF6 fuel cycle related research are directed to obtaining a predictive capability of drift transport, deposition, interception and retention by vegetation and soil, and effects of trace toxicants in drift on biota. Information from the research will aid assessment of environmental impacts of fluorides from UF6 technologies. The results will be useful to define standards and limitations on the release of fluorides from nuclear and non-nuclear industries, and to upgrade monitoring protocols at facilities that routinely release fluorides. Data from fuel cycle related research (cooling towers) are valuable to plant managers and environmental protection agencies for preparation and review of environmental statements of nuclear power plants and process facilities, for setting guidelines and standards for siting of cooling towers, and for suggesting methods to monitor drift in terrestrial environments.
Keywords: isotope separation; gaseous wastes; uranyl fluorides; hydrofluoric acid; chromates; cooling towers; environmental transport; weathering; biological accumulation; plants; uranium hexafluoride; soils; retention; aerosol monitoring; environmental impacts; gaseous diffusion plants.

106419 Actinides in the Environment. Reichle, D.E. (Oak Ridge National Laboratory, Building 1505, Room 286, Oak Ridge, TN, 37830). **Project number:** 000690. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$400,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The goal of this program is to understand the behavior of plutonium and transuranium (TR) elements in environments typical of Eastern United States. The continuing (key) objectives of this program are: (1) to understand the environmental chemistry of TR elements, (solution and solid-phase chemistry) and relate these observations to long-term behavior of TR elements; (2) to evaluate biogeochemical cycling and food-chain transport of plutonium (Pu), americium (Am), and curium (Cm) in floodplain ecosystems contaminated with TR elements in 1944; (3) to determine the kinetics and food-chain dynamics that affect the transfer of TR elements to man from freshwater environments; and (4) to determine the distribution, pool fractions, and transfer coefficients among the biotic components of freshwater ecosystems. Achievement of these objectives will aid the development of quantitative and integrated information on transport and impact of TR elements for representative environments of Eastern United States.
Keywords: americium; curium; plutonium; radioecological concentration; environmental transport; aquatic ecosystems; surface waters;

terrestrial ecosystems; soils; food chains; radionuclide migration; biogeochemistry; man; environmental exposure pathway.

106420 Basic Measurement Science. Blankenship, J.L. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 000723. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: Coal(75); nuclear fission(25) **R and D categories:** Pollutant measurements technology.

The objective of Basic Measurement Science is to explore new concepts, theories, devices, and advanced techniques which advance man's ability to measure or observe new phenomena. To reach this objective, advances in other fields of science, mathematics, and engineering are exploited and applied to the broad field of measurement science. The project is an ongoing one with research areas changing to meet DOE needs. Previous results include the conception and implementation of pole-zero cancellation techniques, the Johnson Noise Thermometer, as well as the one- and two-dimensional RC position sensitive proportional counters. Currently we are developing a three-dimensional position sensitive proportional counter. Development of such a counter will have major impact on x-ray and synchrotron studies of both organic and inorganic materials. In addition, we are developing coded-aperture imaging systems and their associated decoding filters. Development of such imaging systems will improve the image quality and decrease the image acquisition time for x- and gamma-ray images needed for fusion development, for fission fuel-rod melt-down studies and for nuclear medicine diagnoses.
Keywords: position sensitive detectors; fast neutrons; neutron spectrometers; design; plasma diagnostics; neutron spectra; gamma cameras; multiwire proportional chambers; carcinogens; diseases; in vivo; noise.

106421 Mechanical Impacts of Impingement. Coutant, C.C. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** 000863. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this research is to define the biological and engineering parameters which cause physical damages to aquatic organisms as they are impinged, or collected on intake screens of power plant cooling water intakes and to define the behavioral responses of warm-water fish as they approach power plant intake screens and examine their ability to survive impingement. Emphasis will be placed upon one fish species, the threadfin shad (Dorosoma petenense), which comprises the bulk of impingement in the southeastern United States, occasionally resulting in plant damage and often in increased cost of operation. By means of analysis of existing data, the extent will be defined to which fish collected on intake screens of souteastern power plants may be dead or dying from other causes, especially low temperature. At the Kingston Steam Plant, the biological and hydraulic factors resulting in the bulk of fishes being impinged on the two (of 18) screens at one side of the intake will be evaluated. An electromagnetic current meter will be used to examine hydraulic characteristics of the area. The behavioral response of selected warm-water fish species to the range of light, visual references, water temperature, velocity and turbulence associated with power plant intakes will be assessed by experimentation in laboratory flume tank.
Keywords: impingement; aquatic organisms; intake structures; fishes; behavior; biological adaptation; avoidance; biological models; thermal effluents; mortality; temperature effects; cold effluents; hydraulics; power plants; population dynamics; tennessee.

106422 *Environmental Research Park Support.* Harris, W.F. (Oak Ridge National Lab., Environmental Sciences Division, Bldg. 1505, Oak Ridge, TN, 37830). **Project number:** 000929. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The major objectives of Oak Ridge's NERP are to (1) develop methods for the continuous and quantitative assessment of man's activities on the environment, (2) develop models to predict the response of environmental components to proposed technological activities, and (3) provide land-use plans which make preservation of representative regional natural areas compatible with human technological activities. Because the real effects of ecosystem modification can only be delineated if adequate baselines are available with which altered systems can be compared, we are developing a series of research natural areas where information on the structure and function, both spatial and temporal, of ecosystems can be collected. This has and will continue to require inventories of all plant and animal communities occurring on the Reservation. The analysis of natural systems is focusing our research efforts toward formulation of models of ecosystem function as predictive tools. The subsequent synthesis of the dynamic functioning of systems should ultimately increase our resource management capabilities.
Keywords: environmental impacts; nature reserves; oak ridge; mathematical models; human populations; land use; inventories; ecosystems; measuring methods; management; resource conservation; measuring methods; ecology.

106423 Metabolism of Mutagens. Sega, G.A. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002591. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The work performed in this project can be divided into two areas of concentration. These are studies on: (1) molecular dosimetry; and (2) DNA repair in the germ cells of mice. Molecular dosimetry is being used to investigate, both quantitatively and qualitatively, the interaction between mutagenic agents and geneticaly significant targets within the germ cells. The dosimetry work, combined with comparative mutagenesis studies between the mouse and other genetic test systems, is being used to develop a common baseline for estimating the genetic risk to human germ cells posed by chemicals in the environment. In vivo DNA repair studies using mouse germ cells are being carried out to obtain information about the interactions of suspected mutagens with the DNA in the target cells and are important for establishing how well the germ cells are able to repair DNA lesions induced by different classes of mutagens. Another major objective of this work is to determine more about the relationship between DNA repair and repair of genetic damage by comparing the genetic effects induced by chemical mutagens in specific germ cell stages of the mouse with the ability of these same stages to undergo DNA repair.
Keywords: metabolism; mutagens; molecular biology; germ cells; dna; biological repair.

106424 Coal Liquefaction: Carcinogenesis Mouse Skin. Slaga, T.J. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 001562. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$410,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In view of DOE's responsibilities in developing fossil fuels for energy we will be confronted with many biological hazards from polycyclic aromatic hydrocarbons (PAH) which are associated with their conversion and utilization. These PAH may have carcinogenic, tumor initiating or promoting activities in man. We propose to study the mechanism of action of certain PAH carcinogens and tumor promoters in epidermal cells both in vivo and in vitro. The tumor initiating and promoting abilities of benzo(a)pyrene and 7,12-dimethylbenz(a)anthracene and their cellular metabolites are being investigated in order to better define complete carcinogenesis by PAH. We have found that (-trans)benzo(a)-pyrene-7,8-diol-9,10-epoxide is the ultimate tumor initiating form of benzo(a)pyrene. However, this intermediate is not a complete carcinogen; consequently, we are determining which metabolite(s) are responsible for the tumor promoting activity. Since the majority of PAH have only been tested for complete carcinogenic activity, it is imperative that they be tested for both tumor initiating and promoting activity in our sensitive mice. Studies will be expanded on the anti-carcinogenic effects of steroids, benzoflavones, antioxidants and Vitamin A analogs which may lead to a rational approach to chemoprophylaxis of environmental carcinogens. Some of these agents may also be useful in counteracting the harmful effects of accidental exposure to coal conversion products.
Keywords: polycyclic aromatic hydrocarbons; carcinogenesis; biological effects; health hazards; in vivo; in vitro; man; benzopyrene; aromatics; benzanthracene; steroids; vitamin a; response modifying factors; antioxidants; flavones; preventive medicine.

106425 Coal Liquefaction: Comparative Mutagenesis. Epler, J.L. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 001569. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$320,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The major goal of the comparative mutagenesis group is to provide a means of mutagenicity testing of those compounds produced by various existing or proposed methods of energy generation. These include the primary effluents of existing fossil fuel sources such as sulfur dioxide, the oxides of nitrogen, ozone, hydrocarbons, and heavy metals. It will also include products of newly proposed methodology such as coal liquefaction and of auxiliary

methodology. The work is divided into two phases: one dealing with known compounds expected to occur in the environment through energy production, conversion, or use; and another dealing with actual samples from existing or experimental processes. Using rapid screening genetic assays (Ames System), the group is attempting to identify mutagenic agents associated with coal and oil shale extraction, conversion or utilization. To approach the problems of testing large numbers of compounds, we set up a form of the tier system. Operating units utilizing Salmonella, E. coli, yeast, human leukocytes, mammalian cells, and Drosophila have been initiated. An extensive list of compounds isolated or identified in effluents or products have been screened. The major classes of compounds with mutagenic potential include in the basic fractions: quinoline, substituted quinolines, acridines, naphthylamines, aromatic amines and aza-arenes; in the neutral fractions: benzanthracenes, dibenzanthracenes, benzopyrenes, benzofluorenes, and chrysenes.
Keywords: mutagenesis; chemical effluents; sulfur dioxide; nitrogen oxides; ozone; hydrocarbons; coal liquefaction; oil shales; coal; salmonella; escherichia coli; yeasts; leukocytes; animal cells; drosophila; quinolines; acridines; amines; organic nitrogen compounds; condensed aromatics; benzopyrene; chrysene.

106426 Mammalian Chemical Mutagenesis. Russell, W.L. (Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 001570. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$320,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This is a comprehensive mutagenesis program to test those chemicals which pose a potential threat to human populations. Special emphasis is given to compounds and mixtures related to nonnuclear energy production. The program concentrates on the most definitive tests available, namely those which measure transmitted genetic damage in the offspring of treated mammals. A comprehensive battery of methods is used to test for the following effects: gene mutations (specific-locus tests); chromosomal damage (namely transmitted translocations, dominant lethals, sex-chromosome loss and nondisjunction); toxicity (as related to mating behavior); cell killing of germ cells (if there are indications that this is extensive enough for possible selective elimination of sensitive stages); decrease in total reproductive performance of females; and DNA damage in germ cells (as measured by unscheduled synthesis). Compounds that have been or are being tested are benzo[a]pyrene, dimethylbenzanthracene, methylmercuric hydroxide, sulfur dioxide (sodium bisulfite), a synthoil-process fraction, diethylnitrosamine, cyclophosphamide, and various pyrrolizidine alkaloids. Work is being expanded on the testing of fractions from coal-conversion processes. Certain chemicals not directly related to energy production may be used when positive controls are needed, or when the compound has certain features that make it useful for method evaluation.
Keywords: mutagen screening; human populations; organic compounds; mutagenesis; genes; mutations; benzopyrene; sulfur dioxide; mercury compounds; amines; endoxan; cell killing; germ cells; chromosomal aberrations.

106427 Development of Portable Analyzer. Scott, C.D. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001606. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

There are numerous applications in the environmental and biomedical sciences where a miniaturized, portable analytical system would be useful. Examples include field monitoring of environmental pollutants, and emergency or mobile health care, especially in remote regions where it may be necessary or expedient to bring the analytical system directly to the testing area. It would be especially attractive to incorporate within this analytical system a versatile, high performance optical system capable of spectrophotometric, turbidimetric, or fluorometric determination of both ionic and molecular species. Further, the system should produce accurate results while measuring and controlling several parameters automatically with minimum operator involvement. Ideally, very little sample preparation or pretreatment would be required. A portable centrifugal fast analyzer system with the capability to fulfill the above requirements is presently under development at ORNL. The technology resulting from the development of this instrument can be transferred to future instrumentation development in biomedical or environmental monitoring applications, or to other programs.
Keywords: environment; monitoring; centrifugal fast analyzers; chemical analysis; design.

106428 Multidetector Spectrographic Systems. Davidson, J.B. (Oak Ridge National Laboratory, Instrumentation and Controls Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001607. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$170,000.
Related energy source: Coal(75); nuclear fission(25) **R and D categories:** Pollutant measurements technology.

The scope of this program is 75% non-nuclear and 25% nuclear. The goal is the development of spectrographic tools needed in both areas. Specifically we are developing detectors, instruments and techniques for measuring dangerous trace elements such as mercury, arsenic, selenium, etc., and certain hydrocarbons. The projects are: (1) a system for rapid multielemental analysis using an echelle spectrometer (initial testing begun); (2) a comlementary system for analysis by x-ray fluorescence using a room temperature detector (under development); (3) a personal atmospheric monitor (PAM) for certain hydrocarbons (under development); and (4) application of high resolution position-sensing radiation detectors to structure analysis (continuing).
Keywords: spectroscopy; trace amounts; monitoring; mercury; arsenic; selenium; hydrocarbons; cadmium; multi-element analysis; x-ray fluorescence analysis; spectrometers; personnel monitoring; radiation detectors; structural chemical analysis.

106429 Resonance Ionization Spectroscopy. Hurst, G.S. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 001608. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$214,000.
Related energy source: Coal(60); oil shale(40) **R and D categories:** Pollutant measurements technology.

The objectives are to develop advanced instrumentation principles and techniques through the use of resonance ionization spectroscopy and one-atom detection, and to demonstrate super analytical methods of determining extremely low levels of specific chemical species. Dye lasers are used to selectively excite and then ionize atoms. By saturating ionization and detecting electrons in a proportional counter or an electron multiplier, one-atom detection is possible.
Keywords: photoelectron spectroscopy; ionization; microanalysis; sensitivity; dye lasers; atoms.

106430 Development of Environmental Monitors. Scott, C.D. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001609. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(75); nuclear fission(25) **R and D categories:** Pollutant measurements technology.

Dissolved environmental pollutants, particullarly those resulting from coal processing and the nuclear fuel cycle, have been and are presently being viewed with much care and concern. The development of automated analytical systems for isolation and identification of specific pollutants and continuous monitoring systems for on site monitoring of dissolved pollutants constitutes a practical approach to the protection of our aqueous environment from manmade energy sources. In the short term, particular attention will be given to phenolic compounds and dissolved polynuclear aromatic hydrocarbons. In the longer term, the immobilization of pollutant specific biochemicals will be used to isolate specific pollutants for analysis. Particular attention will be given to airborne polycyclic aromatic hydrocarbons. Also, the feasibility of a mutagenic activity monitor based on the Ames test will be investigated.
Keywords: monitoring; water pollution monitors; phenols; polycyclic aromatic hydrocarbons; mutagen screening; design; feasibility studies.

106431 Environmental Fate of Emissions from Coal Combustion Plants. Van Hook, R.I. (Oak Ridge National Laboratory, Environmental Sciences Division, Bldg. 1505, Oak Ridge, TN, 37830). **Project number:** 01624. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project address two issues related to trace emissions from coal combustion plants: the fate of dispersed emissions, e.g., aerosols and gases which exit the stacks, and the fate of concentrated emissions, e.g., precipitator ash, bottom ash and SO/ sub 2/ scrubber sludge. The key objectives are: (1) the quantitative estimation of the role of a forested landscape in the scavenging of atmospheric particles from the ambient air and the subsequent availability of elements associated with these particles for entry into biogeochemical cycles; (2) the evaluation of the ability of a terrestrial-aquatic system to accumulate trace contaminants entering via the atmosphere; and (3) the identification of coal combustion residual disposal practices which minimize or maximize mobilization of trace contaminants into the environment. Information gleaned from these objectives is vital to (1) understanding and predicting responses of both terrestrial and aquatic ecosystems to increased loadings of contaminants; (2) field validation of mathematical models which seek to describe the movement of contaminants in air, soil, and water; (3)

identification of potential pathways for exposure to man; and (4) identification and appraisal of ameliorative strategies.
Keywords: coal; combustion; combustion products; environmental transport; monitoring; aerosols; flue gas; fly ash; ashes; desulfurization; solid wastes; sludges; forests; air pollution; ecosystems; uptake; contamination.

106432 Development of Environmental Monitors. Olson, J.S. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 01669. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The purpose of integrated assessment relating carbon cycles to climate is to reduce uncertainties about the future, eventually showing how the impacts of climatic change on ecosystems and ecological exchanges of CO2 may alter the existing global cycle of carbon, hence the further changes in CO2 and climate, and further ecosystem (and social) changes that collectively constitute a causal feedback loop on the global system. The approach is from: (1) tests and improvements of carbon cycle and time series data and global models, through (2) projections of credible climatic impact on crops, forests, water balance, physiological feedbacks to global CO2 and future fuel scenarios, toward (3) iterated environmental assessments (in cooperation with Oak Ridge Associated Universities, social sciences groups, and individual collaborators from elsewhere).
Keywords: global aspects; carbon cycle; climates; risk assessment; environmental impacts; carbon dioxide; ecological concentration; crops.

106433 Physical and Chemical Characterization of Plutonium in Existing Contaminated Soils and Sediments. Tamura, T. (Oak Ridge National Laboratory, Environmental Sciences Div., Oak Ridge, TN, 37830). **Project number:** 001677. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The physical and chemical characterization of plutonium in soils and associated soils from Oak Ridge National Laboratory, Mound Laboratory, Rocky Flats, and Nevada Test Site in relation to transport through the environment is the primary objective of this project. The methodology of investigation includes particle size analysis with and without dispersive treatments, selective dissolution, mineralogical analysis, and simulation test of plutonium resuspension by sandblasting during wind erosion. The sandblasting phenomenon during wind erosion will influence particle size distribution of airborne dust by separation of aggregates and removal of fine coatings of platelets from exposed surfaces of coarse grains. A soil plutonium index was derived for contaminated sites to permit comparison of the potential transfer of plutonium to man via the inhalation pathway. The order of severity is Nevada Test Site < Oak Ridge National Laboratory < Mound Laboratory < Rocky Flats.
Keywords: plutonium; radionuclide migration; soils; sediments; ornl; rocky flats plant; nevada test site; mound laboratory; particle resuspension; radioactivity; environmental exposure pathway; man; radionuclide kinetics.

106434 Pollutant Damage to Cardiovascular Function. Revis, N.W. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 001702. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$35,000.
Related energy source: Coal(100) **R and D categories:** Health effects assessments.

To determine the role of pollutants in heart disease our Laboratory has been studying the effects of the air contaminants sulfur dioxide, nitrogen dioxide and carbon monoxide and the air and water contaminants cadmium and selenium. The role of the gaseous air contaminants and of obstructive pulmonary disease in the development and the progression of chronic heart failure has been of interest to this group. We have been studying calcium transport and its regulation in the experimentally-induced failing heart. We have observed that in the failing the regulators or calcium transport (i.e., nonadrenaline and cAMP) are depressed. The significance of this observation with respect to calcium transport is currently being studied. Cadmium exposed animals developed hypertension and in epidemiological studies, cadmium has been associated with hypertension in humans. We have observed that cadmium at low concentrations affects the metabolism of catecholamines. We have furthermore observed that the renin-angiotension system is not affected. The relationship of glutathione peroxidase and selenium to myocardial necrosis is also under investigation.
Keywords: cardiovascular system; biological functions; air pollution; pathological changes; diet; sulfur dioxide; nitrogen dioxide; carbon monoxide; cadmium; selenium; water pollution; health hazards; animals.

106435 Dosimetry for New Energy System Pollutants. Gammage, R.B. (Oak Ridge National Laboratory, P.O. Box X, Building 4500S, Oak Ridge, TN, 37830). **Project number:** 001707. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$332,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to produce new or improved monitoring devices for occupational health control in the technologies producing synthetic fossil fuels. Primary interest is in polycyclic aromatic (PNA) compounds with potential carcinogenic activity. Instruments producing real or near real-time analytical data are devised which are suitable for use in industrial hygiene. Pollutants sought may be vapors, aerosols, or oils and tars contaminating surfaces. Miniature, portable spectrometers under microcomputer control are the principal developments and these are being introduced at site specific coal converters such as low Btu gasifiers and the H-Coal liquefaction plant. The first monitor for PNA vapors will be used for characterization studies at the University of Minnesota at Duluth low Btu coal gasifier in the Spring of 1979.
Keywords: polycyclic aromatic hydrocarbons; monitoring; aerosols; gases; oils; tar; industrial medicine; spectrometers; coal gasification; low btu gas; h-coal process; coal liquefaction; air pollution monitors.

106436 Facility for the Chemical Support of Biological and Environmental Studies Related to Coal Technology. Guerin, M.R. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001722. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$235,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to acquire, prepare, characterize, quality control and distribute process samples from coal conversion technology development sites to research groups in the biological and environmental sciences; and to develop economical approaches to chemical-biological screening evaluations of process products and effluents in order to assess the likelihood of hazard to human health and the environment. Collaboration with life sciences research personnel leads to the designation of problems and the experiments needed to find the answers. In this context, the most pertinent materials from fossil fuel processes are chosen for the life sciences studies. In nearly all cases, a certain amount of sample preparation (usually a separation) is required to meet the experimental goals. Therefore, a major part of this project is to develop gentle, quantitative separations methods. Major progress has been made in the development of separations procedures suitable for screening via bioassay and for special biological/environmental research needs. Mutagenic components have been identified in synfuel materials--most notably azzarene compounds.
Keywords: coal gasification; coal liquefaction; sample preparation; biological effects; environmental impacts; sorting; chemical effluents; separation processes; bioassay; mutagens; synthetic fuels; toxicity; toxins.

106437 Ultrasensitive Pollutant Analysis. Garrett, W.R. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 002389. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$48,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Work conducted here on the interaction of protons with noble gas mixtures suggests a number of interesting and new methods for determination of low levels of small molecular atmospheric pollutants. The fast energy transfer from excited rare gas atoms or molecules to pollutants such as Cl2, NO2, NO, Cd, Ht, HtO, etc., causes very strong fuorescence from these molecules. Sensitivities of one part per billion or better have been demonstrated, using proton beam excitation. Using an arrangement consisting of a commercially available CO2 laser (15 J/100-Nsec pulse) or a q-switched yag laser as a source of excitation and a time-resolved fluorescence detector, sensitivities on the order of a few molecules/cubic cm can be detected. Since this method is much simpler than other methods for sensitive pollution analyses, it has high potential for commercial development. Initial studies will be undertaken upon completion of the fabrication of a gas breakdown cell and vacuum system. In a parallel study a seeded molecular jet is combined with time resolved fluorescence utilizing a pulsed dye laser to study heavier organic molecules. Rotational cooling in supersonic jet expansion should make possible high selectivity for molecules whose spectra are otherwise too complicated to facilitate fluorescence identification.
Keywords: protons; rare gases; fluorescence; chlorides; nitrogen dioxide; nitrogen oxides; cadmium; tritium compounds; carbon dioxide lasers; energy transfer; dye lasers; aerosols.

106438 Chemical Characterization of Organic Materials Related to Coal Conversion. Shults, W.D. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001710. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$300,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This research supports analytical needs in ongoing studies of health and environmental effects of coal conversion while affording a concomitant opportunity for the development of methods for particularly important classes of compounds. Chromatographic and spectroscopic techniques are used to separate and identify components in coal derived products and by-products. Multicomponent analyses by gas and liquid chromatographic techniques are emphasized. Gas chromatography is applied with element selective detectors to determine sulfur, nitrogen, and hydrocarbon classes of compounds. Mass spectrometry, infrared, and fluorescence emission spectroscopy are used to identify components. An important part of this work is the isolation and characterization of a polycyclic aromatic hydrocarbon (PAH) fraction from coal derived samples on hand. Development of this methodology is important in programs which are studying the mutagenic and carcinogenic potentials of these materials. This work proposes to study these materials from a stance involving close interaction with life sciences studies in order to provide the best and most efficient use of resources.
Keywords: gas chromatography; mass spectroscopy; hydrocarbons; organic sulfur compounds; organic nitrogen compounds; polycyclic aromatic hydrocarbons; fluorescence spectroscopy; synthetic fuels; chemical analysis; health hazards.

106439 Nucleic Acid Biochemistry of Cells. Volkin, E. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002374. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$250,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Our nucleic acid investigations are targeted towards the effects of deleterious environmental pollutants associated with the chemistry and use of fossil fuels. We have initiated studies on cell lines derived in vitro from tracheal epithelial explants previously exposed in vivo to chemical carcinogens. The objective is to investigate changes in RNA biochemical pathways in tracheal epithelial cells as they progress from a clearly nonmalignant to an altered and finally to a malignant state during subculture in vitro. Events marking the evolution of neoplasia (alterations in growth capacity, morphological transformations, and acquisition of tumorigenicity) will undoubtedly correlate with transitions in the regulation of transcription of these cells. Previous experiments will continue to be directed toward evaluating molecular mechanisms of RNA transcription, processing and degradation associated with chemical toxicity.
Keywords: fossil fuels; pollution; biological effects; cell cultures; animal cells; epithelium; oncogenic transformations; rna; transcription; in vitro.

106440 Radionuclide Sources in the Coastal Zone. Cutshall, N.H. (Oak Ridge National Lab., Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 002528. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this research is to determine rates and mechanisms of the transfer of coastal zone pollutants. Soluble and particulate materials are acted upon by physical, chemical and biological processes which determine their ultimate distribution in the ocean. Natural and artificial radionuclides will be analyzed in samples of sediment and biota. Radionuclides will be used as timing tracers for ecological processes. It is expected that understanding of coastal processes will be improved and governing rates will be determined.
Keywords: gamma radiation; radionuclide migration; sediments; environmental transport; aquatic ecosystems; coastal waters; tracer techniques; ecology; biological effects; water pollution.

106441 Genetic Effect of Plutonium in Mice. Russell, L.B. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002527. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$210,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary purpose of this project is to determine the frequency of plutonium induced transmitted gene mutations in mice. There is at present no information on this subject, and it is needed, as an integral part of environmental impact statements, for an estimate of the genetic risks of plutonium in man. Some plutonium-induced chromosomal damage in mouse reproductive cells has already been detected, and there is reason to believe that gene mutational damage in the stem cells in the testis may be greater. The gene mutatic study will be supported by dosimetry (autoradiography and liqu scintillation counting), and by survival counts on spermatogoni... stem cells. Concomitant with the gene mutation work, two types of chromosomal aberrations, including transmitted translocations, which have not been previously studied with plutonium, will be investigated.
Keywords: mice; plutonium; radionuclide kinetics; genetic radiation effects; mutation frequency; chromosomal aberrations.

106442 Chemical Toxicology. Witschi, H.R. (Oak Ridge National Lab., Biology Div., P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002362. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$266,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The chemical toxicology program will provide information on the possible impacts of new coal conversion technologies on human health. Selected materials associated with energy generation and synthetic fuels production will be examined in acute, subacute and chronic toxicity studies. This will help to classify the agents according to overall toxic potential and help to define possible target organs. Where necessary, in-depth studies on the mechanism of action of selected agents at the molecular and cellular level will be added. This will be accompanied by studies on the pathogenesis of acute and chronic lung disease, particularly toxic lung fibrosis, enhancement of toxicity by interaction of chemicals in respiratory tract and liver, the effects of certain metals (Cd, Ni, Pb, Be) on bone matrix formation, and studies on uptake, distribution, translocation and excretion of toxic agents. The program will enable us to identify toxic hazards associated with coal-conversion technology, to explore and to understand mechanisms of toxicity and to analyze the pathogenesis of acute and/or chronic diseases. Ultimately, predictions of human risk and safety assessments can be made on a scientific basis.
Keywords: coal industry; health hazards; energy conversion; synthetic fuels; toxicity; biochemical reaction kinetics; chemical effluents; pathological changes; respiratory system diseases; liver; cadmium; nickel; lead; beryllium; uptake; distribution; translocation; excretion; biological localization; metabolism; biological models; synthetic fuels industry.

106443 Field Site Environmental Research Related to Coal Conversion. Gehrs, C.W. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** 02382. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$225,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

This proposal serves as the core of the ORNL site specific research activities related to coal conversion. It has two primary objectives during initial phases: (1) to gain insight into the persistence, fate, and availability of various constituents expected to be contained in coal conversion effluents through on-site/near-site collection, chemical analyses, and quantification; and (2) to determine the types of environmental parameters that require investigation at major coal conversion facilities if an environmental assessment of their operation is to be made. Initial research will be directed at a coking plant site with three classes of trace organic contaminants being studied. They are the polycyclic aromatic hydrocarbons (PAH) and their nitrogen- and sulfur-containing analogs.
Keywords: coal gasification; coal liquefaction; liquid wastes; gaseous wastes; chemical analysis; coking plants; organic compounds; trace amounts; polycyclic aromatic hydrocarbons; organic nitrogen compounds; organic sulfur compounds; environmental impacts; ornl; environmental transport.

106444 Intermediary Metabolism of Mutagens. Russell, L.B. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002375. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Experiments on chemical mutagenesis in the mouse, being performed elsewhere in the mammalian genetics section, are aimed at deriving risk estimates for man. The present project will explore the intermediate metabolism of these potential mutagens. Specific ly, it will be investigated whether the initial compound or so other metabolite reaches the target cells, whether a mutagen ... inactivated, whether induction occurs, and if so by what mechanism(s). The early work in this project will concentrate on a type compound of significance in coal technologies. The binding of metabolites to molecular targets in germ cells and in cells of embryos will be investigated. The latter is of significance since part of the

mutagenesis effort involves somatic mutations that are induced in embryos. A spin-off from the intermediate metabolism project will thus also benefit the teratology effort elsewhere in our section. **Keywords:** metabolism; mutagenesis; mice; mutagens; embryos; coal industry; chemical effluents.

106445 Mechanisms of Teratology-B. Filler, R.S. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 0002373. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Methods being developed to study the initiation of teratological pathways will be used in the testing of compounds produced in coal-related technologies. It is hoped that the identification of initiating mechanisms will lead to more rapid testing and may make it possible to predict the teratogenic potential for entire classes of compounds. Teratological pathways are thought to be initiated by differential cell killing or slowing of division rates, by loss or alteration of the differentiational potential of primordial cell types, or by combinations of these factors. Further, in man and other mammals, a teratogenic agent may act not only directly on the embryo itself, but indirectly by exerting an effect on the maternal organism. To test for these various mechanisms, we are (1) looking for inhibitions of differentiational capacity of transplantable teratocarcinomas (normally pluripotent) treated in temporary hosts and then transplanted; (2) studying reduction in survival after in vivo treatment of early cleavage-period embryos; and (3) transplanting treated preimplantation embryos from genetically responsive strains to non-responsive host females, and vice versa. When fully developed with the use of type compounds, these systems will be used for the testing of compounds and mixtures produced by coal-related technologies.
Keywords: teratogenesis; biological models; coal industry; bioassay; mutagen screening; health hazards.

106446 Development of Guidelines for Monitoring Ecological Effects at Department of Energy Sites. Reichle, D.E. (Oak Ridge National Lab., Environmental Sciences Division, Building 1505, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 02936. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: Coal(50); solar(40); geothermal(10) **R and D categories:** Pollutant monitoring.

The objective is to develop ecological effects monitoring protocols for non-radiological impacts of developing energy technologies. Initial phase includes analysis of existing statutory requirements for ecological monitoring and preparation of ecological effects monitoring strategies. Later phases will concentrate on site-specific testing of prototype ecological monitoring programs.
Keywords: energy facilities; environmental impacts; monitoring; us doe; recommendations; energy source development.

106447 Environmental Reference System. Harris, W.F. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** 002937. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

We propose to consider biological and environmental monitoring as a step in the prediction of biological response to environmental changes, monitoring of selected parameters, and assessment. Prediction will focus on hypotheses of change, integrate biological and environmental relationships, and marshall existing information needed to construct conceptual and mathematical models to improve predictions. Monitoring will require the establishment of environmental reference systems where standard protocols and procedures for biological and environmental monitoring are used to assess long-term trends and predicted changes in environmental quality. The establishment of such reference systems will allow the development and testing of impact assessment, will provide test sites for the development and evaluation of predictive models for forecasting environmental and biological response of proposed activities, and will serve as living laboratories for demonstrating the impact of man's activities.
Keywords: environment; monitoring; mathematical models; optimization.

106448 Tritium Oxidation and Exchange. Easterly, C.E. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 002610. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: nuclear fusion(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

One of the principal issues in occupational protection, and environmental assessments is that of the rate of conversion of molecular tritium to tritiated water. An understanding of the formation mechanisms for tritiated water is necessary in order to develop appropriate methods to reduce the conversion rate of HT to HTO, and hence, to reduce the potential occupational risk within an enclosed area. Further, the knowledge of the rate is important in order to perform environmental health effect analyses. Within this program, the rate of conversion will be measured over the anticipated range of concentrations and environmental factors. Additionally, an understanding of the detailed molecular interactions will be pursued.
Keywords: tritium oxides; tritium; oxidation; health hazards.

106449 Automated Analysis for Workplace Environment. Griest, W.H. (Oak Ridge National Laboratory, Analytical Chemistry Division, Bldg. 4500S E160, Oak Ridge, TN, 37830). **Project number:** 002613. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of this study is to develop cost-effective (automated if necessary) methods for the routine determination of workplace pollutants. Polycyclic aromatic hydrocarbons, BaP in particular, were chosen to be examined first. A combined thin layer chromatography-fluorescence method developed by an EPA laboratory for ambient airborne sample analysis has been evaluated for its applicability to complex coal-derived materials. Good agreement with the more laborious standard method was found. The approach offers the possibility of rapid multiple sample analysis. The program has been temporarily terminated to provide resources for a site-specific characterization project.
Keywords: polycyclic aromatic hydrocarbons; benzopyrene; chemical analysis; thin-layer chromatography; fluorescence; working conditions; sampling.

106450 Viral and Radiation Carcinogenesis. Frazier, M.E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000387. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$350,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The measurement of overt pathologic changes induced by ionizing radiation has produced data vital to establishment of radiation protection standards. Such gross changes, however, like most clinical measurements, merely reflect the effects of events occurring early in the growth, development, and differentiation of the cell. The studies included under this project are concerned with basic biological and biochemical indices that may aid in in the detection and understanding of the primary effects of radiation insult and the initiation of the observed malignancies. Our primary objective is to determine the role of virus in radiation-induced malignancies and in the process to identify those changes (virological, immunological, etc.) which might serve to monitor the oncogenic process. We are, in this effort, examining: (a) leukemia induced by the beta-emitter 90-Sr; and (b) the lung and bone tumors resulting from inhalation of the alpha-emitters 238-Pu and 239-Pu.
Keywords: viruses; neoplasms; carcinogenesis; pathological changes; leukemia; radioinduction; plutonium 238; plutonium 239; biological radiation effects; radionuclide kinetics.

106451 Inhalation Hazards to Uranium Miners. Cross, F.T. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000393. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$625,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this project is to determine the specific biological effects of daily exposures to known levels of pathogenic uranium mine air contaminants, using both large and small experimental animal models of human respiratory disease.
Keywords: miners; inhalation; uranium ores; pathological changes; respiratory system diseases; epidemiology; uranium mines; lungs; daughter products; radon; health hazards; air pollution.

106452 Fallout Rates and Mechanisms. Young, J.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000533. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objectives are (1) to provide a continuous record of the atmospheric concentrations of a spectrum of radionuclides which can be used to assess the hazard to the environment resulting from future releases of radionuclides by nuclear weapons tests, nuclear

power reactors, or nuclear fuel reprocessing plants; (2) to detect and characterize episodes of high atmospheric radionuclide concentrations; and (3) to develop an improved understanding of physical processes which determine atmospheric concentrations and rates of removal. The atmospheric concentrations of a spectrum of 39 radionuclides are being measured continuously at Richland, Washington and Point Barrow, Alaska to provide a record of radionulcide concentrations to be used in assessing the hazards resulting from future releases. When episodes of high concentrations occur the concentrations of 47 radionuclides will be measured, the size spectrum and physical, chemical and radiochemical properties of the radioactive particles measured, and the I-131 dose to man through the grass-milk-thyroid pathway calculated from the measurements of I-131 concentrations in grass samples throughout the United States. Radionuclide measurements will be used to calculate atmospheric residence times, vertical diffusion rates, and deposition velocities.
Keywords: nuclear power plants; radioecological concentration; nuclear weapons; fallout; radiation monitoring; testing; earth atmosphere; radionuclide migration; meteorology; food chains; washington; alaska; iodine 131; diffusion; deposition; radioisotopes; radioactive aerosols; health hazards; thyroid.

106453 Air Pollution Dry Deposition. Sehmel, G.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000534. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$110,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

Toxic particles and gases released from nuclear plants and other energy systems constitute a potential inhalation hazard to individuals in the environment. Deposition is a natural air cleaning process which mitigates the airborne exposure. This study will determine deposition rates and will develop predictive models accounting for the influence of particle size, gas characteristics, wind velocity, deposition surface, and other variables on deposition rates. Deposition rates will be measured in wind tunnel and field experiments as a function of these important variables.
Keywords: radioisotopes; particle size; deposition; gases; inhalation; radioactive aerosols; solids; mathematical models; fallout; radiation hazards; health hazards; wind tunnels; surfaces.

106454 Atmospheric Boundary Layer Studies. Horst, T.W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000539. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to gain a better understanding of the dispersive capacity of the atmospheric boundary layer and to provide a basis for the improvement of predictive models. Vertical gradients of the ambient atmospheric pollutants SO/sub 2/, SO/sub 4/, O/sub 3/, and NOx will be measured near the ground in both western and eastern Washington state. These gradients will be combined with concurrent micrometeorological measurements to infer the rate of deposition of these pollutants as a function of the meteorology and of the characteristics of the deposition surface. Additionally, an analytical/numerical simulation of resuspension is being made to determine the contribution which the previously deposited material makes to the annual exposure when it is reinstated into the atmosphere.
Keywords: earth atmosphere; boundary layers; deposition; diffusion; environmental transport; mathematical models; plumes; air pollution; particle resuspension; sulfates; sulfur dioxide; ozone; nitrogen oxides.

106455 Particle Resuspension and Translocation. Sehmel, G.A. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000549. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Radioactive particles once deposited on natural or man-made surface can be resuspended by wind and mechanical activity so that the particles once more might become a radiological hazard to man. The resuspension process may be repeated many times. The objectives of this research are to establish resuspension release rates and to develop models for predicting atmospheric concentrations and downwind movement of particles on the basis of observable and/or measurable particle, surface, and atmospheric variables. An important concern to nuclear energy development is the resuspension of plutonium and other transuranics from inadvertent soil contamination, from transportation accidents, and from fallout from nuclear devices. Resuspension is measured with both controlled inert tracers placed on surfaces and with radioactivity from environmentally contaminated areas. Resuspension rates are measured automatically as a function of wind speed increments and atmospheric stability as well as mechanical disturbances causing resuspension. These field experiments are directed toward determining any resuspension rate changes with time and the effects of increasing resuspension surface roughness. Ultimately, resuspension will be measured for representative climate and geographic conditions.
Keywords: particle resuspension; radionuclide migration; radioactive aerosols; mathematical models; air pollution; plutonium; transuranium elements; fallout; meteorology.

106456 Plant Transuranic Behavior, Soil/Plant. Wildung, R.E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000551. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$320,000.
Related energy source: Coal(20); nuclear fission(80) **R and D categories:** Environmental transport and conversion of pollutants.

Soil and plant studies will include: (1) effects on the soil microbial population and processes; (2) potential for alteration of solubility through formation of transuranic complexes in soil and the microflora role; (3) plant uptake, transocation and deposition of transuranics; (4) the bond types and chemical forms of transuranics or their metabolites in microbial and plant tissues and soils; and (5) the influence of soil properties, environmental conditions and cropping on these processes. The foliar studies will characterize interactions of airborne transuranics (Pu, Am, Np, and mixed U-Pu oxides), fission products (E.D., TC, I) and ultimately, products of fossil fuel conversion and combustion with foliage of terrestrial plants. Crop species of regional and economic importance having differing leaf morphology and surface characteristics are being used to determine the interrelationships of these parameters with physicochemical aspects of foliary-deposited contaminants such as chemical form, particle size (surface area), and presence of a vector (i.e., solutions, soil particles).
Keywords: transuranium elements; actinides; soils; plants; radionuclide migration; radionuclide kinetics; air pollution; uptake; soil chemistry; soil mechanics; foliar uptake; plutonium; americium; neptunium.

106457 Ale Administration. Rogers, L.E. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000618. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$173,000.
Related energy source: Coal(20); oil and gas(10); oil shale(10); nuclear fission(20); solar(20); geothermal(20) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Terrestrial Ecology Program is an integrated ecosystem level research effort designed to ascertain the implications of energy development in the semi-arid regions of the western states. Basic to evaluating potential environmental stresses associated with energy development technology is an understanding of how the shrub-steppe ecosystem functions and its response to perturbations. This program is dedicated to providing the data base essential for environmental evaluation of a multitechnology basis: coal, oil shale, natural gas, oil, nuclear, solar and geothermal.
Keywords: terrestrial ecosystems; arid lands; usa; energy source development; environmental impacts; data acquisition; plants; animals; baseline ecology.

106458 Environmental Behavior of TE-99 and I-129 . Wildung. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000623. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$152,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

, Principal research emphasis is on development of an understanding of the behavior of I-129 and Tc-99 in the environment, based on (1) the important chemical species likely to be released, (2) the chemistry and the microbiology in soils and aquatic systems as these influence the solubility form and biological availability over the long-term, and (3) the mechanisms and kinetics of uptake, sites of deposition, and chemical forms in trophic level components. The approach is based on laboratory studies conducted under controlled conditions in conjunction with the use of other available information to predict behavior in the natural environment. Concurrent ecosystem studies allow verification of hypotheses and development of predictive models.
Keywords: technetium 99; iodine 129; radioecological concentration; environmental transport; terrestrial ecosystems; soils; aquatic ecosystems; food chains; radionuclide migration; soil chemistry; microorganisms; animals; plants; radionuclide kinetics; solubility; mathematical models.

106459 Sublethal Effects of Tritium on Aquatic Systems. Strand, J.A. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000628. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.

Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In preliminary studies at this laboratory on latent effects of chronic low level tritium irradiation, it was demonstrated that immune competence as measured in juvenile and yearling rainbow trout against a naturaly occurring bacterial pathogen was significantly suppressed following exposure to tritiated water administered over embryogenesis. The proposed work is an outgrowth of the above preliminary findings and is necessarily directed to understanding in tritium irradiated test fish.

Keywords: aquatic ecosystems; tritium; chronic exposurc; trout; pathological changes; immune reactions; biological radiation effects; radiosensitivity.

106460 Chemistry of Oceans Solutions. Crecelius, E.A. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000641. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$119,000.

Related energy source: Coal(25); oil and gas(25); nuclear fission(25); geothermal(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This research program is examining the input rate of energy-related contaminants to the Pacific Northwest marine water and the rate of removal of contaminants from these waters. In order to predict the impact of energy-related contaminants introduced into the oceans, it is necessary to establish the input rate and investigate the biogeochemical and physical processes that control the distribution and behavior of these contaminants. The future environmental quality of the oceans is dependent upon man's knowledge of marine chemical processes and his ability to use this knowledge to prevent serious environmental insults from occurring. During the past year, the atmospheric input rate of a dozen elements was determined and the distribution of several elements in the water column established. Atmospheric input contributes more than 25% of several metals to Washington coastal waters compared to the Columbia River input. Measurements of the rate of transfer of elemental mercury vapor from air to sea water were made in the laboratory. These experiments showed that surface microlayer and suspended particulates are important temporary snks for mercury entering sea water from the air. During the next year, the atmospheric input rate of 15 combustion organic compounds (polynuclear aromatic hydrocarbons-PAH) will be determined for the Pacific Northwest. Also, the removal rate of several metals from water to sediments will be measured for the Washington Shelf waters. During the next several years, this program will continue to quantify the input rates of contaminants to the Pacific Northwest marine waters and examine the processes that remove contaminants from these waters. The final product of this program will be a descriptive model that will predict the concentrations and fates of various contaminants in the Pacific Northwest, assuming a given source term.

Keywords: water chemistry; seas; pacific ocean; contamination; spatial distribution; water quality; environmental impacts; washington; coastal waters; columbia river; mercury; polycyclic aromatic hydrocarbons; sediments; air; removal; mathematical models; forecasting; deposition; water pollution.

106461 Trace Metal Metabolism in Ecosystems. Roesijadi, G. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000644. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.

Related energy source: Coal(50); oil and gas(20); nuclear fission(30) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This research program is examining the roles of low molecular weight, metal-binding proteins and lysosomes (two known cellular storage and detoxification systems for metals) in relationship to the toxicity of the metals. Results to date indicate the occurrence of metal-binding proteins in all the species studied (clams, mussels, and polychaetes). Exposure to mercury or copper results in the induction of the metal-binding protein and an increased binding of the respective metal. This binding appears to serve a detoxification function and, thereby, protects the organism from the potentially harmful effects of accumulated metal. Apparent saturation of the metal-binding protein and increased lysomal activity is observed in stressed individuals and may be related to metal toxicity. Field studies using the marine mussel have indicated that metal-binding proteins are involved in the sequestration of mercury in mercury-contaminated environments. Efforts to further characterize the metal-binding proteins and lysosomes and their roles in the detoxification and toxicity of metals are continuing. Continued examination of field-exposed individuals will aid in our understanding of the responses of organisms exposed in the natural environment.

Keywords: metals; trace amounts; ecosystems; toxicity; water pollution; mercury; copper; molluscs; crustaceans.

106462 Radioecology of Nuclear Fuel Cycles. Schreckhise, R.G. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 000834. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$295,000.

Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

This study is designed to provide information to help assess the environmental impacts and certain potential human hazards associated with nuclear fuel cycles including issues associated with nonproliferation alternative systems. This study will facilitate the development of a sufficient data base to define and quantify biological transport routes which will permit credible predictions and assessment of routine and potential large-scale releases of radionuclides and other toxic materials. These data, used in assessment models, will increase the accuracy of estimating radiation doses to man and other biota. Information obtained from existing storage and disposal sites will provide a meaningful radioecological perspective with which to improve the effectiveness of waste management practices. Results will provide information to determine if waste management procedures on the Hanford Reservations have caused ecological perturbations and if so, the source, nature and magnitude of such disturbances.

Keywords: hanford production reactors; plutonium isotopes; americium isotopes; environmental effects; waste processing; ponds; limnology; transuranium elements; distribution; contamination; aquatic ecosystems; radionuclide migration; radioactive wastes; water pollution; reprocessing; nuclear fuels; spent fuels; fuel cycle; radioecology.

106463 Toxicology of Krypton-85. Ballou, J.E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001257. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is concerned with evaluating the biological effects of exposure to 85-Kr in rodents and larger animal species. Included are both short-term and chronic exposure studies to determine tissue distribution and retention kinetics for metabolic modeling purposes, as well as long-term biological effects, for purposes of defining the tissues at risk. Also included are dose-effect studies to determine tumorigenicity, teratologic potency, and capacity to induce changes in lung biochemistry, pulmonary function, and hematopoiesis.

Keywords: krypton 85; toxicity; rats; tissue distribution; metabolism; radionuclide kinetics.

106464 Toxicology of Thorium Cycle Nuclides. Ballou, J.E. (Battelle pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 0001258. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.

Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The uranium-thorium breeder reactors proposed for nuclear power production, and other thorium fuel systems in conventional reactors, utilize fuels and fuel recycle process solutions that have not been evaluated for biological hazard. Compounds of particular interest include the mixed U-Th oxides and nitric acid solutions of these materials and their fission products. The long-term biological effects of inhaled fuels, 232U, 233U, and process solutions will be determined and compared with ongoing studies in rats exposed to transuranic elements.

Keywords: thorium isotopes; toxicity; breeder reactors; uranium 232; uranium 233; reprocessing; biological effects; nitric acid; rats.

106465 National Environmental Research Park - Ecology Studies. Rickard, W.H. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001261. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.

Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project provides for the operation of the Arid Lands Ecology Reserve as a functional but separate entity of the Hanford National Environmental Research Park. It also provides for the promotion and use of the Hanford NERP by the scientific community in general. Another important use of the NERP is for the long-term monitoring of ecological systems likely to be impacted by developing energy technolgies.

Keywords: terrestrial ecosystems; aquatic ecosystems; hanford reservation; monitoring.

106466 Transuranic Weathering in Plants. Schreckhise, R.G. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001329. **Contract:** EY-76-C-06-1830. **Support-**

ed by: Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The effect of time (weathering, aging, and associated biological processes in soil) on the change in availability of transuranium elements to be taken up by plants from soil is studied. Range plants, which provide forage for livestock and important wildlife species, and crop plants are fundamental links in various food chains. This study provides valuable information on the effects of weathering and aging on the uptake of transuranics by plants from soil. Range and crop plants are grown in a realistic field environment in which the soil is exposed to the yearly cycle of wetting, drying, freezing, thawing, and associated microbial processes. The contaminated soil is contained in small weighing lysimeters which allows the measurement of various ecophysiological parameters and facilitates observations to be continued over a 20-yr period.
Keywords: transuranium elements; weathering; plants; radionuclide kinetics; age dependence; time dependence; radionuclide migration; uptake; microorganisms.

106467 Bioavailability of Energy Effluents on Coastal Ecosystems. Gibson, C.I. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001332. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$380,000.
Related energy source: Coal(30); oil and gas(40); oil shale(30) **R and D categories:** Environmental effects assessment.

Research has shown that the quantity of ionic copper is correlated to biological uptake and toxicity, and that natural sea water has a limited capability to complex ionic copper and make it biologically unavailable and nontoxic. The natural complexing capacity is approximately 15 to 20 mu g/l, and the addition of organic compounds such as tris, cysteine, glycine, sodium citrate and histodine will increase the complexing capacity. Other studies are investigating the role sediments play in removing or contributing to the biologically active pool of contaminants. Our research has shown that the metal is available to organisms that feed on sediments, but not available to organisms that feed from the water column. The current investigations are looking at chemical and physical factors affecting the availability of the sediment-bound contaminants and the role microbes play in mediating the distribution of metals between bioavailable and nonbioavailable forms.
Keywords: aquatic ecosystems; biological accumulation; water pollution; copper; metals; seawater; decontamination; complexes; toxicity; organic compounds.

106468 Inhaled Transuranics in Rodents. Sanders, C.L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001406. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$525,000.
Related energy source: nuclear fission(75); nuclear fusion(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Inhalation exposure constitutes the most likely route of entrance of transuranics into the body following release of transuranic compounds. Lung cancer is the most likely consequence of that exposure. The purpose of this project is to examine in small mammals, the fate, effects and pathogenesis in the lung and elsewhere following inhalation of transuranic compounds. This project should provide data required for hazard evaluation and establishment of permissible exposure limits to man for inhaled transuranics, particularly with respect to radiation dose and dose-distribution.
Keywords: transuranium elements; inhalation; rats; toxicity; lungs; pathological changes; man; maximum permissible dose.

106469 Inhaled Plutonium Nitrate in Dogs. Dagle, G.E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001407. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$390,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To determine the carcinogenicity of inhaled soluble plutonium as compared to insoluble plutonium beagle dogs will be exposed to 238Pu(NO3)4 and 239Pu(NO3)4 aerosols in a dose-effect relationship experiment. Three hundred dogs will be held for lifespan observation; 80 dogs will be periodically sacrificed to obtain information on deposition, translocation and excretion of inhaled plutonium nitrate, and on the pathogenesis of dose-related effects.
Keywords: plutonium 239; inhalation; solubility; beagles; lungs; plutonium nitrates; toxicity; pathological changes.

106470 Aerosol and Analytical Technology. Cannon, W.C. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001408. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is concerned with improvement of aerosol exposure techniques for nuclear power source materials, including generation and characterization of inhalation atmospheres, relation of aerosol properties to respiratory deposition and clearance, and accuracy of aerosol exposure dose control. It also seeks to improve the radiochemical analysis procedures and sample analysis and handling techniques, including improvement of sample management and quality control to reduce sample backlog and storage problems, to reduce the cost of low-level Pu analysis, to improve the sensitivity of the Pu analysis procedures, and to develop new techniques for low-level assay of radioisotopes.
Keywords: radioactive aerosols; inhalation; aerosol generators; radiochemical analysis; plutonium; cost; sensitivity; lung clearance; respiratory system; exposure chambers; deposition; sensitivity.

106471 Modifying Radionuclide Effects. Mahlum, D.D. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001410. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$105,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Potentially important factors studied in this project include the effect of pregnancy and lactation, iron deficiency, alcohol ingestion, and protein deficiency. In addition, a study of the relationships between the size of the exposed area and the effects of beta-irradiation on the skin of miniature swine is being continued under this project.
Keywords: radiosensitivity effects; iron compounds; nutritional deficiency; alcohols; ingestion; proteins; pregnancy; beta particles; skin; radiosensitivity; swine; lactation; radioisotopes.

106472 Gut-Related Studies of Radionuclide Toxicity. Sullivan, M.F. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001411. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$255,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is concerned with the behavior of radioactive materials of importance in the nuclear industry that may be ingested as a consequence of a reactor accident or of unavoidable occupational exposure or after release to the environment and incorporation into the food chain. Current emphasis is directed toward evaluating hazards from ingested actinides as a function of animal age, animal species, or chemicophysical state of the radionuclide. This includes information on the disposition of nuclides that are ingested as particulates of various sizes or in combination with animal or plant tissue in which they become incorporated.
Keywords: radionuclide kinetics; toxicity; actinides; food chains; radionuclide migration; animals; plants; ingestion.

106473 Analytical Techniques for Measurement of 99-Tc in Environmental Samples. Kaye, J.H. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001428. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective of this project is to develop a mass spectrometric technique for high sensitivity analyses of Tc-99 in environmental and other materials. The measurement sensitivity to be attained is to be more than 100 times greater than that available with existing analytical techniques. Such sensitivity is required for performance of programmed environmental studies of Tc-99. The analytical approach to be employed involves, first, the addition of a known amount of Tc-97 tracer to the sample. Then a radiochemical separation and purification of the Tc-97 and the unknown quantity of Tc-99 is made. The resulting solution is loaded onto a mass spectrometer filament and the ratio of Tc-97/Tc-99 is determined. Since the amount of Tc-97 which was added is known, the absolute amount of Tc-99 present in the sample can be calculated directly from the measured isotopic ratio.
Keywords: technetium 99; measuring methods; environment; mass spectrometers; specifications; technetium 97; contamination; monitoring; ecosystems; radioactive effluents; radionuclide migration; radiation detectors; mass spectroscopy.

106474 Inhaled Plutonium Oxide in Dogs. Park, J.F. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001460. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$850,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is concerned with: (1) long-term experiments to determine the lifespan dose-effect relationships of inhaled 239PuO2 in beagles; (2) long term experiments to determine the life-span dose-effect relatonship of inhaled 238PuO2 in beagles; (3) continuing studies on the late effects of inhaled 238PuO2 in beagles; (4) continuing studies on the late effects of single large 238PuO2 microspheres in the lungs of beagles; (5) continuing studies on the late effects of inhaled large 238PuO2 microspheres in beagles; and (6) shorter-term experiments in beagles to study the retention and translocation of transplutonium elements, such as 241AmO2 and 244CmO2, that are prominent components of nuclear fuels.
Keywords: plutonium 239; inhalation; plutonium oxides; plutonium 238; americium 241; curium 244; life span; dose-response relationships; delayed radiation effects; acute irradiation; radionuclide kinetics; radionuclide migration.

106475 Fetal and Juvenile Radiotoxicity. Sikov, M.R. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001461. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$330,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Many of the biological parameters used to calculate permissible levels of exposure of adults to radioactive materials are inappropriate for the rapidly growing infant or child or for the pregnant female. These differences, when considered in conjunction with the greater intrinsic radiosensitivity of the immature organism, emphasize the need for more detailed information on the metabolism and toxicity of radionuclides in the prenatal and juvenile mammal. The aim of this project has, therefore, been to obtain the information needed to establish appropriate exposure limits for the radionuclides of the greatest potential hazard to these age groups.
Keywords: adults; radiation doses; maximum permissible dose; infants; pregnancy; plutonium 239; americium 241; fetuses; radionuclide kinetics.

106476 Trace Analysis by Laser Techniques. Buschaw, B.A. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 001617. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$185,000.
Related energy source: Coal(30); oil shale(30); nuclear fission(20); nuclear fusion(20) **R and D categories:** Pollutant measurements technology.

This study is aimed at developing laser techniques for the detection of very low levels of pollutants on either a real-time basis or with minimum sample preparation. The objective of this program will be to develop techniques by which many species of pollutants may be detected at concentrations which are orders of magnitude below those achieved by conventional means. Where possible, real-time detection will be achieved for non-nuclear and nuclear pollutants. The program will take advantage of several properties of dye lasers to allow real-time analysis of low level trace constituents. Species which have excited electron transition states in the near ultraviolet are viable candidates for this technique. Following excitation, the species of interest will be detected either by fluorescent emission or by ion pair detection following further excitation to the ionization level. Since the narrow band widths of dye lasers allow selective excitation of a given species without interference from neighboring atoms or molecules, sample preparation is generally limited.
Keywords: dye lasers; trace amounts; air pollution; laser spectroscopy; monitoring; chemical analysis.

106477 Inhalation Hazards to Coal Miners (Coal Dust and Diesel Engine Exhaust). Kariagenes, M.T. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001975. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this project are to study the biological behavior and effects of present and anticipated coal mine air contaminants, with particular emphasis on the mechanisms of development of the chronic respiratory disease, coal workers pneumoconiosis (CWP), and to evaluate the degree of hazard associated with possible extensive use of diesel engines in coal mines as they are currently used in hard-rock (non-gaseous) mines. This research will correlate results from air sampling in working coal mines, together with experience in characterization of complex organic gas-aerosol atmospheres from combustion engine exhausts, with observed biological changes in large and small experimental animal models developed for study of human respiratory diseases.
Keywords: coal mines; indoor air pollution; dusts; diesel engines; exhaust gases; chronic exposure; inhalation; coal miners; biological effects; pneumoconioses; health hazards; sampling; laboratory animals; biological models; aerosols; carcinogenesis; lungs; pathological changes; toxicity; synergism; etiology.

106478 Effects of Pollutant Metals. Ragan, H.A. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001979. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$105,000.
Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

Nutritional deficiencies are common in both industrialized and underdeveloped countries. Heavy metal pollutants from energy conversion sources are known to be detrimental to the hematopoietic and immune systems, and some are carcinogenic. This project will examine the interactions of specific nutritional deficiencies and heavy metal exposures with particular emphasis on gastrointestinal absorption of the metals and subsequent effect on the hematopoietic and immune system.
Keywords: metals; nutritional deficiency; blood formation; immunity; carcinogenesis; metabolism; toxicity.

106479 Toxicology of Plutonium--Sodium. Hackett, P. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001981. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$250,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project seeks to: (1) devise methodology for the continuous generation of condensation aerosols from vaporization of LMFBR-type fuels; (2) devise methods for producing mixed aerosols of fuel and sodium under several conditions, including passage of the fuel aerosols through sodium vapor; (3) determine the physicochemical characteristics of the aerosols prepared; (4) determine the biological characteristics of such aerosols; and (5) (if results are favorable) evaluate the biological effects of mixed fuel-sodium aerosols prepared under differing conditions.
Keywords: plutonium; sodium; toxicity; lmfbr type reactors; environmental impacts; biological effects; aerosols; air pollution.

106480 Toxicology of Inhaled Acid Aerosols. Ballou, J.E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001988. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will investigate the long-term biological effects in rats following inhalation of inorganic acid aerosols generated from solutions of nitric acid, sulfuric acid, and hydrochloric acid. Studies include both single and multiple exposures to acid concentrations ranging from the threshold limit value (TLV) to higher levels approximating the maximum dose tolerated in repeated exposures under our conditions.
Keywords: toxicity; aerosols; rats; inorganic compounds; nitric acid; sulfuric acid; hydrochloric acid; inhalation; air pollution; biological effects.

106481 Analogs for Transuranic Environmental Chemistry. Weimer, W.C. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002004. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Satisfactory data on the long-term effects of biogeochemical weathering processes on the biological availability of transuranium elements is presently not available. This program addresses this problem by using naturally occurring elements which behave similarly to the transuranic elements and which have been subjected to long-term weathering processes. Concentration ratios for analog elements will be measured from the weathered portions of soils into plants, and these concentration ratios will be compared to corresponding transuranium elements. Extrapolation of these data will allow us to make estimates of the eventual steady-state equilibrium in the environment for soil-to-plant concentrations of transuranic elements. Plant lysimeters will be spiked with chemical forms of Nd, 241-Am, and 244-Cm to compare the soil-to-plant concentration ratios for these elements. Short-term laboratory experiments will be performed using the nitrate form of these isotopes with soils having a significant organic matter content. These studies will allow a determination of the distribution coefficients of these elements in soil--Ca(NO3)2 systems as a function of equilibrium time and soil pretreatment. Chemical extraction methods will be developed to determine the maximum and minimum extractible concentrations of the analogs in order to define the upper and lower concentration limits of the pool of potentially mobile species. These techniques will be applied

to representative soils and associated crops for the determination of the transfer coefficients of the analog elements.
Keywords: transuranium elements; neodymium; americium 241; curium 244; plutonium isotopes; environmental exposure pathway; radioecological concentration; soils; terrestrial ecosystems; radionuclide migration; plants; radionuclide kinetics.

106482 Quantitative Aspects of Transuranic Field Studies. Gilbert, R.O. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002011. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$82,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to provide quantitative and statistical support and methodology for the design and analysis of plutonium and other transuranic ecosystem and field studies. Emphasis is being directed toward the evaluation or development of methods for sampling and statistical analyses designed to identify and deal with the very high variability present in plutonium and other transuranic concentrations in environmental samples. The design problem is being considered in terms of the rather different objectives that may be considered in planning field studies, such as the movement and dynamics of plutonium within between ecosystem components and the estimation of amounts and concentrations in these components and, more generally, sampling to assess the need for clean up or to evaluate hazards.
Keywords: plutonium; transuranium elements; radiation monitoring; environment; ecosystems; radionuclide migration; radioactivity; environmental materials; sampling; risk assessment; statistics; radioecological concentration.

106483 Chemical Reaction Kinetics of Combustion Products. Smith, R.D. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002123. **Contract:** EX-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$175,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The goal of this program is to provide a model whereby the chemical and physical forms of flue gas emissions can be predicted from the given input of coal composition, combustion temperature, flue gas temperature, pressure profiles, precipitation devices and stack conditions. The scope of the model is limited to the physical and chemical transformations which occur from the instance of combustion in the firebox to a point in the plume where chemical and physical transformations of the aerosols are no longer dominated by plume conditions. Physical and chemical measurements will be made of flyash, char and volatile combustion products in the laboratory and at plant sites for empirical parameter definition within a developing physical model. These data will be compared with model calculations. The initial theoretical model will be developed for a specific 600 MW coal-fired power plant.
Keywords: combustion products; flue gas; fossil-fuel power plants; fly ash; chars; combustion kinetics; aerosols; chemical reactions.

106484 *Oil Shale and Tar Sand Effluent Characterization.* Fruchter, J.S. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002126. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$280,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

This study will identify potential pollutants which may reach the environment as a result of emissions from oil shale and tar sand retorting operations. Such a study is necessary at the present time because of currently vigorous interest in oil shale and tar sand technology being shown by both private and government sectors. Effluents from both above-ground and in situ processes will be characterized for a wide spectrum of inorganic, metallorganic and organic compounds and species. A wide variety of analytical methods including gas chromatography-mass spectroscopy, neutron activation, x-ray fluorescence, high pressure liquid chromatography, atomic absorption and plasma DC-emission spectroscopy will be used for the characterization measurements. Effluents to be characterized will include raw oil shale, spent shale, crude shale oil, various shale oil boiling fractions, upgraded shale oil, process water, offgases, as well as tar sand and crude oil from the sand. Priority will be given to those processes which show promise of early commercialization. On analysis, priority will be given to compounds of elements known or suspected as being carcinogenic, toxic or otherwise harmful. A list of such compounds and elements to be looked for will be formulated and reported as part of the project. Source term calculations will be made for each process.
Keywords: oil shales; oil sands; in-situ retorting; spent shales; shale oil; shale oil fractions; waste water; elements; lead; mercury; particles; retorting; chemical effluents; oil shale processing plants; oil sand processing plants; oil sands; bitumens; chemical analysis.

106485 Restoration of Surface-Mined Lands in Arid Regions. Sauer, R.H. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002147. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$207,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to demonstrate the use of unmodified spoil banks to direct precipitation to a strip of topsoil between the spoil banks to increase the effectiveness of natural precipitation so the relatively high value agricultural crops can be cultivated without irrigation. It will be demonstrated that a combination of surface treatment, unmodified spoil bank shape and crop species can survive and be productive without irrigation in arid areas. Artificial spoil banks or mounds have been constructed on the Hanford Reservation in one of the driest areas of the U.S. Four mounds of native alluvium, each 100 m long by 5 m high by 20 m wide are oriented perpendicular to the strongest winds (SW) and four similar mounds, 100 m away, are oriented parallel to these winds, forming six valleys. Each valley will be instrumented for precipitation, wind, soil and air temperature, and soil water content, and planted with relatively valuable and drought-resistant crops such as winter wheat, crested wheatgrass, grapes, and ponderosa pine. These crops require irrigation for survival here. Runoff and surface stability of the mound slopes will be modified with various treatments such as rubbersheeting and paraffin. A seventh area away from the mounds will be similarly instrumented and planted. Plant survival and production will be correlated with microenvironment and surface treatment.
Keywords: coal mining; surface mining; land reclamation; arid lands; spoil banks; revegetation; agriculture; water resources; management.

106486 Oil Shale and Tar Sand Materials. Fruchter, J.S. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002278. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

This program will prepare and document oil shale and tar sand materials to be used for health effects and environmental exposure studies. This material will also be used for analytical procedure development studies. It will provide uniform and well characterized samples for all workers in ERDA laboratories as well as outside laboratories working in analysis and health environmental effects studies. The quality and reliability of results will be improved because they will be obtained on known and homogeneous samples. All such results will be directly comparable. Research materials to be collected and prepared will include oil shale and specific fractions thereof, spent oil shale, crude shale oil, upgraded shale oil, tar sand and crude oil from tar sand. The samples will be suitably prepared, stabilized and characterized for a broad spectrum of inorganic, metallorganic and organic species and compounds. A number of analytical techniques will be used for the characterization including gas chromatography--mass spectrometry, high pressure chromatography, fluorospectrometry, neutron activation, X-ray fluorescence and specific ion electrodes.
Keywords: oil shales; oil sands; health hazards; environmental effects; sample preparation; shale oil; spent shales; chemical analysis; petroleum.

106487 West Coastal Zone Coordination. Templeton, W.L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002547. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

Energy related programs currently sponsored by the Division of Biomedical and Environmental Research are diverse in disciplines and objectives and are being conducted independently. Under the new charter responsibilities and objectives of DOE, it is essential that the programs of these diverse contractors become focused on DOE's programmatic marine science issues and needs. DBER has appointed four coordinators to cover three major geographical areas. This proposal provides for coordination of the Pacific Coast region.
Keywords: pacific ocean; oceanography; research programs; data compilation; recommendations.

106488 Environmental Pollutant Characterization by Direct Inlet Mass Spectrometry. Lagergren, C.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002324. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.

Related energy source: Coal(80); geothermal(20) **R and D categories:** Pollutant measurements technology.

A new analytical technique (based on direct-inlet mass spectroscopy) for air sampling and real-time detection, characterization, and monitoring of airborne particulate pollutants is being developed. **Keywords:** aerosol monitoring; particles; air pollution monitors; mass spectroscopy; sampling; design; aerosols.

106489 Toxicology of Sodium and Lithium. Busch, R. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002718. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will obtain data necessary for establishing emergency standards for sodium-release accidents. It will involve the conceptualization, design, and fabrication of an aerosol generation system and an exposure system for rodents; and the whole-body exposure of adult and immature rats to different concentrations of appropriate aerosols, probably for periods up to 2 hours. The acute response will be determined for the eyes, skin, and pulmonary and gastrointestinal systems. Additional experiments will be designed on the basis of the data obtained in the initial phase of the study. **Keywords:** sodium; lithium; toxicity; emergency plans; air pollution; rats; reactor accidents; aerosol generators; design.

106490 Biological Effects of Magnetic Fields. Mahlum, D.D. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002720. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$290,000.
Related energy source: nuclear fusion(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The development of magnetic fusion power sources will undoubtedly result in the occupational exposure of personnel to magnetic fields of varying strengths and geometries. These proposed studies will investigate the biological effects of magnetic fields, using several experimental systems, involving studies of mammalian developmental effects, developmental effects in the trout, cellular growth and transformation, genetic effects, neurophysiologic effects and mechanistic studies using synthetic membranes.
Keywords: magnetic fields; biological effects; trout; growth; neurology; physiology; behavior; membrane transport; cell cultures; animal cells.

106491 Cigarette Smoke and Plutonium. Filipi, R.E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002300. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is concerned with experiments to evaluate whether cigarette smokers are at a greater risk than nonsokers to potential health effects of inhaled plutonium. Because a large fraction of the population are cigarette smokers, a synergistic effect of plutonium and cigarette smoke could influence estimates of the health risk of plutonium and other transuranics released to the equipment and should be considered in establishing occupational and nonoccupational exposure standards. This project will be directed at determining: (1) the influence of cigarette smoking on distribution and retention of inhaled plutonium in the bronchial and bronchiolar-alveolar regions of the lungs; and (2) the influence of cigarette smoking on plutonium toxicity. The results of initial studies with rats will determine the need for studies with larger animals such as dogs. **Keywords:** tobacco smokes; human populations; plutonium; synergism; radionuclide kinetics; toxicity; retention; rats; dogs.

106492 Beryllium/Lithium Effects on Aquatic Organ. Emery, R.M. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002311. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: nuclear fusion(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this study is to add resolution to the conceptual understanding of the ecological significance of lithium and beryllium compounds. This task will be approached using acute and chronic toxiciy methodologies to assess effects on specific organisms, and also using experimental stream techniques to evaluate the response of aquatic communities to lithium and beryllium compounds. The eventual results of this work are expected to take the form of a mathematical model that may be used for impact and predictive assessment.
Keywords: lithium compounds; beryllium compounds; acute exposure; chronic exposure; aquatic organisms; toxicity; biological effects; aquatic ecosystems; environmental impacts; mathematical models; water pollution.

106493 Long-Range Tracer Development and Testing. Barr, S. (Los Alamos Scientific Lab., Chemistry-Nuclear Chemistry Group 11, Los Alamos, NM, 87545). **Project number:** 002558. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Environmental transport and conversion of pollutants.

This project is being conducted to demonstrate the feasibility and application of heavy methane (13-CD4 and 12-CD4) as long range atmospheric tracers. This objective will be met by releasing small amounts of tracer, collecting whole air samples at predetermined distances downwind, analyzing these samples for the tracer, evaluating the transport and diffusion factors involved in the experiments and correlating them with observed and modeled meteorological trajectories. Two intermediate range (approximately 100 kilometers) and one long range (approximately 2000 kilometers) tracer experiments have been conducted. Short range (few kilometers) experiments are being designed to provide an opportunity for refinements of analytical and sampling procedures. A tandem two-stage gas mass spectrometer is being built which will provide a tracer sensitivity of approximately 1 part in 10/sup 17 to 18/ of air. **Keywords:** air pollution; environmental transport; earth atmosphere; diffusion; tracer techniques; methane; deuterium compounds; carbon 12; carbon 13; mathematical models.

106494 Synfuel Carcinogenesis Assay. Mahlum, D.D. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002710. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$320,000.
Related energy source: Coal(70); oil and gas(15); oil shale(15) **R and D categories:** Biological effects of pollutants in experimental systems.

A broad-based multidisciplinary toxicological evaluation of materials from the SRC process streams of the Fort Lewis Pilot Plant is described. The study evaluates short and long term routine toxicological tests and in-depth delayed toxicity to respiratory, skin and other systems at risk from worker exposure. The approach uses a battery of short-team cellular bioassays coupled with animal validation. Present emphasis is on toxicity and carcinogenicity of products and by-products which are found to contain mutagenic and potentially carcinogenic chemicals. The class of chemical agents responsible have been identified and possible ways to remove or reduce the activities proposed.
Keywords: synthetic fuels; carcinogenesis; bioassay; toxicity; animal cells; respiratory system; skin; chemical effluents; solvent-refined coal; src process; coal; health hazards.

106495 Marine Sciences: Ship Time. Templeton, W.L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002734. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$35,000.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Ship time funding to support research projects involved in efforts of energy related pollutants on west coast marine coastal ecosystems is described. The projects involved are marine chemistry of energy related pollutants, bioavailability of energy effluent materials in coastal ecosystems; fate and effects petroleum hydrocarbons in marine ecosystems; and in-situ pollutant measurements. In FY 81 these funds will be directly allocated to the NW Program.
Keywords: coastal waters; monitoring; water chemistry; water pollution; baseline ecology; chemical effluents; biological effects; aquatic ecosystems; biological models; ships; economics.

106496 Magnetic Field Dosimeter Development. Lemon, D.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002747. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(50); nuclear fusion(50) **R and D categories:** Pollutant measurements technology.

High intensity magnetic fields may affect living organisms that are exposed to them. As increasing numbers of researchers work with high-field laboratory magnets, symptoms of ill effects may show up or be claimed. In order to examine correlation between magnetic field exposure and specific biological effects, dosimeters for personnel need to be developed. The purpose of the project is to develop working prototype dosimeters: one type will measure maximum field intensity, the other will measure kilogauss-hour of exposure. This will be accomplished in four phases: (1) literature survey of those physical effects of magnetic fields potentially utilizable for measuring the magnetic field exposure of personnel; (2) formulation of dosimeter concepts for two measures of magnetic field exposure--maximum field intensity and kilogauss-hours of exposure; (3) prelimi-

nary tests of the physical effects selected as measures of dose with available laboratory magnets; and (4) design, testing, selection and refinement of dosimeter concepts.
Keywords: magnetic fields; data compilation; electromagnetic radiation; biological effects; dosemeters; personnel dosimetry; design; testing.

106497 Ecological Monitoring of Long-Term Effects. Hinds, W.T. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 003009. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Pollutant measurements technology.

The key research objectives are: (1) establish guidelines for short- and long-term investigations; (2) provide a sampling protocol to measure slowly paced changes in biological production and/or species composition; (3) determine background levels of natural and exotic elements and compounds in soils, sediments and biota; and (4) provide a long-term record for relating changes in biota (individuals, species, or populations) to release or accumulation of chemicals.
Keywords: environment; monitoring; quality control; recommendations; sampling; optimization; terrestrial ecosystems; biological models.

106498 Effects of Chronic Exposure to Inhaled Radionuclides. Lundgren, D.L. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 000477. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$360,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies of the effect of repeated inhalation exposure, also designed to simulate chronic inhalation exposures, are in progress to assess effects on radiation dose pattern and the resulting biological effects. An apparent increase in the long-term retention of 137Cs labeled fused aluminoslicate particles has been observed in beagle dogs exposed weekly for up to 40 weeks compared with dogs exposed once. Beagle dogs, mice and Syrian hamsters have been repeatedly exposed to 144Ce in relatively insoluble forms. The only biological effect observed in the dogs to date (about 3 years) has been a lymphopenia. Significant increases in the incidence of pulmonary tumors and decrease in life span have been observed in mice and Syrian hamsters repeatedly exposed to 144CeO2 compared with those exposed once. Syrian hamsters appear to be more resistant to the biological effects of repeated exposure than mice. Similar studies are in progress in SPF rats. Mice and Syrian hamsters have been repeatedly exposed to inhalation to 239PuO2 resulting in significantly shortened survival.
Keywords: radioisotopes; inhalation; chronic exposure; biological radiation effects; dogs; hamsters; mice; neoplasms; life span; cesium 137; cerium 144; plutonium 239.

106499 Dose-Response Relationships for Inhaled Beta-Emitting Radionuclides. Hahn, F.F. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 001435. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$500,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is directed to establishing dose-effect relationships for inhaled beta-emitting radionuclides. Animals have been exposed by inhalation to selected beta-emitting radionuclides with different physical parameters which result in different radiation dose patterns in the body. Animals are maintained for their life span to determine longevity and the types of diseases induced. Beagle dogs have been exposed once to graded levels of relatively soluble (90Sr-Cl2, 144Ce-Cl3, 91Y-Cl3, 137Cs-Cl) and relatively insoluble forms (90Y, 91Y, 144Ce and 90Sr in fused aluminosilicate particles). Initial body burdens range from very high, which cause acute injury and early deaths, to low, which are equivalent to the maximal permissible body burden for man. Dogs are exposed at 13 months of age except for one study of influence of age at exposure on biologic effects in which dogs 3 months or 8 to 10.5 years old are exposed to 144Ce in fused aluminoslicate particles. Syrian hamsters, C57Bl/6J mice and Balb/C mice have been exposed to aerosols of 144Ce-O2 to determine the differences in species response to inhaled beta-emitting radionuclides.
Keywords: beta decay radioisotopes; inhalation; biological radiation effects; life span; dogs; hamsters; strontium 90; cerium 144; yttrium 90; yttrium 91; cesium 137; dose-response relationships; age dependence.

106500 Project Da Vinci: Manned Scientific Balloon Expedition. Zak, B.D. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** 001520. **Contract:** EY-76-C-04-0789. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$245,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

It is the primary objective of Project Da Vinci to provide information necessary to control the large-scale regional (50 to 1000 km) and subcontinental scale air quality problems which the national shift to less desirable fossil fuels will entail. It is the approach of Da Vinci to make use of a judicious combination of aircraft and balloon-borne measurement systems to overcome recognized obstacles to understanding long range air pollution phenomena. Balloon technology will be employed in three ways, using much the same hardware, in collaborative experiments involving aircraft, ground-based, and remote sensing measurement systems as well: (1) Lagrangian Measurement Platform (LAMP) - a balloon payload instrumented for measuring all important air quality parameters which eliminates or alleviates 3 of the 4 identified obstacles to understanding; (2) Prototype Lagrangian Tracer (PLAT) - an automated lightly-instrumented payload which addresses only one obstacle, uncertainty in air parcel trajectory; and (3) Skyhook - a slightly modified LAMP payload to be borne at the end of a cable by a helicopter for plume sampling to overcome a fourth obstacle to understanding, lack of knowledge of transformations occurring close-in to stacks. This technology will be applied in a collaborative program which systematicaly studies important types of conventional power-producing air pollution sources as well as unconventional sources under development by DOE. The end products of the program will be a long distance transport and transformation data base, and a verified quasi-Lagrangian long distance transport and transformation model, both of which will impact long distance effects control strategies to be implemented in the early to mid 1980's. The research and development proposed here is a high-leverage investment. The deleterious effects which are to be brought under control, and the control measures to be adopted both will cost the U.S. economy billions of dollars per year over the next decade.
Keywords: balloons; remote sensing; aerial monitoring; air pollution; air pollution monitors; cost; data acquisition.

106501 Low Btu Gasifier Biological Characterization of Field Collected Effluents. Carpenter, R.L. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002676. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$140,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Low Btu coal gasification will see extensive use in the future as a method of combusting coal in a clean efficient manner. In this study, the process streams of the low Btu gasifier are being sampled to determine potential aerosol emissions. The initial approach to this sampling task involves the use of an extractive probe system which cools and dilutes the sample, permitting the use of laboratory sampling equipment which cannot withstand the extreme temperatures and pressures present in the process streams. Methods are under development to obtain aerosol and gas samples at process temperatures and pressures. Following method development aerosol samples will be obtained for chemical, physical, biological and toxicological characterization. Emphasis will be placed on characterizing potential organometallic and trace metal emissions. Deposition retention studies in rodents using the material from gasifier streams will determine the lung burden build-up and removal rates of materials. In vitro dissolution studies will be correlated with dissolution rates in the lung. Analysis of the dissolved fraction of effluent samples as well as in vivo data will be used to determine dissolution kinetics for selected materials. These data will assist in selecting specific materials for more definitive health risk assessment studies.
Keywords: coal gasification plants; low btu gas; health hazards; evaluation; aerosols; sampling; toxicity; organometallic compounds; elements; trace amounts; lungs; biological effects; gaseous wastes; environmental effects; in vitro; in vivo; hydrocarbons; chemical effluents; particles.

106502 Fluidized Bed Combustor (FBC): Biological Characterization of Field Collected Effluents. Carpenter, R.L. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002670. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$215,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The combustion of coal in fluidized bed combustors (FBC) is one of the most promising technologies under development for the large scale use of coal as an energy source. In this study, the process streams of FBC are being sampled to determine potential aerosol emissions. The size selective samples obtained are being characterized to determine their physical and chemical characteristics relative to their potential toxic properties and inhalation hazard to man and

to provide a basis for designing control strategies. Experimental animals are being exposed to aerosols of the material collected to determine pulmonary deposition and retention patterns. In vitro studies are being conducted to determine the relative solubilities of materials to predict their long-term retention in the lung. The results from these studies will be utilized to select materials for further toxicological testing in cellular and animal systems. Sampling is being conducted under varied conditions of operations of the FBC and when several feedstocks are being burned. It is anticipated that these studies will be useful in determining optimal operating conditions and the control technologies neccssary to minimize the hazard to man from this technology.
Keywords: fluidized-bed combustion; chemical effluents; biological effects; health hazards; inhalation; air pollution; toxicity; man; lungs; particles.

106503 Fluidized Bed Combustor (FBC): Early Damge Indicators for Inhaled Effluents. Henderson, R.F. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002672. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$140,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The burning of coal in a fluidized bed combustor (FBC) is a promising technology under development for the increased utilization of coal. In this project relatively rapid and inexpensive in vitro and in vivo screening tests are being utilized to determine the relative toxicity of potential effluents from an FBC. Size selective aerosol samples collected from FBC and characterized as to their chemical and physical properties are being utilized. The rabbit alveolar macrophage test is being used to screen particulate materials for cytotoxicity and the Ames test is being used to screen materials for mutagenic potential. Both tests show differences in the response to fly ash collected at different points in the effluent stream. Other in vitro cellular tests are under development. In vivo tests such as enzymatic and cytological profiles in fluids from the lungs of exposed animals are being utilized to detect cellular damage in the intact animal. Initial exposures of animals to Cd++ and Cr+++ showed good correlation between indicators of lung damage measured in lavage fluid and morphological changes observed through histopahological examination. These screening studies will be utilized to select and reduce the number of materials on which more extensive toxicological testng is necessary.
Keywords: fluidized-bed combustors; health hazards; coal; fly ash; rabbits; mutagens; cadmium; chromium; lungs; physiology; biological indicators; toxicity.

106504 FBC: Kinetics of Lung Cells in Response to Inhaled Effluents. Hackett, N.A. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002673. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Conventional coal burning power facilities emit effluents that produce acute lung disorders at high concentrations and minimal damage at lower concentrations. Fine particulates in thse effluents which serve as condensing surfaces for aerosols of volatile trace heavy metals and organics can carry these potentially hazardous agents into the deep lung. Biological indicator systems are needed for rapid in vivo screening of cytotoxicity, mutagenicity and carcinogenicity. Cytokinetic techniques provide a sensitive indicator of lung cell damage as cellular proliferation as the primary means by which pulmonary injury is repaired. Autoradiographic methods indicate differential injury effects on various cell populations by evaluation of (1) increased cell renewal, (2) rate of cell replacement, and (3) duration of repair sequence following an acute inhalation exposure. Cytokinetic evaluation of cell proliferation will be applied during chronic exposures and will be used to determine possible synergistic action of mixtures of pollutants. Histochemical and cytochemical methods will enhance evaluation of cellular interaction mechanisms of damage and repair. Cell replacement will be correlated with physiologic and pathologic changes to assess the relationship between cell division and development of specific pulmonary diseases.
Keywords: fluidized-bed combustion; health hazards; chemical effluents; inhalation; toxicity; metals; organic compounds; lungs; nitrogen dioxide; air pollution; flue gas; fly ash.

106505 FBC: Influence of Inhaled Effluents on Pulmonary Defense Mechanisms. Bice, D.E. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002674. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The use of FBC as a major energy source may result in the production of effluent materials which, if inhaled by workers or the general public, might result in adverse health effects. The products of primary concern are trace metals and hydrocarbons and other pollutants that may be associated with fine particle emissions. The degree to which these materials may pose a health hazard depends upon the functional integrity of various pulmonary defense mechanisms. Notable among these are immunologic responses, macrophage responses, mucocilliary clearance, and non-specific antimicrobial defenses. To assess the effects of FBC effluent products on immunologic function, rodents and dogs will be exposed by inhalation and instillation to selected materials and at various times after exposure the response to instilled or aerosolized antigen determined both in lung, lung-associated lymph nodes, spleen and blood. The additive effects of inhaled pollutants on antimicrobial defenses in compromised animals will be evaluated. Finally, the effects of inhaled FBC effluent materials on mucocilliary clearance will be assessed through the conduct of retention studies with labeled particles at various times after inhalation exposure. These data will assist in predicting human health hazards that might be associated with FBC technology.
Keywords: fluidized-bed combustion; health hazards; respiratory system diseases; respiratory system; dynamic function studies; inhalation; air pollution; animals; flue gas; dogs; rats; man.

106506 FBC: Chronic Respiratory Disease from Inhaled Effluents. Mauderly, J.L. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002675. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$235,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary mode of human exposure to FBC effluents is expected to be chronic inhalation over varying periods of time ranging to lifespan. The extent to which these exposures may result in chronic lung disease is largely unknown, although the effluents contain known irritants, cytotoxic agents and possibly carcinogens. Animals will be exposed by inhalation to components of FBC or conventional coal combustion and evaluated by functional and morphological endpoints to study the occurrence and nature of any lung disease produced. Studies will initially focus on rodents exposed to fly ash, trace metals and hydrocarbons. Subsequent exposures may include these materials in combination with irritant such as SOx and NOx. Endpoints will include lifespan shortening, functional disorders and structural changes, including carcinogenesis. More detailed, mechanistic studies will be initiated as appropriate to study specific disease processes. The effect of pre-existing disease in modifying responses will be studied using animal models of emphysema, asthma and fibrosis. Effort to date has been largely directed toward development of exposure methodology, biological assessment systems, and disease models.
Keywords: respiratory system diseases; fluidized-bed combustion; health hazards; toxicity; flue gas; fly ash; sulfur oxides; nitrogen oxides; pathogenesis.

106507 Development of an Integrated In Vivo/In Vitro System for the Study of Carcinogenic Effects of Energy-Related By-Products. Yuhas, J.M. (University of New Mexico, Cancer Research and Treatment Center, Albuquerque, NM, 87131). **Project number:** 007446. **Contract:** EE-77-S-04-3972. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$58,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Research proposed under this contract has as its ultimate objective the development of an in vitro/in vivo hybrid system for the study of lung carcinogenesis in the mouse. Intermediate objectives to be reached in sequence include: (1) development of a means of isolating Type II alveolar cells from the mouse lung in a reproductively intact condition; (2) growth of these cells in monolayer culture; (3) serial sub-cultivation of these cells in vitro; (4) production of transformants in vitro by addition of carcinogens to the cultures; (5) production of transformants in vivo by carcinogen injection before cellular isolation; (6) verification of the tumorigenic potential of the in vitro or in vivo transformants and their qualitative characteristics (cell type, etc.); (7) quantitation of in vivo and in vitro transformation processes; and (8) comparison of the quantitative aspects of the two systems with each other and with in vivo tumor yield patterns.
Keywords: carcinogenesis; by-products; lungs; mice; cell cultures; carcinogens; in vitro; in vivo; biological models.

106508 Environmental Effects of Solid Wastes as Supplemental Fuel. Shanks, H. (Ames Lab., Ames, IA). **Project number:** 001534. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.

Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The Ames Municipal Power Plant has been modified to burn solid waste as a supplemental fuel with coal. A program is being carried out to determine the environmental effects of the change in fuel composition. Particular emphasis is placed on the changes in the particulates in the stack emissions and also the heavy organics. The effect of boiler size, type of fuel injection and burners, and the type of particulate removal equipment are being studied in relation to the fuel composition used and the boiler load. The study is yielding data on the relative ability of tangentially fired and traveling grate boilers to build for use with coal with a minimum impact on the environment. The efficiencies of the fly ash collectors on the boilers are also being determined.

Keywords: solid wastes; waste product utilization; health hazards; pyrolysis; boiler fuel; coal; environmental impacts; energy conservation; aerosols; organic compounds; metals; air pollution control; removal; fly ash; pollution control equipment; efficiency; fossil-fuel power plants; health hazards.

106509 Effect of Chemical Carcinogens on Hemopoiesis, Immunopoiesis, and Viral Oncogenesis. Okunewick, J.P. (Allegheny-Singer Research Corporation, Allegheny General Hospital, Pittsburgh, PA, 15212). **Project number:** 006004. **Contract:** EP-78-S-02-4800. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$37,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to study the interactions of leukemia causing viruses with radiation and/or chemical carcinogens. The studies will be carried out in vivo, taking into consideration effects on the kinetics of the virus target cells of the animal and effects on the immune status of the animal. Effects on cell kinetics will be measured in the whole tissue using standard techniques involving tritiated thymidine labelling and measured in the pluripotent stem cells using CFU-S assay techniques. Immune activity will be evaluated using techniques which measure both humoral and cellular immune function. Assay of the hematopoietic tissue for viral infection, transformation and production will be carried out using the X-C syncytia formation technique.
Keywords: ionizing radiations; carcinogens; leukemia viruses; synergism; biological radiation effects; in vivo; biochemical reaction kinetics; immune reactions; animal cells; blood formation.

106510 The Toxicology and Metabolism of Nickel Compounds. Sunderman, F.W. Jr. (University of Connecticut, School of Medicine, Health Center, Department of Laboratory Medicine, Farmington, CT, 06032). **Project number:** 006026. **Contract:** EY-76-S-02-3140.A002. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$102,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); solar(20); hydroelectric(20) **R and D categories:** Biological effects of pollutants in experimental systems.

The toxicology and metabolism of nickel compounds (including particularly alpha-Ni3S2, alpha-Ni3Se2, NiSe, NiS, NiCl2, and Ni(CO)4 are being investigated following administration to mice, rats, hamsters and rabbits. The objectives of these investigations include: (1) elucidation of the mechanisms of nickel toxicity and carcinogenesis; (2) evaluation of the teratogenicity and mutagenicity of nickel compounds; (3) understanding of the nutritional and physiological roles of nickel and of the disturbances of nickel metabolism in pathological conditions; (4) delineation of potential hazards to man and animals from environmental or occupational exposures to nickel compounds, particularly in relationship to nickel exposures from coal-gasification technologies; (5) development of new techniques for identification and measurement of nickel compounds in biological materials and environmental samples; (6) development of new biochemical indices of nickel exposure; and (7) introduction of improved methods for the prevention, detection and therapy of poisoning by nickel compounds. The procedure involves the study of Ni-63 metabolism following administration of 63-Ni(CO)4, 63-Ni3S2, and 63-NiCl2 to animals in order to identify (a) the nickel-binding constituents of body fluids, (b) the organ distribution and routes of elimination of Ni-63, (c) the biochemical alterations which are associated with nickel carcinogenesis, (d) evaluations of the teratogenicity and mutagenicity of nickel compounds in animals, and (e) the use of atomic absorption spectrometry to determine Ni-59 concentrations in biological fluids and tissues of normal men and of men who are subject to environmental or occupational exposures to nickel. The test objects and agents include rats, hamsters and rabbits, and blood, urine, feces, hair, sweat and saliva from human subjects.
Keywords: nickel compounds; toxicity; metabolism; nickel 63; sulfur compounds; carbonates; chlorides; animals; carcinogenesis; teratogenesis; mutagens; men; rats; hamsters; rabbits; man.

106511 Radioactivity Studies. Cohen, N. (University of New York, New York, NY). **Project number:** 006065. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$107,000.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

This is a proposal for continuation of studies of the metabolic behavior of heavy alpha-emitting radionuclides in man and in non-human primates; in particular, we will concentrate on metabolic studies of the bone-seeking radionuclides, 241Am, 244Cm, Pb, and 210Po. The objective is to continue current research efforts which have been directed at defining those metabolic parameters associated with potential radiological health problems resulting from radionuclides encountered at various stages of the nuclear fuel cycle.
Keywords: bone seekers; americium 241; lead 210; polonium 210; curium 244; metabolism; miners; uranium mines; radionuclide kinetics; health hazards; radon isotopes; apes; edta; dtpa; biological localization; biological radiation effects.

106512 Radiation Carcinogenesis. Warren, S. (New England Deaconess Hospital, Boston, MA). **Project number:** 006060. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$96,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This investigation of radiation and carcinogenesis is primarily concerned with the induction of tumors of various sorts in mice and rats and the relative responsiveness of the parent tissue. Much of the radiation is administered in the 1000 rad dose range using chiefly 250 kvp x-rays. Both leukemia and solid tumors are used as indicators of effect. Parabiosis is used in some animals to permit survival at high dose levels of radiation and also to produce hormonal imbalance. Hormonal imbalance appears to be an important factor in relation to the induction of mammary and adrenal cortical tumors among others. Asbestos is used as a cocarcinogen in some animals. Methylcholanthrene is used in combination with radiation and with asbestos. The asbestos is injected intratracheally, intrapleurally, and intraperitoneally in both rats and mice.
Keywords: x radiation; carcinogenesis; biological radiation effects; rats; mice; neoplasms; dose rates; asbestos; 3-methylcholanthrene; synergism; parabiosis.

106513 Tumorigenic Action of Beta, Proton, Alpha and Electron Radiation on the Rat Skin. Burns, F.J. (New York University, Institute of Environmental Medicine, 550 First Avenue, New York, NY, 10016). **Project number:** 006064. **Contract:** EV03380. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$64,000.
Related energy source: Coal(25); nuclear fission(50); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The investigation of the effect of ultraviolet light, carcinogenic chemicals, fractionation and age on the oncogenic response of rat skin to various types, doses, and dose rates of ionizing radiation is continuing. The existence of a linear term in the dose response relationship at low doses will be studied by means of a multiple dose fractionation schedule. Epidermal stem cell lethality following irradiation will be determined as a function of cell cycle and the kinetics of recovery for tumor induction and cell lethality in vivo will be compared. The carcinogenic interaction of the polycyclic hydrocarbon, DMBA, and electron radiation will be studied. The dependency of tumor induction on radiation dose rate will continue to be studied with emphasis on the proposed theoretical model. The importance of epidermal cells will be determined with respect to tumor induction. The kinetics of damage and repair of DNA in the epidermal cells following irradiation will be investigated and compared with cell lethality and tumor induction. Tumor yield in rat skin is roughly proportional to the square of the radiation dose for electrons and protons. The recovery halftime for tumor induction was about 4 hrs for electrons and substantial recovery was evident for protons. A model describing dose rate effects in tumor induction has been developed.
Keywords: rats; skin; biological radiation effects; radiosensitivity; beta particles; proton beams; alpha particles; electron beams; ultraviolet radiation; polycyclic aromatic hydrocarbons; carcinogenesis; biological effects; biological models.

106514 Problems in Radiation Embryology. Brent, R.L. (Jefferson Medical College, Stein Research Center, Philadelphia, PA, 19107). **Project number:** 006099. **Contract:** EY-76-S-02-3268. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The research program involves the study of environmental factors on developing mammalian embryos. The emphasis is on the effects and mechanism involved in embryopathology and reproductive pathology following exposure to ionizing radiation. Experiments deal with oncogenesis, teratogenesis, growth retardation and mortality in mammals exposed to environmental agents during the prenatal period. Dose-rate phenomenon, threshold levels, importance of cell death, species variation, indirect effects, recovery, long term effects,

and embryo culture are several parameters under investigation in order to better understand the effects of environmental hazards on the developing mammalian embryo. We are particularly interested in correlating the extensive experience we have had with in vivo x-irradiation of developing embryos with the use of in vivo screening techniques such as embryo culture, in order to improve the accuracy and predictability of the embryo culture technique.
Keywords: ionizing radiations; biological radiation effects; embryos; mammals; ontogenesis; carcinogenesis; teratogenesis; growth; mortality; pathological changes.

106515 DNA Damage: Human Lymphoid Cells. Strauss, B.S. (University of Chicago, 920 East 58th Street, Chicago, IL, 60637). **Project number:** 006156. **Contract:** EY-76-S-02-2040. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Two different pathways for excision repair occur in mammalian cells: (1) nucleotide excision, and (2) base excision (apurinic) repair. The activity of both is controlled by cellular regulatory mechanisms. We propose: (1) to determine the pathway for the excision of polyaromatic hydrocarbon adducts from DNA using human lymphoblastoid cells; (2) to establish rodent liver cell cultures and determine their repair activity for the two pathways; (3) to compare the repair activity of rodent liver cells with other rodent cells including neuroblastomas and gliomas in order to determine whether the sensitivity of neutral tissue to carcinogenesis is related to a repair deficiency in a specific pathway; (4) to characterize a new reaction in which DNA with polycyclic aromatic hydrocarbon residues binds to columns of BND-cellulose; and (5) to continue our studies on the mechanism by which DNA synthesis is able to bypass lesions.
Keywords: dna; biological repair; cell cultures; man; rodents; lymphocytes; nucleotides; polycyclic aromatic hydrocarbons; liver; nerve cells; sensitivity; biochemical reaction kinetics.

106517 Chemical and Radiation Carcinogenesis. Ts'o, P.O.P. (The Johns Hopkins Univ., School of Hygiene and Public Health, Division of Biophysics, 615 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** 006221. **Contract:** EY-76-S-02-3280. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Research is proposed in the following 5 projects: (1) study of the chemistry and metabolism of polycyclic hydrocarbons in rat liver microsome, nuclei, and in Syrian hamster embryonic fibroblasts; (2) development of the Syrian hamster embryonic fibroblasts (both normal and transformed) as a model system for the investigation of somatic mutation and as a system for the investigation of the effects of carcinogens on cells; (3) development of the Syrian hamster embryonic fibroblast as a model system for the investigation of in vitro neoplastic transformation, particularly concerning the progressive phenomena of the transformation; (4) study of biochemical and biological effect of incorporating radioactive 3H-DNA precursor and 3H-RNA precursor (vs. EH-water or 3H-manitol)-identification of target macromolecule or critical intracellular structure for neoplastic transformation and somatic mutations; and (5) comparative study of biological effect of b(a)pquinones to those generated by incorporation of radioactive precursors.
Keywords: chemical effluents; radioactive effluents; carcinogenesis; biological models; cell cultures; polycyclic aromatic hydrocarbons; rats; hamsters; metabolism; neoplasms; benzopyrene; quinones; tracer techniques; laboratory animals; preferred species.

106518 Study of the Molecular Bases for Radiation Mutagenesis. Wang, S.Y. (Johns Hopkins University, Department of Biochemistry, 615 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** 006223. **Contract:** EY-76-S-02-3286. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Because a multiplicity of radiation products usually results from the irradiation of a single compound, it must be ascertained whether and how a particular product produces certain biological effects before methods of protection against and repair can be effectively designed. Acquisition of such information involves four stages: (1) establishment of procedures for the separation, isolation, and characterization of radiation products of nucleic acid bases, nucleosides, etc.; (2) development of methods for the synthesis of these products once they are identified so that a constant supply in milligram to gram quantities is available for the studies in stages 3 and 4; (3) examination of the apparent biological effects of each product in vitro and in vivo; and (4) study of the molecular mechanism related to an observed biological phenomenon. Progress has been made in all four of these areas.
Keywords: biological radiation effects; nucleic acids; nucleosides; biochemical reaction kinetics; radioinduction; ionizing radiations; mutagenesis; biosynthesis.

106519 Neutron-Induced Mutation Experiments. Abrahamson, S. (University of Wisconsin, Madison, WI). **Project number:** 006312. **Contract:** EV01748. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$39,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The main purposes of this experiment are: (1) to determine the RBE for neutrons of different energies in gonial cells; (2) to obtain insight into the nature of the dose/frequency response curves for neutrons of different energies; and (3) to obtain information on specific locus mutations induced by neutrons in gonia for purposes of interspecies comparison. There presently exists an extensive body of data on this germ cell stage in D. melanogaster for 250 kvp x-rays. The linear component of the dose/frequency response curve for these x-rays should serve as a basis for understanding RBE of neutrons. It has been previously found that the mutation rate per locus per rad of x-rays is directly proportional to the total amount of DNA per species haploid complement. It is hoped that a similar relationship can be shown for neutron-induced mutations.
Keywords: neutrons; ionizing radiations; rbe; animal cells; drosophila; dose-response relationships; mutation frequency.

106520 Transport and Transfer Rate in Waters off the Continental Shelf. Biscaye, P.E. (Columbia University, Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 006345. **Contract:** E(11-1)2185. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$423,000.
Related energy source: Coal(20); oil and gas(20); nuclear fission(60) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to combine a number of physical oceanographic, geochemical and marine biological techniques to understand the pattern and the rates and scales of the active vertical and horizontal mixing processes and the variations in these parameters as a function of seasonal hydrographic regime, and other forcing functions such as storm induced wind and wave pulses, radium-228 in advection-diffusion models of mixing of shelf water and shelf open ocean water. Suspended particulates, the natural carrier of most energy-related pollutants, are being studied by several microscopic, gravimetric, and other analytical and radioactive techniques.
Keywords: radionuclide migration; continental shelf; mathematical models; radium 228; oceanography; coastal waters; sediments; particles; radiation monitoring; diffusion.

106521 Biogeochemistry of Trace Metals in Chesapeake Bay. Gross, M.G. (Johns Hopkins University, Chesapeake Bay Inst., Baltimore, MD, 21218). **Project number:** 006364. **Contract:** EY-76-S-02-3292. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$53,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

This project is a continuing study of the transport pathways of trace metals in the Chesapeake Bay. The principal goals are to understand pathways and mechanisms of particle-associated trace metal transport and alterations in sufficient detail to permit identification and projection of the effects of man's activities on a major estuary. Results to date indicate that metal rich Susquehanna River material dominates the suspended sediment throughout the entire water column for a distance of 60 to 80 km from the river mouth and is a measureable constituent of the material for at least 140 km from the river mouth. These observations contrast with previous assumptions regarding the components of suspended sediment farther than 40 to 50 km from the river mouth. In the middle Bay region, suspended sediment is composed in large part of in-situ produced biological material whose composition varies seasonally.
Keywords: chesapeake bay; susquehanna river; elements; trace amounts; environmental transport; environmental exposure pathway; sediments; suspensions.

106522 Phytoplankton Growth, Dissipation and Succession in Estuarine Environments. Seliger, H.H. (Johns Hopkins University, McCollum--Pratt Institute, Baltimore, MD, 21218). **Project number:** 006365. **Contract:** AT(11-1)-3278. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$136,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); solar(25) **R and D categories:** Environmental effects assessment.

This is a study of the dynamics of phytoplankton growth and succession in a natural estuarine system. Our marine station is at the Rhode River on the Chesapeake Bay just south of Annapolis. The study includes: (1) light spectral and nutrient dependent physiology

of growth and migration; (2) relative contributions to the nutrition of herbivores and filter feeders of phytoplankton and detritus; (3) development of instrumentation, biochemical diagnostic parameters and statistical sampling procedures for modeling the stability of localized plankton ecosystems nutrient, biocide, or thermal loading (New growth over a division cycle is measured in plankton cages containing capture natural samples, replaced in situ, and in pumped water with metered additions. Underwater measurements of absolute spectral scalar irradiance are made seasonally for the Chesapeake Bay and used to obtain ecological photosynthetic efficiencies); and (4) mechanisms of dinoflagellate accumulations into blooms.
Keywords: chesapeake bay; aquatic ecosystems; phytoplankton; population dynamics; algae; photosynthesis; biological models; nutrients; thermal pollution; water pollution.

106523 Effects of Energy Related Activities on the Plankton of Chesapeake Bay. Taft, J.L. (Johns Hopkins Univ., Chesapeake Bay Inst., Baltimore, MD, 21218). **Project number:** 006366. **Contract:** AT(11-1)-3279. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) identify the major factors regulating phytoplankton primary productivity during each season in Chesapeake Bay and on the adjacent continental shelf; (2) determine the effects of potential pollutants from energy technologies now sited on Chesapeake Bay (and its tributaries) on productivity regulation; and (3) determine the effects of heated power plant effluents and cooling tower effluents on bacterial processes in Chesapeake Bay. Field studies are conducted with natural phytoplankton and bacterial populations employing both experimental introduction of selected pollutants (heat, acid, biocides, hydrocarbons, heavy metals) and physiological measurements on natural populations subjected to power plant effluents.
Keywords: plankton; chesapeake bay; energy conversion; population dynamics; environmental impacts; bacteria; thermal pollution; pesticides; hydrocarbons; metals; physiology; toxicity; water pollution.

106524 Nutrient Enrichment and Entrophication of Lake Michigan. Schelske, C.L. (University of Michigan, Great Lakes Research Division, Ann Arbor, MI, 48109). **Project number:** 006378. **Contract:** AT(11-1)2003. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$96,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives are to determine the environmental factors, primarily chemical, limiting phytoplankton growth in Lake Michigan, to determine the influences of nutrient inputs on phytoplankton and to assess the effects of resulting changes on the Lake Michigan ecosystem. The approach has been two fold. First, the effects of nutrients, phosphorus, silica and nitrogen, on phytoplankton growth have been assessed experimentally by adding nutrients to lake water with its natural phytoplankton assemblages. Second, data on phytoplankton abundance, species composition and nutrient chemistry have been collected at different locations in the lake so the experimental results can be related to the lake system. Results from several of our previous studies have indicated that data on physical processes, particularly those concerned with water transport and diffusion and mixing of river water with lake water must be integrated with our studies of plankton communities for a better understanding of environmental processes. Responses of phytoplankton to nutrient additions can be modeled under experimental conditions in the laboratory, but to extrapolate such results to field conditions it will be necessary to model some of the physical processes.
Keywords: lake michigan; phytoplankton; productivity; eutrophication; aquatic ecosystems; rivers; lakes; nutrients; phosphorus; silica; nitrogen; mixing; surface waters; additives; water pollution; population dynamics; bioassay.

106525 Vertebrate Behavior and Ecology. Tester, J.R. (University of Minnesota, Dept. of Ecology and Behavioral Biology, 310 Biological Sciences Center, St. Paul, MN, 55108). **Project number:** 006381. **Contract:** EY-76-S-02-1332. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$94,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Pollutant measurements technology.

Three subprojects of this contract nearing completion are: (1) coexistence and population dynamics studies of selected vertebrates; (2) fish (salmon) response to alterations in water quality resulting from power production; and (3) seasonal migrations and habitat selection of pronghorn antelope on the INEL site. Drs. Tester and Siniff propose to continue and expand the research they have been conducting in two other areas: (1) engineering design and development of radiotelemetry devices and methods; and (2) statistical procedures and quantitative methods for analysis of ecological and behavioral and population studies of sea otters. Engineering design and development will be directed toward increasing the versatility and sophistication of electronic measuring devices. The focus will be on three areas: (1) the design of a versatile field recording system using microprocessors (small transmitters which are in reality small computers with data output already in computer format); (2) the development of a portable, automatic animal positioning system; and (3) the continued engineering evaluation and design improvement of existing equipment. The sea otter work in Alaska and along the California coast involves a continuing long-term research commitment using telemetry technology to resolve some of the basic problems in animal censusing and population studies. Tester and Siniff propose to continue studies in Prince William Sound, Alaska, so as to build up a population of marked animals which will be monitored over several years. They also propose to continue studies on a yearly basis of areas involving reaction of otters to oil spills and other environmental disturbances
Keywords: wild animals; ecology; population dynamics; telemetry; alaska; petroleum industry; oil spills; environmental impacts.

106526 Radioelement Studies in the Ocean. Bowen, V.T. (Woods Hole Oceanographic Institution, Woods Hole, MA, 02543). **Project number:** 006423. **Contract:** EY-S-02-3563. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$575,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to establish a data base to support prediction of the pathways, rates of movement, biological interactions, and fates of any long-lived artificial radionuclides entering aquatic environments, and to ascertain how these data change in response to different modes of entry of the nuclides. Many of the data have strong relevance to similar questions concerning chemical pollutants deriving from energy production. In 1979 we will carry out a very limited sampling effort to the central North Pacific, to obtain more detailed sampling of the mid-depth layer of high Pu and Am concentrations; especially we will be directing our attention to the distribution of the transuranium nuclides among particulate vs. dissolved phases, and to the valence or complexation of the latter. Much of the effort in the laboratory will be concentrated on the radiochemical analysis of 55Fe, 80Co, 90Sr, 137Cs, 238Pu, 239,240Pu, 241Pu, 241Am, 242mAM, 242Cm, and 244Cm in water, sediment or biota samples, especially on samples from the close-in fallout areas near the test sites. Some analytical effort will be directed to older samples as well. An ongoing study of barium, copper, and silicon uptake by phytoplankton cells in culture will be expanded both to examine 226Ra uptake and to look at collected plankton samples to see whether the relationship developed in culture experiments can be seen in the field.
Keywords: data compilation; transuranium elements; radionuclide migration; seas; biological effects; environmental exposure pathway; pacific ocean; plutonium; americium; radioecological concentration; phytoplankton; radon 226; uptake.

106527 Distribution of Some Chemical Elements Between Particulate and Dissolved Phases in the Ocean. Spencer, D.W. (Woods Hole Oceanographic Institution, Woods Hole, MA, 02543). **Project number:** 006427. **Contract:** E(11-1)-3566. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: Coal(25); nuclear fission(75) **R and D categories:** Environmental transport and conversion of pollutants.

Research on the behavior of the natural decay-series radionuclides in the ocean is aimed at further understanding the complex chemical, physical, and biological interactions that govern the distribution of trace metals, particularly in coastal waters. Previous work has shown that 210Pb is strongly depleted in coastal waters and that seasonal variations in the 210Po concentration may occur. The sediment-water boundary may act as an important sink for 210Pb, possibly by coprecipitation with Mn and Fe oxides forming near the interface. During the coming year, the study of the seasonal variations of 210Pb and 210Po in Buzzards Bay and the Gulf of Maine will be completed. By studying the distribution of 210Pb in Saanich Inlet and in deep-sea sediment cores, the role of MnO2 formation in scavenging 210Pb from the water column will be examined. Finally, the investigation of enrichments of 210Pb, 210Po, and other radionuclides in the sea-surface microlayer will be continued.
Keywords: particles; seas; spatial distribution; coastal waters; lead 210; polonium 210; seasonal variations; sediments; interfaces; manganese oxides; iron oxides; radioisotopes; radionuclide migration; environmental transport; gulf of maine; scavenging.

106528 Fate of Nuclides in Natural Water Systems. Turekian, K.K. (Yale University, Dept. of Geology and Geophysics, New Haven, CT, 06520). **Project number:** 006430. **Contract:** E(11-1)-3573. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.

Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to understand metal fluxes in the estuarine system. Members of uranium decay series, Mn, Fe and selected trace metals are followed in soil profiles, ground water, streams, estuarine waters and deposits to elucidate sources, sinks and kinetics of transfer. Systematic studies will be conducted of major drainage basins (e.g., Susquehanna) and major estuarine systems (e.g., Long Island Sound) involving time series analyses of water samples, particulate materials and sediment cores for uranium and its decay products, Mn, Fe, Cu, Pb, Zn and Cd as well as major elements.
Keywords: trace amounts; uranium; manganese; iron; copper; lead; zinc; cadmium; soils; ground water; estuaries; environmental transport; chemical analysis; water pollution; mathematical models.

106529 Atmospheric Pollution Scavenging. Semonin, R.G. (Illinois State Water Survey, Box 232, Urbana, IL, 61801). **Project number:** 006440. **Contract:** EY-76-S-02-1199. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$300,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the importance of cloud and precipitation processes in the transport and removal of airborne aerosols. A 5-year measurement program was concluded in August 1975. The measurements were obtained as part of the St. Louis Metromex Project on inadvertent weather modification. The continuation of this work will include: (1) final analysis and interpretation of all collected data for the Metromex final report; (2) preparation of a preliminary design for field participation in the multistate atmospheric power production pollution study; and (3) the establishment of a baseline precipitation chemistry station.
Keywords: air pollution; aerosols; washout; environmental transport; clouds; weather.

106530 Global Transport Processes and Interactions with Trace Constituents. Newell, R.E. (Massachusetts Inst. of Technology, Department of Meteorology, Cambridge, MA, 02139). **Project number:** 006443. **Contract:** 80-EV02195. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

We are trying to understand the large-scale energy budget of the atmosphere-ocean-cryosphere system with the hope that we may then arrive at rational explanations for the observed changes in the energy budget. There has been much speculation that anthropogenic carbon dioxide, or tropospheric aerosol may, or will soon, influence climate. There has also been much consideration of possible changes of ozone to anthropogenic effects and the resulting possible changes on ultraviolet radiation received at the ground and on climate. It is desirable to understand in detail the operation of the system as it is presently constituted before one attempts to gauge the influence of potential changes. Our approach has been to study global observations in an effort to gain this understanding. Global data on wind, air, and sea temperature, pressure, moisture, and other trace constituents are studied. Computations of means, variances and covariances, empirical orthogonal representations, and trends are made. Correlation between results and measurements of total ozone, volcanic eruptions, stratospheric and tropospheric aerosol, and food production in several countries is developed. Computation of radiative heating rates by trace substances, such as carbon dioxide, water vapor and ozone is made. The data base for atmosphere and ocean has been developed at MIT. The ozone data was obtained from Atmospheric Environment Service, Canada.
Keywords: earth atmosphere; seas; climates; temperature distribution; oceanography; carbon dioxide; aerosols; water vapor; ozone; diffusion; annual variations; seasonal variations; volcanoes; chemical effluents; trace amounts; aerosol monitoring; food; meteorology; sulfur dioxide; environmental transport.

106531 Balance of the Tropospheric Ozone and Its Relation to Stratospheric Intrusions Indicated by Cosmogenic Radionuclides. Reiter, R. (Institute for Atmospheric Environmental Research, D-8100 Garmisch-Partenkirchen, West Germany). **Project number:** 006450. **Contract:** EY-76-C-02-3425. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The balance of the tropospheric ozone is governed by the distribution of ozone sources and sinks. The influx of the stratospheric ozone into the troposphere as a result of stratospheric intrusions and the portion of the tropospheric ozone due to photochemical production are under study. The influence of trace gases and aerosols on ozone decay is examined. During interesting intervals of time the diurnal variations of the atmospheric ozone profiles are measured up to 35 km altitude by means of balloon sondes. Causes of the variations are discussed. A filter photospectrometer for the measurement of the total atmospheric ozone is tested as to its suitability by direct intercomparison with a Dobson spectrometer. Ozone concentrations $\geq$ 70 ppB are observed in pure-air regions after stratospheric intrusions as well as due to photochemical production in the boundary layer. An observation series covering a period of 20 months of the stratospheric aerosol is presented.
Keywords: troposphere; stratosphere; ozone; chemical composition; mathematical models; ecological concentration; earth atmosphere; photochemistry; aerosols; radioisotopes.

106532 Biological and Clinical Dosimetry. Laughlin, J. (Sloan-Kettering Institute for Cancer Research, New York, NY). **Project number:** 006482. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$41,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective of this research is to develop primary and secondary dosimetric systems for applications in biological research and clinical situations. A portable tissue equivalent plastic calorimeter system has been developed for this purpose and measurements carried out in 60-Co, neutron and proton fields. The thermal defect in tissue equivalent plastic is also under study.
Keywords: dosemeters; uses; calorimetric dosemeters; neutrons; protons; tissue-equivalent materials; dosimetry.

106533 Energy Generation and the Sulfur Carbon Cycles. Brock, T.D. (Wisconsin University, Dept. of Bacteriology, 1550 Linden Drive, Madison, WI, 53705). **Project number:** 006515. **Contract:** 79-EV02161.001. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$37,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Current work in this program is aimed at assessing the relative importance of sulfate reduction and methane formation on carbon turnover in anaerobic sediments, and definition of the mineralization of carbon in whole lakes. The primary objective is to specify the factors controlling the rate limiting step(s) in the conversion of organic matter to methane. Experiments during the current year will be on the effect of temperature, electron acceptors, and microbial metabolic inhibitors on cellulose, pectin, chitin, and peptidoglycan in lake sediments.
Keywords: sulfates; methane; sediments; anaerobic conditions; mineralization; carbon; lakes; cellulose; temperature effects; binding energy; electrons; valence; metabolism; pectins; chitin; methanogenic bacteria; carbon cycle; biosynthesis; reduction.

106534 Response of a Forest Ecotone to Ionizing Radiation. Murphy, P.G. (Michigan State University, Department of Botany and Plant Pathology, East Lansing, MI, 48824). **Project number:** 006639. **Contract:** EY-76-S-02-2283.001. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$2,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The primary objectives of this study are to determine the effects of ionizing radiation on the tree species composition of the ecotone between two forest types and to compare the postirradiation recovery of the tree flora in the ecotone with that in the bordering forest types. Relatively distinct ecotones constitute a spatially significant portion of many second-growth forest ecosystems. Belt transects concentric to the radiation source are being used to detect compositional changes in the ecotone from aspen to maple-birch forest types. Additionally, several characteristics of the canopy foliage are being studied, including leaf area index and leaf litter production per species. All studies are being conducted in the Enterprise Radiation Forest near Rhinelander, Wisconsin. A description of the experimental vegetation prior to irradiation has been completed (and published) and the immediate effects of radiation on the ecotone and adjacent forest types have been documented. Information available includes population densities by size class, importance values, and diversity values. Estimates of leaf area index and leaf litter production, by species, have also been obtained. Succession in the radiation-disturbed areas is presently under study.
Keywords: gamma radiation; chronic irradiation; forests; biological radiation effects; trees; population density; species diversity; revegetation; biological recovery; comparative evaluations.

106535 Biological/Environmental Relationships in Desert Ecosystems of the Nevada Test Site. Beatley, J.C. (University of Cincinnati, Dept. of Biological Sciences, Cincinnati, OH, 45221). **Project number:** 006656. **Contract:** EY-76-S-02-2307.A002. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$6,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Measurements data were collected on 68 selected sites in 8 drainage basins of the Nevada Test Site during the years 1962-1975.

These included data for plant, rodent, and environmental variables (rainfall, air temperatures, soils moisture, and gamma radiation) collected concurrently during the period in all of the 68 systems, which represented the major kinds of biological/environmental systems of the region. Overall objectives are an assessment of the effects of nuclear testing on biological components of certain of the systems, and the elaboration of models defining many of the fundamental interrelationships between the biological and environmental variables of desert (Mojave, Great Basin, and transition) ecosystems. **Keywords:** nevada test site; nuclear explosions; environmental effects; terrestrial ecosystems; deserts; data compilation; mathematical models.

106536 Effects of Mesoscale Weather Disturbances on Contamination Concentrations. Kreitzberg, C.W. (Drexel University, Dept. of Physics and Atmospheric Science, Philadelphia, PA, 19104). **Project number:** 006675. **Contract:** EY-76-S-02-2360. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$64,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is a Prototype Regional Meteorological Forecast System (PRMFS) in the Eastern United States with a demonstrated capability both in post-analysis and real-time forecasting of air pollution. The set of PRMFS codes will be replaced by an integrated system of codes that run from data available in real-time. The boundary layer nested mesh and vegetated ground layer will be incorporated into the 3-dimensional code, and plume dispersion will be added to the trajectory and cleansing codes. The case of July 19, 1978, for which special observations are available, will be used to demonstrate post-analysis capability. The real-time system will be demonstrated during the Sesame '79 field experiment in April 1979. **Keywords:** air pollution; forecasting; p codes; boundary layers; real time systems.

106537 Sorption of Pollutant Gases by Soils. Bremner, J.M. (Iowa State University of Science and Technology, Department of Agronomy, Ames, IA, 50011). **Project number:** 006789. **Contract:** EY-76-S-02-2530. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to assess the ability of soils to sorb nitrogen and sulfur gases identified as major air pollutants, to identify the factors affecting sorption of these gases by soils, and to determine the mechanisms of sorption of these gases. The soils used are selected to obtain a wide range in properties. Gas sorption is studied by soil analysis and by gas chromatographic and chemiluminescent techniques. Findings include the following: (1) soils have substantial capacities for sorption of SO2, H2S, and NO2, and their capacities for sorption of these gases can be predicted from various soil analyses; (2) soils can act as sinks for atmospheric N2O under some conditions, but usually act as sources of this gas; and (3) N2O is produced during nitrification of fertilizer nitrogen in soils. The latter finding has important implications in regard to the potential threat of soil-derived N2O to the ozone layer. Work planned is designed to identify the factors affecting sorption of N2O, NO and NO2 by soils, to elucidate the mechanisms by which soils sorb these gases, and to evaluate recent work indicating there is a major ground surface sink for N2O.
Keywords: chemical effluents; air pollution; gaseous wastes; sulfur compounds; nitrogen compounds; soils; air cleaning; absorption; sorptive properties; biodegradation; earth atmosphere; environmental transport; gaseous wastes.

106538 Thermoregulation of Fish and Turtles in Thermally Stressed Habitats. Spotila, J.R. (State Univ. of New York at Buffalo, Dept. of Biology, Buffalo, NY, 14222). **Project number:** 006796. **Contract:** EY-76-S-02-2502. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$36,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The proposed overall objectives of this renewal are to: (1) continue to develop and perfect a mathematical model to predict the temperature of a fish in a heterothermal environment, (2) determine the specific physical and physiological adaptations by which large fish and other ectotherms adjust to changes in water temperature, (3) continue field studies in the biophysical ecology of turtles in thermally stressed environments of the Savannah River Plant, and (4) continue energy budget modeling of heat transfer between large ectotherms and their environment.
Keywords: reptiles; biological stress; alligators; turtles; fishes; environment; mathematical models; thermal effluents; biological effects; nuclear power plants; temperature effects; control.

106539 Studies of the Environmental Impact of Evaporative Cooling Tower Plumes. Norman, J.M. (Pennsylvania State University, Dept. of Meteorology, University Park, PA, 16802). **Project number:** 006815. **Contract:** 80-EV02463. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The objectives of this research are to characterize the environmental effects of evaporative cooling tower plumes. This involves obtaining a variety of field data around the Keystone-Connemaugh power plant in SW Pennsylvania such as: (a) plant operating conditions as an input to a plant energy balance model to specify the tower as a source of heat and moisture for plume model validation studies; (b) temperature and droplet concentrations inside towers to relate environmental effects to tower characteristics; (c) aircraft turbulence measurements of temperature, water vapor and vertical velocity inside plumes for tests of plume model predictions and a better understanding of plume behavior; (d) surface based Doppler Sodar measurements; (e) drift-drop size distribution measurements in plumes; (f) measurements of aerosol size distributions, particle identification and SO2 in merging stack and cooling tower plumes to define the sulfur balance in this region and predict deposition of sulate; and (g) measurement of ambient conditions from the surface to 10,000 feet altitude to provide background information for models. Techniques utilized include: (1) measurements within cooling water; (2) ground based measurements such as with the Sodar equipment; and (3) use of instrumented aircraft for plume measurements of temperature, velocities, drift particle size, and SO2 concentration.
Keywords: cooling towers; environmental impacts; air pollution; plumes; meteorology; environmental transport; fossil-fuel power plants; pennsylvania; mathematical models; earth atmosphere; thermal effluents; precipitation scavenging; aerosol monitoring; sulfates.

106540 Effects of Environmental Stresses on the Species Composition of Phytoplankton Populations. Ryther, J.H. (Woods Hole Oceanographic Inst., Woods Hole, MA, 02543). **Project number:** 006848. **Contract:** AT(11-1)-2532. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This is a study on the effects of increased temperature, nutrient enrichment, chlorine, and the heavy metals copper and zinc on the succession and dominance of phytoplankton species in natural communities taken from Vineyard Sound, MA. Water from that source containing its natural phytoplankton is circulated through cultures ranging in size from 10 to the third power to 10 to the 5th power liters at rates that permit the establishment of steady-state populations, following which the above stresses are applied, singly and in combination, at increments until new steady state populations of different community structure (species composition, dominance, and diversity) and/or magnitude (biomass and primary productivity) are observed.
Keywords: water pollution; environmental effects; phytoplankton; communities; biological stress; thermal pollution; nutrients; chlorine compounds; copper compounds; zinc compounds; aquatic ecosystems; population dynamics.

106541 Plutonium, Cesium and Uranium Series Radionuclides in the Hudson River Estuary and Other Environments. Simpson, H.J. (Columbia University, Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 006855. **Contract:** E(11-1)2529. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to collect sediment samples in the Hudson River Estuary and adjacent continental shelf, and to analyze them for Cs-137, Cs-134, Co-60 and Mn-54 by direct gamma counting and for Pu-239, Pu-240 and Pu-238 by alpha-spectrometry. Our purpose is to describe the behavior of fallout-derived plutonium in estuarine sediments as a function of a number of environmental parameters, and to exploit the reactor-release tag of Hudson sediments as an indicator of the sediment transport and accumulation patterns which control the distribution of plutonium in the sediments.
Keywords: plutonium; cesium; hudson river; estuaries; radioecological concentration; sediments; continental shelf; cesium 137; cesium 134; cobalt 60; manganese 54; plutonium 239; plutonium 238; plutonium 240; radionuclide migration; fallout.

106542 North Pacific Disposal of High Level Ra-Wastes. Anderson, D.R. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** 002221. **Contract:** EY-76-C-04-0789. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$300,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The broad objective of the Seabed Program is to determine the technical feasibility, including the determination of environmental acceptability and comparability, of controlled emplacement of radioactive waste materials under the sediments of the deep ocean floor. Sub-objectives include: (1) oceanographic investigations describe the modern ocean environment, determine present and past rates of the natural processes on and beneath the seafloor, and characterize the environmental media which will interact with the wastes once emplaced; (2) effects investigations which will develop understanding of the interactions of the natural systems with the wastes and the emplacement operation; (3) systems development engineering for transportation, handling, and emplacement operational requirements and costs; (4) site selection and survey for detailed information about the specific sites of interest; (5) environmental assessment to determine those operational, safety, and emplaced waste effects on the environment; and (6) environmental impact definition which is simply those special effects of the operation and of the emplaced wastes on the natural system in a full operational phase. These objectives are being met by working within the established capabilities of several laboratories and oceanographic institutions as well as several engineering firms. The Division of Ecological Research-supported portion of the work, which is mostly conducted by Scripps Institute of Oceanography, concerns the respirometry and microbiology of deep ocean sediments, biological transfer processes across the benthic boundary layer, and biological transport mechanisms in the water column.
Keywords: pacific ocean; high-level radioactive wastes; radioactive waste disposal; marine disposal; sea bed; feasibility studies; oceanography; environmental impacts.

106543 Revegetation Following Artificial Disturbance. Fraley, L. Jr. (Colorado State University, Dept. of Radiology and Radiation Biology, Fort Collins, CO, 80523). **Project number:** 006989. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$19,000,000. **Related energy source:** nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) determine the potential for revegetation at Rocky Flats; (2) determine recovery of grasslands vegetation following exposure to ionizing radiation disturbance by fire, tilling or scraping; and (3) determine the radiosensitivity of grassland vegetation to chronically administered radiation. The approach includes (1) removing existing vegetation by tilling and reseeding with various mixtures of native species under varying conditions; (2) exposing grasslands vegetation to ionizing radiation on burn, rototill or scrap and measuring secondary succession; and (3) chronically exposing grassland vegetation to ionizing radiation. Results indicate that plant communities continue to be in equilibrium with radiation dose rate. All nuclear characteristics have been determined for Tradescantia occidentials and Ornithogalum virens.
Keywords: land reclamation; revegetation; ionizing radiations; fires; rocky flats plant; environment.

106544 Strip Mine Reclamation: Remote and Direct Measurement of Revegetation Success. Carrel, J.E. (University of Missouri, 407 Tucker Hall, Columbia, MO, 65201). **Project number:** 006998. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$6,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are: (1) to describe quantitatively the natural recovery of strip mines; and (2) to design a technique for rapid strip mine restoration by endemic organisms. The island biogeographical and ecosystem nergetic approaches of ecology are being used in stripped grasslands.
Keywords: coal mining; surfacc mining; land reclamation; aerial monitoring; revegetation.

106545 Health Effects of Combustion-Generated Soots and Polycyclic Aromatic Hydrocarbons. Thilly, W.G. (Massachusetts Institute of Technology, Room E18-666, Cambridge, MA, 02139). **Project number:** 007293. **Contract:** EE-77-S-02-4267. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$169,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Human cell mutation by soot and soot constituents will be measured using an assay developed by the contract laboratory. The principal effort, however, will be (1) to develop novel means for storage and use of drug metabolizing elements derived from mammalian tissues as part of the mutation assay, and (2) to develop means to automate the overall assay procedure.
Keywords: animal cells; man; soot; mutagen screening; bioassay; enzymes; storage; automation; bioassay.

106546 Impact of Atmospheric SO2 and CO2 on the Ecophysiology and Competitiveness of Plants. Bazzaz, F.A. (Univ. of Illinois, Department of Botany, Urbana, IL, 61801). **Project number:** 007232. **Contract:** EE-77-S-02-4329. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$47,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to understand the physiological and ecological responses of a variety of plant species including crops, trees, and weeds, to elevated concentrations of SO2 and CO2 separately and together since these gases may act antagonistically with respect to photosynthesis, water use and ultimately growth. Experiments on corn, soybean, sunflower, silver maple, cottonwood, and sycamore grown under controlled conditions and under 300, 600, and 1200 ppM CO2 have been conducted. It was found that the species differ in their rates of photosynthesis, transpiration, water use efficiency, and growth. Generally photosynthesis and growth increased more in soybean and sunflower than in corn when the plants were grown at 600 and 1200 ppM CO2. SO2 fumigation experiments using the species mentioned above have begun and will be followed by other experiments which will elevate the concentrations of SO2 and CO2 simultaneously.
Keywords: earth atmosphere; sulfur dioxide; carbon dioxide; plants; physiology; environmental impacts; air pollution; biological effects; maize; soybeans; trees; sunflowers; photosynthesis; water requirements; synergism; plant growth.

106547 Air Pollution Effects on Food Quality. Pell, E.J. (Pennsylvania State University, 211 Buckhout Lab., University Park, PA, 16802). **Project number:** 007234. **Contract:** EE-77-S-02-4331. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$52,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The impact of ozone on food quality of three major crops is being studied. Quality of alfalfa foliage, potato tubers and soybean seeds is being evaluated in relation to acute injury to foliage induced by ozone. Qualitative parameters under consideration are as follows: (1) alfalfa foliage--estrogenic flavonoid status including coumestrol, daidzein, genistein and formononetin, protein (quantitative and qualitative); (2) potato tubers--reducing sugars, starch, protein glycoalkaloids; (3) soybean seeds--proteins, lipids, and carbohydrates. Plants are grown in a conventional greenhouse. Alfalfa plants are exposed to a single acute exposure of ozone and foliage expressing different levels of injury is harvested and analyzed for parameters enumerated above. Potato plants and soybean plants are exposed to acute doses of ozone at semiweekly intervals and tubers or seeds harvested at maturity and analyzed for above parameters. All ozone exposures are carried out in controlled environment chambers. Ozone does not induce coumestrol in the 5 cultivars of alfalfa which we considered. Other estogenic compounds may be present and are presently being investigated. Such compounds would reduce quality of this forage. One flavonoid 4', 7-dihydroxyflavone is induced by ozone as identified and verified in this study. Glycoalkaloids are not induced in potato tubers of plants exposed to ozone. Effects on other quality parameters are presently being evaluated. The induction of certain compounds like coumestrol in alfalfa or glycoalkaloids in potato tubers would reduce their respective qualities. Shifts in protein composition of alfalfa foliage or soybean seed would alter their respective qualities.
Keywords: air pollution; food; wholesomeness; crops; alfalfa; potatoes; soybeans; ozone; toxicity; tolerance.

106548 Likelihood Estimations of Vegetative Alteration Near Known or Proposed Sources of Air Pollution. Davis, D.D. (Pennsylvania State University, Department of Plant Pathology, University Park, PA, 16802). **Project number:** 007297. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this project is to construct a computer model to simulate and predict injury to vegetation by sulfur dioxide. Characteristics of pollutant dose, climate, and species susceptibility will be obtained from literature reviews and experimental studies and used to construct a mathematical model which will predict the probability of foliar injury to vegetation.
Keywords: plants; metabolism; air pollution; biological effects; forecasting; sulfur dioxide; mathematical models; environmental impacts.

106549 Chemical Composition of Precipitation in Minnesota. Gorham, E. (University of Minnesota, Department of Ecology and Behavioral Biology, St. Paul, MN, 55108). **Project number:** 007439. **Contract:** EE-77-S-02-4327. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this study is to determine the deposition of nutrients and pollutants in dust, rain and snow at polluted and unpolluted sites in Minnesota and North Dakota. Automatic precipitation and bulk deposition collectors will be used for sampling dust,

rain and snow and analyses will be performed for major cations and anions and physical characteristics of samples. Chemical data will be used to evaluate the role of various ions and their origins on precipitation quality. Sampling sites range across a region of gradient air quality from Minnesota to North Dakota.
Keywords: atmospheric precipitations; nutrients; air pollution; deposition; precipitation scavenging; minnesota; south dakota; sampling; air quality; dusts; rain; snow; particles; aerosols; ph value; mathematical models; environmental transport.

106550 Uptake of Sulfuric Acid Mist by Plant Canopies. Wedding, J.B. (Colorado State Univ., Dept. of Civil Engineering, Ft. Collins, CO, 80523). **Project number:** 007476. **Contract:** EE-77-S-02-4367. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose of this study is to determine the deposition of sulfuric acid aerosol on plant canopies and to determine injurious effects on foliage. Plants with different canopy densities will be exposed to a simulated aerosol in a wind-tunnel and mass and number of droplets intercepted will be determined as a function of aerosol and canopy characteristics. Plants will be exposed to sulfuric acid aerosols in a growth chamber and anatomical, cytological and physiological measurements will be made. Physiological response of the test plants appears to be related to the H2SO4 loading and the degree of hydration of the H2SO4.
Keywords: sulfuric acid; plants; uptake; environmental transport; aerosols; acid rain; leaves; simulation; physiology; cytology; deposition; environmental effects.

106551 Trace Elements in Oil Shale. Chappell, W. (University of Colorado, Denver, CO). **Project number:** 007098. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$357,000.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The program has three major parts: a baseline study, a mass balance study, and a transport/biological effects study. The purpose of the baseline study is to establish the natural levels of several trace metals in soils, stream sediments and biota in the regions which will be subjected to impact during oil shale development. Some trace metals will be volatilized during the retorting process and others will either be released in liquid waste effluents or are subject to leaching from spent shale. The mass balance studies will involve measurement of the trace metal contents of raw shale and spent shale. Some of this work can be done with spent shale from pilot and industrially-owned units of varying scales which are now operating. Some work will be done with bench scale models. An extension of the mass balance studies will include work on the transport of trace metals after release as in stack gases or after mobilization from the spent shale. These studies will be concentrated on the mobilization of trace elements in spent shale and the potential for contamination of ground or surface waters and the role of stream sediments and soil in eliminating or reducing this potential problem. The third major effort will deal with biological availability of the trace metals to plants used to revegetate the massive amounts of spent shale which will be generated.
Keywords: oil shales; chemical composition; impurities; elements; trace amounts; soils; sediments; oil shale processing plants; waste water; solid wastes; leaching; mass balance; spent shales; environmental transport; emission; ground water; surface waters; revegetation; water pollution; environmental effects; biological effects; chemical effluents; plants.

106552 Rehabilitation Potential and Practices of Colorado Oil Shale Lands. Cook, C.W. (Colorado State University, Department of Range Science, Ft. Collins, CO, 80523). **Project number:** 007100. **Contract:** EY-76-S-02-4018. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$280,000.
Related energy source: oil shale(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objective of the project is to study the effects of seeding techniques, species mixtures, fertilizer, ecotypes, improved plant materials, mycorrhizal fungi, and soil microorganisms on the initial and final stages of reclamation obtained through seeding and subsequent succession on disturbed oil shale lands. Several of the studies associated with the project have some phases being conducted principally in laboratories and greenhouses. Field studies are being conducted on a 20-hectare Intensive Study Site in the Piceance Basin of northwestern Colorado. Products will include the following: (1) determination of revegetation techniques for establishing diverse plant communities; (2) determination of plant successional patterns on overburden material and retorted shale as influenced by species mixtures, cultural practices, and soil conditions; (3) determination of methods for establishing adequate long-term fertility levels on disturbed soils; (4) identification of naturally occurring ecological-genetic variation of important revegetation species; (5) description of naturally occurring phytosociological structures in the Piceance Basin; (6) development of improved strains of grasses and legumes for revegetation; (7) determination of microbial responses during establishment of plants on disturbed soils and retorted shale; (8) development of management alternatives where plant-microbe relations can be controlled; and (9) determination of the importance of mycorrhizal fungi in stabilizing disturbed soils and retorted shales.
Keywords: colorado; oil shales; oil shale processing plants; environmental effects; land reclamation; revegetation; plant growth; fertilizers; nitrogen; phosphorus; nutrients; spent shales; chemical composition; terrestrial ecosystems; biological effects; soils; genetics; mycorrhizas; microorganisms.

106553 Maintenance of a Rural Precipitation Chemistry Center at Whiteface Mountain. Mohnen, V. (State University of New York, Atmospheric Sciences Research Center, Albany, NY, 12222). **Project number:** 007099. **Contract:** EY-76-S-02-2986. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Atmospheric Sciences Research Center (ASRC) maintains and operates one of eight precipitation chemistry sites in support of MAP3S. In addition selected pollutants are measured in ambient air in support of related studies on stratospheric input of ozone and MAP3S studies.
Keywords: new york; air quality; air pollution; monitoring; rural areas; acid rain; sulfur dioxide; ozone; stratosphere.

106554 Development of an Aerosol Size Classifier. Forney, L.J. (University of Illinois, Urbana, IL). **Project number:** 007443. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$42,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The purpose of this proposed research is to develop and test a simple aerosol size fractionator for use in sampling and characterizing fine suspended atmospheric particles (less than 3 micrometers in diameter). The principle of virtual impaction will be used together with a continuously variable slit width. While the versatility of single stage fractionators incorporating these principles has been demonstrated, additional R and D and tests are needed to optimize design and performance. Tests will be made using monodispersed DOP particles to determine the magnitude of internal wall losses. An evaluation of performance compared to other currently available size fractionators will be conducted.
Keywords: particle size classifiers; design; testing; coal; combustion; particles; aerosols; sampling; air pollution.

106555 Microbiological Air Quality: Ames Southwestern Disposal. Kniseley. (Ames Laboratory, Ames, IA, 50011). **Project number:** 002485. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$73,000.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

Bacteriological sampling is being conducted at the Ames Solid Waste Recovery Plant, the Atlas Storage Bin, the Ames Power Plant and at several ambient locations throughout the city of Ames. The samples are collected with impinger and six-stage Anderson 2000 air samplers. The bacteria are identified using mini-tek systems as well as other conventional microbiological techniques. Work is also underway for the determination of specific toxins present in the samples. Future work will involve modification in the processing plant which would control any microbiological hazards that are discovered.
Keywords: waste processing plants; storage facilities; refuse-fueled power plants; air quality; pathogenesis; bioassay; air pollution; health hazards; bacteria; toxins; sampling; iowa.

106556 Competitive Effects of Introduced Annual Weeds on Some Native and Reclamation Species in the Powder River Basin, Wyoming, University Station. Knight, C. (University of Wyoming, University Station, Laramie, WY, 82070). **Project number:** 007218. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$21,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The experimental design consists of three 20 x 72 m plots, each a different distance from introduced weed seed sources. Plots with and without weeds will be compared to determine effects of the weeds on the native species invading naturally. Randomly selected plots with and without weeds will be irrigated at a level not to exceed maximum precipitation for the study area. An area undergoing reclamation will be studied in a similar manner, with the following treatments being applied where reclamation species have been planted: (1) introduced weeds and water, (2) no weeds and water, (3) weeds and no water, and (4) no weeds and no water. Measurements of the ecophysiological characteristics will be done on the dominant

species in field and greenhouse experiments. The experiments have been initiated near stripmining sites in the Powder River Basin south of Gillette, Wyoming.
Keywords: plants; grass; population dynamics; revegetation; preferred species; cultivation techniques; surface mining; land reclamation; wyoming.

106557 Characterization of Gaseous Molecular Pollutants. Svec, H.J. (Ames Lab., Ames, IA). **Project number:** 001359. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The broad objectives of this study are to develop the basic science, the investigative methods, and the hardware so that the demanding analytical requirements associated with the characterization of organic and inorganic pollutants in effluents from energy generating sources can be met in a viable, practical manner. Particular emphasis is devoted to the development of multipollutant analytical concepts and on the determination of ultratrace pollutants. Special attention is being placed on those inorganic and organic pollutants which are or may be emitted from fossil-fueled energy sources and from coal liquefaction and gasification plants. Many of these pollutants are certainly health hazards, and some already identified are proven carcinogens. Two projects are now supported and a request for the initiation of a third project has been submitted with the FY 1979 Schedule 189. The three projects are as follows: (1) isolation, characterization, and quantitation of higher molecular weight organic pollutants; (2) x-ray excited optical luminescence of polynuclear aromatic hydrocarbons; and (3) personnel and plant monitors for known and potential toxic substances.
Keywords: air pollution; atmospheric chemistry; chemical analysis; multi-element analysis; fossil-fuel power plants; coal liquefaction; coal gasification; chemical effluents; polycyclic aromatic hydrocarbons.

106558 Nucleic Acid--Protein Interactions: Conformational Studies. Fasman, G.D. (Brandeis University, Graduate Department of Biochemistry, Waltham, MA, 02154). **Project number:** 007974. **Contract:** EP-78-S-02-4962.A000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The biological functions of both proteins and nucleic acids are frequently under conformational control. Studies will be conducted on both biological materials and synthetic models of these biological macromolecules. Research will be directed towards methods of determining and predicting the conformation and conformational transitions in protein models (poly-alpha-amino acids) and nucleic acids (model polynucleotides). Physical--chemical techniques such as optical rotatory dispersion, circular dichroism, tritium exchange, and fluorescence will be exploited. Research will be directed towards elucidating the conformational consequences and biological significance of the interaction of DNA and both the histones and non-histone proteins found in the nucleus. Model systems, utilizing model polypeptides and polynucleotides, will be studied to investigate the interdependence of the conformation of both components of these models. Such studies will perhaps lead to the understanding of how nucleoproteins are involved in control of genetic expression, and how failures in control mechanisms operate.
Keywords: proteins; nucleic acids; conformational changes; biological functions; biological models; biochemical reaction kinetics; genetic control.

106559 INEL National Environmental Research Park. Markham, O.D. (Idaho National Engineering Laboratory, Radiological and Environmental Sciences Lab. (RESL), 550 2nd Street, Idaho Falls, ID, 83401). **Project number:** 000983. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The objectives of this project are to administer environmental studies on the Idaho National Engineering Laboratory (INEL) National Environmental Research Park (NERP); and to provide field facilities, site characterization, and dissemination of information. The objectives are being met through the appointment of a NERP coordinator. Several studies are in progress to characterize the INEL Site environment. Meetings were held with all personnel involved in ecological studies at the INEL and proceedings are currently being mailed. A NERP brochure and two displays describing the INEL NERP are being planned. A symposium on September 11 and 12, 1978, presented the program to a large group of Rocky Mountain Region scientists and government agency officials. Thirty-five papers were given and abstracts are available at RESL.
Keywords: idaho national engineering laboratory; nature reserves; environment; ecology; plants; animals; population dynamics; research programs; management.

106560 INEL Ecological Studies: NERP. Markham, O.D. (Idaho National Engineering Laboratory, Health Services Laboratory, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** 000988. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of this project are to obtain basic information on the flora and fauna of the Idaho National Engineering Laboratory (INEL) Site which will enhance future environmental planning, preparation of environmental impact statements, and provide data to determine the movements and effects of radioactive materials in the ecosystem involved; and to characterize the environment of the INEL National Environmental Research Park. The studies being conducted or in planning are: (1) a study of raptor species; (2) demographic analysis of the burrowing owl; (3) vegetation analyses on grazed and ungrazed areas; (4) faunal populations levels correlated with different land use practices; (5) validation study of rodent populations; (6) plant and animal succession on a burned area; (7) a study of plant succession by use of long-established (26 yr) plant transects; (8) seasonal diet of coyotes; (9) a demographic analysis of the pygmy rabbit; (10) a study of amphibian and reptilian fauna; and (11) periodic distribution and food habit relationship of fishes.
Keywords: idaho national engineering laboratory; baseline ecology; plants; animals; decision making; data acquisition; environmental impacts; terrestrial ecosystems; radionuclide migration; nature reserves; population dynamics; species diversity; land use; revegetation; population relocation.

106561 INEL Site Radioecology Program. Markham, O.D. (Idaho National Engineering Lab., Health Services Laboratory, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** 001390. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objecties of the project are to: (1) establish concentrations of radionuclides in biological materials onsite and downwind of the INEL Site; (2) establish antelope migration routes so radionuclide tissue data significance can be established; (3) determine food habits and radionuclide concentrations in mourning doves; (4) determine secondary succession, wind erosion, and radionuclide resuspension on a burned area; (5) determine distribution of Pu, Cm, and Am in the Test Reactor Area Radioactive Waste Ponds; (6) determine gamma radionuclide concentrations and describe biomass of ecosystem components in a waste pond; (7) determine external radiation exposure to small mammals near radiation areas; (8) determine effects of radiation exposure to swallow young; (9) determine repopulation of small mammals in a burned area; (10) determine radionuclide buildup and retention by waterfowl using a radioactive leaching pond; (11) determine radionuclides near the INEL Radioactive Waste Management Complex; and (12) determine I-127 and I-129 relations on and near the INEL Site. Radionuclide data are just now accumulating to the point where good statistical interpretation can be made. FY 1979 should bring animal dose estimates and transport parameters for I-129 and transuranic elements.
Keywords: idaho national engineering laboratory; radioactive waste management; radioactive effluents; aquatic ecosystems; terrestrial ecosystems; contamination; radionuclide migration; americium isotopes; curium isotopes; plutonium isotopes; iodine 127; iodine 129; radioecological concentration; radioecology; deer; birds; migration; radionuclide kinetics; soils; erosion; particle resuspension; mammals; radiation doses; buildup; radiation monitoring.

106562 Meteorological Research and Development. Randerson, D. (National Weather Service, Western Region, P.O. Box 14985, Las Vegas, NV, 89114). **Project number:** 000542. **Contract:** EY-76-A-08-0351. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$45,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Under this agreement the principal investigator will serve as editor of a book entitled Atmospheric Science and Power Production. This book is designed to update and to replace the widely used Meteorology and Atomic Energy: 1968. The book will contain 20 chapters authored by 25 professionals. Consisting of four sections (Fundamentals, Atmospheric Physics, Atmospheric Chemistry, and Applications), the book will cover a wide variety of atmospheric topics related to the fate of power plant effluents. In addition, research will be conducted on the effect of complex terrain on the long-range transport of radioactive debris that might be released accidentally from underground nuclear tests. Previously collected field data will be analyzed and used to describe the effect of complex terrain on mesoscale transport and diffusion. Furthermore, the available data will be surveyed to determine if reliable estimates can be

made of eddy diffusion coefficients for space scales of the order of 100 km and time scales of 1 to 2 days.
Keywords: atmospheric chemistry; power plants; environmental effects; air pollution; chemical effluents; underground nuclear stations; nuclear explosions; radioactivity; radionuclide migration; meteorology.

106563 Mid-Pacific Marine Laboratory. Reese, E. (University of Hawaii, Hawaii Institute of Marine Biology, P.O. Box 1346, Kaneohe, HI, 96744). **Project number:** 000661. **Contract:** E(26-1)-628. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$205,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project provides management support to marine research projects conducted in and about the Marshall Islands in the areas of: (1) biogeochemistry of atolls; (2) radionuclide pathways to man; and (3) human presence in the atoll ecosystem. Both intramural and extramural programs are supported with investigators from the University of Hawaii conducting intramural projects and investigators from other universities funded for the extramural program. A fuller understanding of the atoll ecosystem is expected as a result of these investigations.
Keywords: marshall islands; radiation monitoring; aquatic ecosystems; terrestrial ecosystems; radionuclide migration; fallout deposits; radioecological concentration; animals; plants; aquatic organisms; radionuclide kinetics; sediments; seawater; sampling; research programs; management; human populations; environmental exposure pathway; biogeochemistry.

106564 Computer Support. (Computer Science Corporation, P.O. Box 15390, Las Vegas, NV, 89114). **Project number:** 000807. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$5,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this project is to provide data processing support to CETO organizations on sponsored research studies at the Nevada Test Site.
Keywords: data processing; computers; research programs; management.

106565 Hydrogeochemistry of Eniwetok. Buddemeier, R.W. (Lawrence Livermore Laboratory, Livermore, CA, 94550). **Project number:** 3329. **Contract:** E(26-1)-641. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are the description and quantitative understanding of the hydrology and groundwater geochemistry of Eniwetok Atoll and the use of these results to interpret groundwater radioactivity in terms of leaching, cycling, transport, and residence time models for the groundwater, soil, vegetation system of specific locales, and for the atoll system as a whole. Measurements of tidal lag and efficiency on wells and surface pits were performed. Changes in water elevation in wells and pits were measured and dye and chemical tracer experiments were conducted. The data should provide information on groundwater movement and amount of radionuclides in the groundwater system.
Keywords: eniwetok; ground water; hydrology; geochemistry; radionuclide migration; radioisotopes; environmental transport; leaching; soils; plants; radionuclide kinetics.

106566 NTS National Environmental Research Park Activity. (Nevada Operations Office, P.O. Box 14100, Las Vegas, NV, 89114). **Project number:** 000991. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives are to coordinate arrangements for new environmental research studies by others at the Nevada Test Site, and to sponsor specific studies needed to characterize the environment and plan for wise use of the land. The first phase of the endangered plant species survey was completed and technical report was prepared and published. An archaeological survey of the NTS was begun. A handbook of policies and procedures will be prepared to instruct NERP program candidates and participants how to interface with the NTS organization and how operations must be conducted to be compatible with existing rules and regulations.
Keywords: nature reserves; environment; research programs; land use; nevada test site; endangered species; plants; archaeology; manuals; environmental policy; ecology.

106567 Late Somatic Effects of Energy Pollutants. Walburg, H.E. Jr. (UT-DOE Comparative Animal Research Laboratory, 1299 Bethel Valley Road, Oak Ridge, TN, 37830). **Project number:** 000210. **Contract:** EY-76-C-05-0242. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Many toxic agents are carcinogenic or produce other late effects at levels which do not cause detectable acute injury. The principal current experiment is a study of irradiation effects in burros begun in 1951. The most interesting finding to date is that the incidence of spontaneous neoplasia in this species is very low and that exposure to ionizing radiation does not seem to be carcinogenic. Continuation of the study is needed to place these results on a statistically valid basis. Studies on platelet aggregation as influenced by age, species, and prior irradiation treatment are also being conducted. Preliminary experiments on the influence of species on chemical carcinogenesis have been initiated.
Keywords: toxicity; carcinogenesis; low dose irradiation; neoplasms; epidemiology; burros; delayed radiation effects.

106568 Atmospheric Turbulence and Diffusion Research. Gifford, F.A. (National Oceanic and Atmospheric Administration, Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN, 37830). **Project number:** 000532. **Contract:** EY-76-C-05-3688. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$585,000.
Related energy source: Coal(20); oil and gas(20); oil shale(10); nuclear fission(10); solar(20); geothermal(10); hydroelectric(10) **R and D categories:** Environmental effects assessment.

The purposes of the program are to conduct basic and applied research in atmospheric turbulence and diffusion, and to provide meteorological services to DOE and its contractors. Current emphasis is on the effects of waste heat and moisture from energy generation on the atmosphere, diffusion and dispersion in forests, plume rose and regroup transport processes considering terrain features and/or variable boundary layers. Theoretical modeling coupled with field observation and laboratory research (wind tunnel) will be used to develop new or improved models. Model verification will be made against literature data sets, field program data, etc. A forest meteorology workshop was held in 1978. Various heat and moisture sources such as cooling towers, ponds, and lakes were characterized and observed efforts described in a report, Atmospheric Heats of Energy Generators, June 1978. A cooling tower drift deposition model has been developed.
Keywords: earth atmosphere; turbulence; diffusion; meteorology; waste heat; plumes; air pollution; boundary layers; forests; mathematical models; power generation; environmental effects.

106569 Marine Pollution Studies. Gonzales, J. (Puerto Rico Univ., Caparra Heights Station Center for Energy and Environment, San Juan, PR, 00935). **Project number:** 000615. **Contract:** E(40-1)-1833. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$410,000.
Related energy source: Coal(30); oil and gas(70) **R and D categories:** Environmental effects assessment.

The objective is to investigate and evaluate the effects of stresses on a coastal marine ecosystem caused by the continuing development of the largest energy converting and petrochemical complex in Puerto Rico. An integrated team approach will be used to investigate the interaction of physical, chemical and biological systems in the Guayanilla-Tallaboa area. The research will identify and characterize the pollutants in the area and attempt to describe their transport within and through the Bay ecosystem. The stresses on the biological systems caused by these pollutants will be measured and evaluated. The project will culminate in a set of management alternatives for the wise utilization of energy and marine resources.
Keywords: contamination; puerto rico; aquatic ecosystems; stresses; petrochemicals; production; environmental effects; petroleum industry; environmental transport; water pollution; biological effects; aquatic organisms; seas; pollution.

106570 Terrestrial Ecology Project. Tilley, L. (Center for Energy and Environment Research, Caparra Heights Station, San Juan, PR, 00935). **Project number:** 000616. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$275,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The purpose of the Espirito Santo Drainage Basin Program is twofold: (1) to provide baseline ecological data for future environmental assessment studies at the local and regional level; and (2) to determine through an ecosystem approach management alternatives for the wise utilization of energy, water, and land resources. Environment management involves planning and decision making and both of these require data. At present, little is known about the interworking of a complete, integrated system such as the drainage basin. While many isolated, ecologically oriented studies have been conducted in a tropical environment, few, if any, have provided the

data base required for environmental management. In view of rapidly changing socioeconomic conditions and natural resources limitations, management urgently requires input data from three systems: (1) the physical (geological--meteorological), (2) the biological, and (3) the cultural.
Keywords: terrestrial ecosystems; baseline ecology; land use; energy policy; water resources; planning; decision making; puerto rico.

106571 Mechanism of Carcinogenesis. Coggin, J.H. (University of South Alabama, College of Medicine, Mobile, AL, 36688). **Project number:** 007593. **Contract:** EE-77-S-05-5601. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$19,000.
Related energy source: Coal(35); nuclear fission(65) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to examine the antigenic and biochemical changes associated with the earliest stages of cell transformation induced by oncodnaviruses acting synergistically with x-irradiation (low-level) or radiomimetic chemicals. A highly specific, cytotoxic antiserum has been prepared against fetal antigen (EA) present on 10- but not 14-day gestation hamster fetal or embryonic cells. The serum antibody responsible is also capable of destroying a wide variety of sarcomas which are known to carry EA. This serum is being used to detect (by cell cytotoxicity) the earliest appearance of EA on newly transformed sarcoma cells induced in vitro by the co-carcinogenic interaction of x-irradiation, chemicals, and SV40. A new method for detecting the earliest transformed cells that appear in an SV40 infected normal cell population employs the culture of cells in polyacrylamide gels which permit only transformed, EA+ cells to attach and proliferate. The release of soluble EA from new transformant cells induced by co-carcinogenic action will be determined and temporally studied.
Keywords: x radiation; oncogenic viruses; synergism; oncogenic transformations; cell cultures; hamsters; animal cells; low dose irradiation; antigens; carcinogenesis.

106572 Portable XRF Survey Meter and Personal Sample Reader for Elemental Dosimetry of Industrial Atmospheres. Rhodes, J. (Columbia Scientific Industries, Austin, TX, 78766). **Project number:** 007465. **Contract:** 77EV05464. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(20); geothermal(20) **R and D categories:** Pollutant monitoring.

Dr. John Rhodes, Columbia Scientific Industries, proposes to develop, demonstrate and evaluate a new kind of portable x-ray fluorescence (XRF) analysis survey meter or personal monitor for sampling and analyzing air contaminants. The instrument will be capable of monitoring airborne concentrations of most trace metals, inorganics, and organometallics that comprise at least 50 of some 500 controlled substances. The instrument will be a hand portable, battery operated survey meter that can collect air filter samples in situ and analyze them, compute concentration from stored calibration data, and register the output in suitable units (and provide an alarm if required). The instrument will be usable as a reader for analyzing samples on the spot from personal air samplers worn by workers.
Keywords: air pollution monitors; x-ray fluorescence analyzers; design; fabrication; performance testing; survey monitors; personnel; monitoring; air samplers; metals; inorganic compounds; organometallic compounds; industrial plants; indoor air pollution; data acquisition.

106573 Fate of Chlorine in Seawater. Wong, G.T.F. (Old Dominion University, Department of Oceanography, Norfolk, VA, 23508). **Project number:** 007616. **Contract:** EE-77-S-05-5572. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The goal of this project is to identify the products and to estimate their rates of formation during the chlorination of seawater. The effects of bromide ion concentrations, temperatures, and sunlight on the rate of chlorine consumption will be followed by three methods: an amperometric titration with phenyl arsene oxide at pH 4 for hypohalites; an iodometric titration with sodium thiosulfate at pH 1.4 for hypohalites and some halates; and uv spectroscopy.
Keywords: seawater; chlorine; chemical effluents; marine disposal; chlorination; nuclear power plants.

106574 Marine Research Boat Operation. Gonzales, J.G. (Puerto Rico University, Caparra Heights Station, Center for Energy and Environment Research, San Juan, PR, 00935). **Project number:** 001326. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: Coal(30); oil and gas(70) **R and D categories:** Environmental effects assessment.

The research boat, Sultana, was purchased during FY 1976. This boat will serve as the primary field platform and base station for the work by the Marine Ecology Division. The vessel is capable of operating in both shallow and deep water, from bays and inlets to 40 miles off the coast and has a cruising range of 600 miles. In the field, the Sultana can provide berthing and mess facilities for six personnel for a continuous 5-day operation. She has a davit and A-frame for handling scientific instruments and fishing gear up to 600 pounds. A hydraulic winch with 1000 feet of 1/8-inch stainless steel cable is mounted aft. The working cockpit area is 17 feet long by 12 feet wide. The Sultana is small enough (42 feet long) to maneuver easily within most bays and near shore and is ideally suited for carrying out the field programs in the Tallaboa/Guayanilla Bays area and projects in the Mona Channel off the coast of Puerto Rico where heavy sea conditions are often encountered.
Keywords: ecology; aquatic ecosystems; ships; research programs; laboratory equipment; field tests; water pollution monitors.

106575 Environment Research Park. Clements, R.G. (Univ. of Puerto Rico, Center for Energy and Environment Research, College Station, Mayaguez, PR, 00708). **Project number:** 001629. **Contract:** EY-76-C-05-1883. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are: (1) to determine the feasibility of setting aside an outdoor laboratory where the impact of man's activities on the natural environment, especially those related to energy, can be assessed; (2) to develop methods to assess and monitor the environmental impact of man's activites; (3) to develop methods to estimate and predict the environmental response to proposed and on-going activities; and (4) to demonstrate the impact of various activities and evaluate methods to minimize adverse impact. Several studies characterizing the climate of this area were completed. The precipitation regime has been determined and the report is in preparation. Preliminary studies on temperature and humidity profiles in this forested tract have been completed. Net radiation studies have shown that the radiation flux during the winter is about 12 to 14 percent less than the summer.
Keywords: nature reserves; feasibility studies; human populations; environmental impacts; measuring methods; pollution abatement; planning.

106576 Atmospheric Carbon Dioxide Effects on the Climate. Rotty, R.M. (Oak Ridge Associated Universities, Institute for Energy Analysis, Oak Ridge, TN, 37830). **Project number:** 002932. **Contract:** EY-76-C-05-0033. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$202,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

This work is a broad investigation of the potential impacts of increasing atmospheric CO2 concentrations as a result of fossil fuel use. DOE has a major research effort in several scientific areas relating to the CO2 problem. The Institute is providing assistance with meetings of the CO2 Study Group and additional inputs to the DOE efforts through evaluations of other (non-DOE sponsored) research, e.g., work on climate models and on anthropogenic CO2 sources.
Keywords: carbon dioxide; environmental impacts; fossil fuels; combustion products; climates.

106577 Mutagenic Effect of Radionuclides Incorporated into DNA of Drosophila melanogaster. Lee, W.R. (Louisiana State University, Baton Rouge, LA, 70803). **Project number:** 006226. **Contract:** EV03728. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$34,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this research is to measure the genetic effect of tritium incorporated into specific sites in DNA and protein of Drosophila melanogaster spermatozoa. Previous experiments with prokaryotes have shown that transmutation of tritium in the 5-position of cytosine results in deamination of cytosine and converts it to uracil. Uracil then codes as thymidine thereby causing a C-to-T transition. Work on this project with the eukaryote D. melanogaster has shown that when tritium is incorporated into the 5-position of cytosine there is an increase in the mutation frequency over that observed when the DNA precursor deoxycytidine is generally labeled. Additional data are needed to verify this finding and to determine the efficiency of inducing mutations by transmutation of tritium in the 5-position of cytosine and the genetic effect of tritium labeling in other positions within the DNA and in a non-DNA molecule. The mutations studied in this project are chromatin loss as measured by loss of dominant markers on the Y chromosome, sex-linked recessive lethals observed in both the F2 and F3, temperature-sensitive lethals and mutations at the ADH locus.

Keywords: tritium; genetic radiation effects; dna; proteins; drosophila; spermatozoa; mutation frequency; transmutation.

106578 Effect of Radiation-Sensitive Mutations and Mutagens/ Carcinogens on Bacterial Recombination and Mutagenesis. Matney, T.S. (University of Texas, Health Science Center, Graduate School of Biomedical Sciences, P.O. Box 20334, Astrodome Station, Houston, TX, 77030). **Project number:** 006297. **Contract:** EY-76-S-05-4024. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$27,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Recombination in F-merodiploid derivatives of E. coli K-12 has been used to quantitate gene conversion and specific marker effects and to demonstrate that the excision repair system provides part of the conversion enzymology. Similar studies will be made in strains in which recombination proceeds by the alternate RECE pathway. These derivatives with various combinations of repair deficiencies will be used in the construction of F' HIS and F' TRP hemizygotes which will permit the quantitation of specific base-pair substitution mutations and detect position effects in response to specific mutagens/carcinogens. Deep rough mutants have been isolated in E. coli which are permeable to the polycyclic hydrocarbon type of carcinogen. An additional system has been developed which quantitaties recombination between F-merogenotes carrying homologous information. The donor in the F' x F' cross may be pretreated with mutagen/carcinogen and the effects on subsequent events noted. The system is also amenable to studying the indirect induction of lambda bacteriophage. The effects of repair deficiencies on the types of mutations induced by various carcinogens will be determined in a forward mutation system in which HIS mutations are detected as colonies appearing at 43 degrees C in a Salmonella typhimurium population carrying a HIS operator constitutive mutation.
Keywords: mutations; radiosensitivity; mutagens; carcinogens; escherichia coli; mutagenesis; salmonella typhimurium; biological models.

106579 Physico-Chemical Studies of Radiation Effects in Cells. Powers, E.L. (University of Texas, Department of Zoology, Lab. of Radiation Biology, Austin, TX, 78712). **Project number:** 006298. **Contract:** EY-76-S-05-3408. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The events leading from the absorption of radiation energy to the expression of damage at the cellular level will be characterized. With the use of bacterial spores mostly, radiation effects have been modified by changing environmental parameters such as water content, heat, gaseous atmospheres, and a large range of organic and inorganic compounds that modify sensitivity. Emphasis is given to the participation of water-derived free radicals. Numerous approaches will continue to be used, mostly those at the present time emanating from studies in free radical chemistry in model compounds by the radiation chemists, including the fast techniques of pulse radiolysis. The bacterial spore will continue to be the main test object and the chief emphasis will be on inorganic agents and their mechanisms of action. Other approaches will be studied, including the use of in vitro DNA.
Keywords: ionizing radiations; biological radiation effects; radiation injuries; dna; bacteria; radicals; biochemical reaction kinetics; response modifying factors; radiosensitivity.

106580 Ecological Behavior and Effects of Energy Related Pollutants. Ragsdale. (Emory University, Department of Biology, Atlanta, GA, 30322). **Project number:** 006351. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Work on adaptation of natural plant communities to sulfur dioxide stress is being conducted to examine how natural plant communities have become altered as a result of long term exposures, to identify SO2 tolerant species and populations, to determine the genetic and physiological bases of tolerance, to provide inputs to decision making processes for siting of new fossil fuel power plants, to provide tolerant species to help stabilize ecosystems under stress, and to test the adequacy of present national ambient air standards for SO2.
Keywords: sulfur dioxide; plants; communities; biological effects; biological adaptation; tolerance.

106581 Ecology of Subtropical Shallow-Water Environments. Carpenter, J.H. (University of Miami, 4600 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** 006371. **Contract:** AT(40-1)-3801. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$108,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The objectives of this research are to understand part of the environmental effects of energy production in subtropical environments. The program has two elements: the first is directed toward a quantitative description of the importance of mangrove leaf detritus in such ecosystems; the second has the goal of understanding the physical and chemical states of copper and chlorine that are released to these environments from energy-related activities. The food preferences and breakdown of plant and detrital substrates is measured in the laboratory. The mangrove detritus system is being characterized by quantitative studies of laboratory systems that closely approximate the natural systems. The copper and chlorine studies are predicated on adding these substances to natural waters and observing the products of the reactions.
Keywords: florida; estuaries; copper; chlorine; aquatic ecosystems; ecology; thermal effluents; environmental effects; chemical effluents; fishes; toxins.

106582 Effects of Atmospheric Variability on Energy Utilization and Conservation. Reiter, E.R. (Colorado State Univ., Dept. of Atmospheric Sciences, Solar House 3, Ft. Collins, CO, 80523). **Project number:** 006436. **Contract:** EY-76-S-02-1340. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$163,000.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objectives are to specify recurrent weather regimes causing anomalous energy consumption rates, and determine weather effects upon different demands for energy. Interannual variability of global circulations will be defined and related to characteristic US weather patterns by severity. Physical bases for assessing impacts of weather upon energy demand by end use will be developed, and adaptive considerations of socio-economic factors which influence conservation measures will be incorporated.
Keywords: earth atmosphere; weather; consumption rates; energy consumption; environmental effects; energy conservation; seasonal variations; mathematical models.

106583 Dynamics of the Recovery of Damaged Tundra Vegetation. Amundson, C.C. (University of Tennessee, Knoxville, TN, 37916). **Project number:** 006402. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$23,000.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to document environmental factors affecting recovery of damaged tundra landscapes; develop measurement technology to allow rapid acquisition of data amendable to analyses of pattern and process of landscape recovery; document response of native plant species indicative of various pollutants resulting from man's activities on tundra landscapes, or recovery following insults; and train ecologists to collect, analyze, and evaluate such data. Disturbances are classified according to age, type, cause, and subsequent history. Disturbances are also classified topographically, edaphically, and by vegetation type. Field samples are collected across disturbances to obtain data for analyses in the laboratory. This project is a yearly study to detect successional changes. Annual reports are issued on the state of disturbed areas.
Keywords: air pollution; land pollution; water pollution; environmental effects; biological effects; terrestrial ecosystems; tundra; plants; biological recovery; revegetation; data acquisition; population dynamics; species diversity.

106584 Geochemical Behavior of Uranium and Thorium Series Nuclides and of Plutonium in the Gulf of Mexico. Scott, M. (Texas A and M University, Dept. of Oceanography, College Station, TX, 77843). **Project number:** 006403. **Contract:** E(40-1)3852. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the distribution and chemical behavior of uranium, thorium, and plutonium isotopes in the Gulf of Mexico. Box core samples of Gulf sediments and suspended sediments from streams contributing to the Gulf will be analyzed for Pu isotopes; core samples will be dated by 228-Th, 232-Th ratios and 210-Pb concentrations. Ligand concentration effects on the adsorption of Th and Ra on clays will be measured on core samples as well as tested experimentally under lab conditions.
Keywords: geochemistry; uranium; thorium; plutonium; gulf of mexico; radioecological concentration; radionuclide migration; thorium 228; thorium 232; lead 210; radium.

106585 Studies of Drosophila Dispersal and Species Packing. Richardson, R.H. (University of Texas at Austin, Dept. of Zoology, Austin, TX, 78712). **Project number:** 006404. **Contract:** 79-

EV04023.002. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$33,000.
Related energy source: geothermal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) investigate population structure in rapidly evolving and/or ecologically disrupted populations; (2) determine if isolated sub-populations within a single area are representing incipient or actual species; (3) relate evolving isolated subpopulations to species packing, to community complexity, and to community stability; and (4) relate behavioral processes and responses to formation of population structure. New statistical analyses allow the use of molecular variation in enzymatic systems to identify the units of a structured population (i.e., a population with partially isolated sub-units). Samples of Drosophila species evolving in areas of active geological change (Kilanea and Mauna Loa Volcanoes, Hawaii) and biogeographic shifts (deserts of North America) are taken to determine the population structure present. The behavior of the insects with respect to environment cues (wind humidity, temperature, chemical constituents in the air) is investigated. The responses are related to the ability to make adaptive changes to become reproductively isolated, or to become ecologically specialized.
Keywords: drosophila; population dynamics; terrestrial ecosystems; genetic variability; geography; environment; environmental effects; mutations; mutagenesis; computer codes; enzymes; volcanic regions; deserts.

106586 Atmospheric Tritium. Ostlund, H.G. (University of Miami, 4600 Richenbacker Causeway, Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL, 33149). **Project number:** 006446. **Contract:** 80-EV03944. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

Tritium escapes to the atmosphere from nuclear industry and research. The HTO originates from atmospheric nuclear testing; the HT from reprocessing of nuclear fuel elements and accidental releases; and tritiated hydrocarbons possibly from the underground gas stimulation experiments of several years ago. We are regularly monitoring HT and HTO in Miami, Alaska, Hawaii, and New Zealand; tritiated hydrocarbons (primarily methane) in Miami. We also do synoptic sampling on a global scale by ship, and sample the stratosphere by aircraft. The distribution pattern of these tritium compounds yields data on the interhemispheric mixing time scale of the troposphere (HT), the residence time in the lower stratosphere of water vapor (HTO), and the chemical lifetime of hydrogen gas (HT) and, perhaps, methane. We are able to detect large new tritium injections into the atmosphere and the distribution by space and time of these perturbations. In addition to the intrinsic scientific value according to reasoning above, the distribution patterns, as they emerge, will make it possible to project the fate of future releases, accidental or not, of tritium into the environment on global or local scales from the nuclear industry, fusion energy and nuclear weapons testing.
Keywords: tritium; earth atmosphere; heavy water; rain; radiation monitoring; radioecological concentration; spatial distribution.

106587 Effect of Cyclic Temperature on Larvae of Marine Invertebrates. Costlow, J.D. (Duke University Marine Laboratory, Beaufort, NC, 28516). **Project number:** 006637. **Contract:** AT(40-1)-4377. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to determine the effects of cyclic temperatures, as opposed to constant temperatures, on larval development of estuarine and continental shelf species of marine invertebrates. The research entails: (1) a more detailed consideration of the relative roles of temperature cycle constituents; (2) an extension of the use of cyclic temperatures to cover a wider range; (3) an examination of the response of larval stages to cyclic temperatures at the metabolic and biochemical level; and (4) efforts to determine the possible synergistic effects between cyclic temperatures, other natural environmental factors, and artificial factors such as pollutants. Larval stages of estuarine and continental shelf invertebrates, including crustacea, molluscs, and polychaetes were cultured from hatching to the juvenile stages in cyclic temperature regimes as opposed to constant temperatures. Temperature cycles, 5 degrees C/24 hr, were designed which incorporate equal rates of increase or decrease combined with equal periods of maximum and minimum temperatures, unequal rates of increase and decrease combined with equal periods of maximum and minimum temperatures, and unequal rates of increase and decrease combined with unequal periods of maximum and minimum temperatures. Data on survival, rates of development, and incidence of abnormalities should provide an insight into which elements of a temperature cycle are most important in regulating developmental patterns of marine invertebrates.
Keywords: continental shelf; estuaries; aquatic organisms; invertebrates; larvae; metamorphosis; ontogenesis; temperature effects; medium temperature; temperature gradients; variations; biological effects; thermal power plants; thermal effluents; thermal pollution.

106588 Environmental Aspects of Coal Production in the Appalachian Region. Minear, R.A. (Univ. of Tennessee, Dept. of Civil Engineering, Knoxville, TN, 37916). **Project number:** 007010. **Contract:** EY-76-S-05-4946. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The research consists of 4 interrelated tasks compositely dealing with effects of strip mining on hydrology, water quality and stream biota. The continuing objective of the research is to interrelate the geology, physical characteristics, and climatologic conditions to provide predictive models for water quality and quantity behavior. Results to date have led to inclusion of a new task in the coming project year designed to develop an Environmental Assessment Manual to assist in management of runoff and sediment produced by surface mining. New models, refinement of previous models, continued long term data base development, and expanded biological recovery studies are contained within current objectives. Results from the past 3 years related to development of significant water quality (low and stormwater) data bases, sediment production measurements, development of storm water runoff, water quality, spoil bank hydrology, and other models relating to strip miing effects. Biological effects and recovery behavior after strip mining have been evaluated.
Keywords: coal mining; surface mining; environmental effects; water pollution; hydrology; aquatic organisms; water quality; geology; manuals; biological effects; appalachia.

106589 Development and Coordination of a Program of Energy-Related Oceanographic Research in the Continental Shelves of the Gulf of Mexico. Treadwell, T.K. (Texas A and M University, College Station, TX, 77843). **Project number:** 007075. **Contract:** 76-S-05-5017. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to monitor the execution of an energy-related oceanographic research program in the Gulf of Mexico. This program will be structured as an inter-disciplinary and inter-institutional effort. It will emphasize the processes in the marine environment, and build on the base of data gathered in studies such as those sponsored by BLM and USGS. The geographical areas of concern will be the estuarine and continental shelves of the Gulf. Methods utilized will be: (1) to evaluate the present and potential energy-related activities of the Gulf of Mexico; (2) to identify those process of the environment which may affect, or be affected by, energy activities; (3) to highlight research work which will aid in understanding these processes; and to identify researchers and institutions which are capable and available to carry out the work. Close integration of the different studies which are to be awarded will be accomplished for maximum efficiency and minimum cost.
Keywords: gulf of mexico; continental shelf; oceanography; estuaries; biomass; aquatic ecosystems; chemical effluents; oil spills; water.

106590 Properties and Impact of Submarine Geothermal Springs on the West Florida Continental Shelf. Pyle, T.E. (University of South Florida, Department of Marine Science, St. Petersburg, FL, 33701). **Project number:** 007367. **Contract:** EY-77-S-05-5486. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: geothermal(100) **R and D categories:** Environmental effects assessment.

This study will test the feasibility of using an existing natural phenomenon (warm, saline discharge of a major submarine spring in the eastern Gulf of Mexico) to determine the long-term effects upon shelf biota of thermal discharge from offshore power plants. The study will assess the regional setting, magnitude variability and properties of the Mud Hole Submarine Spring by means of geophysical, geological, chemical, hydrographic and limited biological sampling. Reconnaissance and quarterly shipboard surveys will be supplemented by continuous in situ monitoring of flow rate and temperature and by periodic aerial mapping of sea surface temperature patterns. Mathematical modeling of the spring's flow regime and its interaction with ambient shelf waters will help determine the near-field and far field significance of discharge plume in comparison with nutrient, trace metal, dissolved oxygen and primary productivity anomalies. The results expected are advances in understanding the distribution of continental shelf fracture patterns, the potential flow paths of waste injected in deep wells, the nature of geothermal

processes in non-volcanic areas and the dynamics of water-sediment-organism interactions.
Keywords: thermal springs; gulf of mexico; continental shelf; aquatic ecosystems; monitoring; chemical properties; geophysical surveys; geochemical surveys; feasibility studies; flow rate; temperature measurement; mathematical models; offshore nuclear power plants; environmental impacts; thermal effluents; offshore operations.

106591 Health Effects of Coal Particulates. Wallace, W.E. (Morgantown Energy Technology Center, Morgantown, WV). **Project number:** 002494. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project, initiated in FY 1977, is designed to detail in-vitro interactions of well characterized materials, representative of selected fractions of fluidized bed combustion or low Btu coal gasification process streams and effluents, including feed coal preparation atmospheres, process bottoms, scrubber liquors, and other clean-up technology omissions, with biochemical and cellular systems. The objective of these studies is to help find the pathogenic species and mechanisms responsible for deleterious effects of fractionated and unfractionated materials from those sources, as observed in a coordinated program of cellular and laboratory animal bioassays. This in-house effort is part of a larger program involving the West Virginia University School of Medicine, the Lovelace Inhalation Toxicology Research Institute, and others, with the mission of predicting potential biomedical and environmental impacts of the use of low Btu gasification and fluidized bed combustion of coal for electrical power generation or industrial use. The intent of the program is to obtain information suitable to direct the development of control techniques for those process cycles from fuel preparation to flue gas clean-up.
Keywords: coal; fluidized-bed combustion; coal gasification; process solutions; chemical effluents; particles; biological effects; cell cultures; pathogenesis; in vitro; biochemistry; air pollution; hydrocarbons; health hazards; low btu gas.

106592 Management of the Red Cockaded Woodpecker, an Endangered Species. Jackson, J.A. (Mississippi State University, Dept. of Zoology, State College, MS, 39762). **Project number:** 007241. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$34,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The purpose of this study is to determine the habitat requirements and preferences of the Red-Cockaded Woodpecker, so that tree plantations can be managed and utilized in such a way as to maintain, if not enhance, populations of this endangered species.
Keywords: birds; endangered species; habitat; ecology.

106593 Measurement of Gulf Stream and Wind Induced Shelf Circulation in the South Atlantic Bight. Lee, T.N. (University of Miami, Division of Meteorology and Physical Oceanography, Miami, FL, 33149). **Project number:** 007158. **Contract:** EY-76-S-05-5163. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$349,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the program is to continue a physical oceanography program to explore the dynamics of seasonal evolution of circulation on the continental shelf of the Georgia Bight. The guiding scientific objective is to improve the capability for prediction of the physical environment on the continental shelf. The principal scientific tasks are to determine the relative importance of driving mechanisms and to measure the shelf response on seasonal time and space scales. A long term array of 2 current/temperature/pressure moorings and 2 inverted echo sounder/pressure/temperature recorders will be installed across the shelf near Savannah. Hydrographic sections, coupled with frontal and eddy mapping will be conducted on quarterly array maintenance cruises. The initial observations in the South Atlantic Bight will be directed toward measuring the eddy flux from the Gulf Stream and atmospheric forcing to determine their relative influence on the shelf circulation. Close coordination with existing and ongoing shelf dynamics programs in other disciplines in this geographical area will be sought throughout the program.
Keywords: oceanography; continental shelf; georgia; atlantic ocean; mathematical models.

106594 Transport and Reaction of Heavy Metals in Alaskan Fjord Estuaries. Burrell, D.C. (University of Alaska, Fairbanks, AK, 99701). **Project number:** 006324. **Contract:** E(45-1)-2229. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$58,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is the identification and characterization of physical and chemical processes responsible for the cycling of heavy metals in Alaskan fjord-estuaries. At the present time we are particularly concerned with transport of chemical species to and from the fjord basin sediments and changes in chemical speciation within the surface sediments. The fjords studied have been chosen to serve as type examples of local coastal environments most likely to be impacted by energy resource development. The primary objective proposed here concerns the chemical and sedimentological character of the particular sediment - the primary transporting medium - seasonally and within the basin column. Secondary objectives include work on better determining transport rates of soluble species away from the sediment boundary and on organometallic speciation within the interstitial water.
Keywords: alaska; estuaries; elements; mineral cycling; environmental transport; sediments; chemical state; sediment-water interface; seasonal variations; energy source development; environmental impacts.

106595 Pollutant Transport and Sediment Dispersal in the Washington-Oregon Coastal Zone. Smith, J.D.; Hickey, B.M. (University of Washington, Dept. of Oceanography, Seattle, WA, 98195). **Project number:** 006512. **Contract:** E(45-1)-2225-035. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$214,000.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

The ultimate goal is to provide tested predictive models to characterize the current field, wave motion and associated movement of sediment on the continental shelf. A field program of direct current, wind and hydrographic measurements on the continental shelf is designed to produce data that are required to elucidate the physical processes of major concern and to provide input to physical oceanographic models of shelf circulation. Measurements of the flow and pressure fields in the bottom boundary layer are made to provide input for sediment transport modeling.
Keywords: sediments; continental shelf; water currents; mathematical models; wave forces; wind; environmental transport; fluid flow; boundary layers; washington; coastal waters; oceanography.

106596 Chemical and Geochemical Studies off the Coast of Washington. Carpenter, R. (University of Washington, Dept. of Oceanography, Seattle, WA, 98195). **Project number:** 006513. **Contract:** E(45-1)-2225. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$61,000.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

This proposal is for the continuation of chemical and geochemical research off the coast of Washington. The planned research is an extension of that begun in 1961 under Contract AT(45-1)-1725 to determine the properties, distribution, and movement of Columbia River water and its dissolved and suspended load in the northeast Pacific and to water at sea. Our primary focus now is more directed to developing a base for predicting and testing the behavior and fate of various trace chemicals in coastal and estuarine areas in general. The proposed research continues several lines of investigation begun in the last few years and which are in varying stages of completion: (1) surface chemical studies of the scavenging of various species dissolved in sea water, beginning with lead-210, by well-characterized natural particulates; (2) studies of uptake and transfer of several isotopes, starting with polonium-210, by particularly well-defined parts of the marine food web which we are in a unique position to study; (3) studies of the behavior of Pb-210 and Po-210 in sediments off the Washington coast and the application of lead-210 dating to determine sediment accumulation rates over the past 100 years. We also propose new investigations of aliphatic and aromatic hydrocarbons in some of the same samples of surf zone diatoms, neuston organisms, salmon and shrimp at different life stages, and in sediment cores whose accumulation histories we have determined with lead-210.
Keywords: washington; continental shelf; coastal waters; geochemical surveys; columbia river; flow rate; plumes; pacific ocean; trace amounts; lead 210; polonium 210; food chains; sediments; environmental transport; hydrocarbons; aromatics; radionuclide migration.

106597 Proposal to Investigate the Transport of Actinide-Bearing Soil Colloids in the Soil Aquatic Environment. Sheppard, J.C. (Washington State University, Department of Chemical Engineering, Pullman, WA, 99163). **Project number:** 006781. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$39,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the proposed research are to determine distribution ratios and diffusion coefficients of $Am3+$, $Cm3+$, and $Np02+$ in representative soil-aquatic environments. Determination of the important environmental factors, such as adsorption, complex formation with organic components of the soil, and radiocolloid formation, is a secondary objective of the research. Distribution

ratios of Am3+, Cm3+, and NpO2+ for the soil-water system will be determined using alpha counting techniques. Diffusion coefficients will be determined by the method developed by Olsen, Kemper, and Van Schaik. To minimize contamination problems, submicrocurie amounts of Am-241, Cm-244, and Np-237 will be used. Gamma counting techniques will be used for the diffusion experiments. Radiocolloid formation of Am3+, Cm3+, and NpO2+ will be determined by autoradiographic, dialysis, centrifugation, and filtration methods. Complex formation will be determined by well known distribution techniques.
Keywords: americium; curium; neptunium; soils; aquatic ecosystems; radioecological concentration; radionuclide migration.

106598 Establishment, Succession, and Stability of Vegetation on Surface Mined Lands in Eastern Montana. Sindelar, B.W. (Montana State University, Animal and Range Sciences Department, Bozeman, MT, 59715). **Project number:** 007002. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$18,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to investigate plant establishment and succession on treated surface mined coal lands in SE Montana, to investigate the stability and permanence of artificial plant communities on surface mined lands; and to investigate the nature and rate of soil development on surface mined lands. Establishment, succession and soil development are being investigated on strip-mine spoil dumps created 45 to 53 years ago. Revegetation of sites disturbed less than 5 years ago are included in the chronological sequence evaluation. Basic methodology includes detailed monitoring of quadrants located within fenced enclosures on lands mined for coal since 1923. Thirteen enclosures on 1 to 8 year old reclamation plantings and on 44 to 53 year old naturally revegetated coal spoils were established. Transects were set up to monitor plant population parameters including cover, density, frequency, constancy, and diversity. Root production, above ground biomass, and soil development are monitored. Rate and trends of plant succession over a five-year or longer period will be analyzed. Permanent stereophotographic records of vegetational development over the period are being collected.
Keywords: surface mining; coal mining; land reclamation; revegetation; spoil banks; plants; inventories; plant breeding; preferred species.

106599 Viability of Indigenous Plants to Ft. Union Basin. Eddleman, L.E. (University of Montana, School of Forestry, Missoula, MT, 59801). **Project number:** 007003. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to: (1) inventory natural seed maturation and production, (2) determine optimum seed collection and handling procedures, (3) determine physical and chemical requirements for breaking seed dormancy, (4) measure seed viability and seedling vigor, (5) examine vegetative propagation characteristics, and (6) determine phenology of native species for application to reclamation of strip-mined land. The methods employed are to: (1) study the phenology of seed maturation and dispersal, (2) measure production of viable seed in the field by species and ecotype, (3) examine several systems of collection, treatment, and storage, (4) measure germination under controlled environment conditions, and (5) use various mechanical and chemical means of breaking dormancy as required. Chemicals used are acetone, ethanol, and sulfuric acid (all under vent-hood conditions). Seedling vigor is to be determined from root and shoot rate production. Cuttings are to be studied for ease of rooting. Test plots are established on strip-mined land.
Keywords: grass; shrubs; inventories; seeds; vegetative propagation; surface mining; land reclamation; preferred species; revegetation; plant breeding; cultivation techniques; viability.

106600 Nutritional Significance of the Copper-Bering River Intertidal Systems to Spring-Migrating Shorebirds Breeding in Western Alaska. Norton, D.C.; West, G.C. (Alaska Univ., Inst. of Arctic Biology, Fairbanks, AK, 99701). **Project number:** 007224. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Because of the energy-related projects now under construction and those proposed for rapid implementation on or adjacent to the coast near the mouth of the Copper-Bering River system, it is imperative to document the importance of this area to the survival of two species of migrant shorebirds, the western sandpiper and the dunlin. This question arises because of three potentially threatening energy-related developments close to the Copper River intertidal system: (1) marine oil-tanker traffic through Prince William Sound, (2) offshore continental shelf leasing, and (3) development of a large natural gas liquefaction plant at Sheep Bay. Up to 100 birds of each species will be shot for detailed carcass analysis at stopover locations for the two species during April and May. Cinematographic records on 16 mm film will be made periodically at Bodega Bay, California, and the Copper River Delta to determine whether rates of jabbing and probing actually differ significantly between wintering and migrating birds. A trip to the major collections in the continental US will be made to record occurrence, phenology, body weights and other pertinent parameters recoverable from museum collections at low cost and at great benefit to extending the span of years covered by the study.
Keywords: estuaries; baseline ecology; petroleum industry; natural gas industry; environmental impacts; birds; population dynamics; inventories; oil spills; hydrocarbons; biological effects; california; watersheds; nutrition.

106601 Cycling of Transuranic Radionuclides in the Columbia River. Beasley, T.M. (Oregon State Univ., School of Oceanography, Corvallis, OR, 97331). **Project number:** 007205. **Contract:** EY-76-S-06-2227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are: (1) to characterize the concentrations and distributions of transuranics in sediments of the Columbia River, its estuary and offshore Pacific Ocean; and (2) to determine uptake, loss, and tissue distribution of Pu in aquatic and marine organisms, with emphasis on determining whether main uptake route is food or water. Core samples will be collected and analyzed for Pu by alpha spectroscopy and sections age dated by the 210Pb method. Aquaria experiments using 237Pu tracer will be conducted with the aquatic and marine organisms.
Keywords: columbia river; water pollution; radioisotopes; transuranium elements; environmental transport; radioecology; radionuclide migration; pacific ocean; uptake; aquatic organisms; plutonium; food chains; quantity ratio.

106602 Mesoscale Studies of Flow Regimes and Fluxes of Particulate Matter in Coastal Waters. Pak, H.; Zaneveld, J.R.V. (Oregon State Univ., School of Oceanography, Corvallis, OR, 97331). **Project number:** 007240. **Contract:** EY-76-S-06-2227 No. 29. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

We propose to continue to study the water flows and the concurrent flux and fate of suspended particulate matter (SPM) in an area off Oregon that is characterized by smooth bathymetry and smooth crystal topography. We consider an area with smooth contours the simplest area in which to predict patterns and fluxes, and suggest that such an area can serve as a model for other regions with similar pathymetry and topography. Specifically we propose to (1) define the distributional patterns of SPM simultaneously with the distributional patterns of major hydrographic variables; (2) determine characteristic optical properties of SPM, including concentration, particle size distribution, and index of refraction; (3) characterize the patterns and non-conservative behavior of the biogenic fraction of total SPM, including phytoplankton growth and removal by grazing zooplankton; (4) calculate the fluxes of conservative and non-conservative properties, with particular reference to the rate of horizontal transport of SPM; and (5) determine, when possible, the temporal variations of concentrations and fluxes, and to assess sample-to-sample variability.
Keywords: coastal waters; particles; flow models; environmental transport; oregon.

106603 Precipitation Scavenging Studies. Slinn, W.G.N. (Oregon State University, Atmospheric Science Dept., Corvallis, OR, 97331). **Project number:** 007350. **Contract:** EY-76-S-06-2227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$54,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Environmental transport and conversion of pollutants.

This effort is an attempt to consolidate existing knowledge in the fields of atmospheric cleaning processes and to resolve substantial differences between data and theory in the precipitation scavenging of submicron aerosols. Theoretical modeling and field scavenging experiments will be utilized to improve and extend the applicability of the scavenging term. The chapter Precipitation Scavenging Estimates, prepared for Atmospheric Sciences and Power Production is in the review and editing processes. The Critical-Creative, Review Series contribution Natural Atmospheric Cleansing Processes, is in final stages of preparation and will be used as a text at Oregon State University.
Keywords: precipitation scavenging; earth atmosphere; aerosols; air cleaning; forecasting; education; technology utilization; technology assessment; air pollution.

106604 CTD (Clorinity, Temperature, Density) System for West Coast DOE Contractors. Small, L.F. (Oregon State University, School of Oceanography, Corvallis, OR, 97331). **Project number:** 007409. **Contract:** EE-76-S-06-2227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$7,000.
Related energy source: general science(100) **R and D categories:** Pollutant monitoring.

A CTD system (Chlorinity, Temperature, Density) is being provided to DOE contractors in the Pacific Northwest for oceanographic studies. The availability of the CTD to the contractors will allow them to charter the smallest vessels needed for their studies rather than use vessels which have a CTD on board but may be larger than necessary. Oregon State will purchase and maintain a CTD system. Cooperative use of the instrument for maximum efficiency and minimum cost is expected.
Keywords: oceanography; seawater; chemical analysis; sampling; chlorine; measuring instruments; temperature measurement; pacific ocean; density; monitoring.

106605 Basic Studies of Physiological Systems and Their Reactions to Ionizing Radiation. Patt, H.M. (Univ. of California, San Francisco, Lab. of Radiobiology, San Francisco, CA, 94143). **Project number:** 000216. **Contract:** EY-76-C-03-1012. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$600,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Radiations and other toxic agents may act directly on organized cell populations, by killing cellular components or altering their genome, or indirectly, by affecting proliferative, secretory, and other cell functions. This program embraces several lines of investigation that are concerned with the way in which bone marrow cells, connective tissue cells, and other critical cell systems respond to physiological stimuli in their immediate environment and to toxic substances produced during the generation of energy from nuclear and fossil fuels. The research is inter-related in that the integrity of the organism's internal environment depends upon interplay between cells derived from bone marrow and components of connective tissues. Specific connective tissue environments are known to exercise a directive influence on developmental processes, for example in lung. The overall goals of the research are to develop methods and models to characterize normal and abnormal states in the cell systems of interest and to use various methodologies to elucidate mechanisms of injury and repair and to establish tolerances for tissues and organs at risk.
Keywords: ionizing radiations; biological radiation effects; tissues; animal cells; physiology; lungs; bone marrow.

106606 DNA Replication and Repair. Painter, R.B. (Univ. of California, San Francisco, Lab. of Radiobiology, San Francisco, CA, 94143). **Project number:** 000217. **Contract:** EY-76-C-03-1012. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$365,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The effects of energy-related toxic agents, e.g., radiation and chemical carcinogens, on the organization, replication, and repair of DNA are studied. Perturbations of normal DNA replication by various agents are measured in terms of their effects on initiation, on rate of DNA chain elongation, and on termination of and/or joining of adjacent growing DNA chains. Repair after induced damage to DNA is studied in normal human cells and in repair-deficient human cells, with the aim of uncovering the details of the various enzymatic repair systems - excision, post-replication, and photoreactivation. The mutagenic consequences of DNA damage are studied in mammalian cells and in certain viruses that infect them.
Keywords: dna replication; biological repair; carcinogens; radioactive effluents; chemical effluents; man; animal cells; viruses; biological radiation effects; biological effects.

106607 Coal Liquefaction: Chromosome Damage and Repair. Wolff, S. (Univ. of California at San Francisco, Lab. of Radiobiology, San Francisco, CA, 94143). **Project number:** 000218. **Contract:** EY-76-C-03-1012. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$275,000.
Related energy source: Coal(45); nuclear fission(25); geothermal(10); hydroelectric(10); conservation(10) **R and D categories:** Biological effects of pollutants in experimental systems.

At low levels of contaminants from energy sources, biological effects are caused by damage to DNA and chromosomes. This genetic damage, if in somatic cells, can cause cancer, or if in germ cells, can cause sterility or mutations that could affect future generations. Within the last few years, a new technique has been developed to observe sister chromatid exchanges that allows us to visualize many more genetic changes than heretofore. This new tool is used to quantify the effects of mutagenic carcinogens and to study the mechanisms involved in the induction of genetic exchange and recombination in both meiotic and mitotic cells. Means to study chromosome structure and replication in Drosophila, whose genetics is well understood and for which many mutants are available, also have been developed. This is an ideal system for correlation of molecular effects with mutations. The intermediates of chromosomal replication, the enzymes catalyzing this replication, and the effects of known mutations on chromosome structure and replication are being studied.
Keywords: sister chromatid exchanges; somatic cells; germ cells; genetic effects; polycyclic aromatic hydrocarbons; biological pathways; mutagenesis; drosophila; mutations; dna replication; biological repair; coal liquefaction.

106608 Somatic Effects of Protracted Low Dose Rate Radiation. Goldman, M. (University of California at Davis, Davis, CA). **Project number:** 000433. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$220,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The efficient manner in which chronic gamma-irradiation induces myeloproliferative disorders in beagles is being utilized to investigate mechanisms involved in radiation-induced leukemogenesis. Using a variety of bone marrow, peripheral blood and lymphoid organ cell culture systems developed for the investigation of hematopoiesis and cell mediated immunity in beagles, the 60-Co facility will be utilized to study the following: (1) disturbances in hematolymphopoiesis and promotional aspects of leukemogenesis as reflected in bone marrow culture systems supporting hematolymphopoietic progenitor cells as well as poietin producing populations; (2) the role of candidate mesenchymal progenitors in radiation-induced leukemia; (3) the ability of bone marrow culture techniques to serve as sensitive biological indicators of radiation-induced injury; (4) development of immunological methods for detecting radiation-induced damage; (5) correlation of general and leukemia-specific immune responses to the pathogenesis of radiation-induced disease; and (6) efficacy of bone marrow transplantation and immunotherapy in the radiation-induced leukemia model.
Keywords: low dose irradiation; chronic irradiation; gamma radiation; beagles; radioinduction; leukemogenesis; biological radiation effects; biochemical reaction kinetics; bone marrow cells; blood; cell cultures; lymphocytes.

106609 Radium-226 and Strontium-90 Toxicity. Goldman, M. (University of California at Davis, Davis, CA). **Project number:** 000438. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$1,180,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the project is to provide information on the possible long-term consequences to man from chronic exposure to alpha and beta emitting bone seeking radionuclides. The study provides a model for comparison of effects of continual 90-Sr ingestion to 1.5 years of life with effects produced by fractionated injections of 226-Ra into young adult beagles. The many similarities between dog and man provide opportunities to assess hazards to man from radionuclides.
Keywords: toxicity; bone seekers; strontium 90; beta particles; alpha particles; beagles; radionuclide kinetics; radiation hazards; man; nuclear industry; radium 226.

106610 Cellular Radiobiology. Myers, L.S. (University of California at Los Angeles, Los Angeles, CA). **Project number:** 000454. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$165,000.
Related energy source: Coal(25); oil and gas(25); oil shale(25); nuclear fission(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The goals of this program are to obtain information needed to evaluate hazards of long-term low-level exposure of living organisms to alpha, beta, and gamma radiations associated with fission energy, and to toxic chemicals associated with coal, oil, and oil shale; and to explore means of preventing or repairing biological damage and of utilizing the damage to improve cancer therapy. Research is carried out mainly with nucleoprotein and nucleoprotein constituents such as DNA, proteins, DNA bases, and amino acids because extensive evidence suggests that damage of nucleoprotein is a major cause of adverse responses of living organisms to radiation and chemicals. Topics presently under investigation include mechanisms of damage by simulated plutonium alpha-particles and other high LET radiations, mechanisms of damage of nucleoprotein and its constituents by chemically and radiation induced attachment of small organic molecules or formation of crosslinks between macromolecules; effects of metal ions alone and acting synergistically with radition; and extent of cellular repair in normal human lymphocytes following exposure to radiation or energy related toxic chemicals.

Keywords: ionizing radiations; biological radiation effects; toxic materials; biological effects; dna; proteins; amino acids; synergism; biological repair; lymphocytes.

106611 Non-Nuclear Pollutants in Arid Environments. Turner, F.B. (University of California at Los Angeles, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000650. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$137,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this research is to determine natural storages and pathways and rates of transfer of trace elements (e.g, Cd, Ni, B, Mo, and Cu) in and between components of desert environments. Potential sites of accumulations will be identified. Field work is being carried out in southern Nevada, near Southern California Edison's Mohave Generating Station, and at the Nevada Test Site. Amounts of trace elements in desert plants, soils, and animals are determined by emission spectroscopy and atomic absorption spectroscopy. Biological storages of elements are estimated by combining chemical analyses of tissues with biomass estimates of natural populations. Greenhouse experiments with desert shrubs and soils amended with coal fly ash measure rates of uptake of trace elements, and how such elements are distributed in plant tissues. Field experiments determine rates at which litter falls from desert shrubs and how rapidly such material decomposes and returns elements to the soil.
Keywords: elements; coal; combustion products; fly ash; environmental transport; environmental exposure pathway; deserts; plants; uptake; biological accumulation; soils; animals; distribution; mineral cycling.

106612 Chemical Problems. Wood, R.A. (Univ. of California, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000653. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$115,000.
Related energy source: Coal(30); nuclear fission(50); geothermal(20) **R and D categories:** Pollutant measurements technology.

The objectives of this research are (1) to support and collaborate with researchers in those areas where specialists are needed in solving problems relative to analytical, inorganic and radiochemistry; and (2) to assist the biomedical cyclotron facility in solving problems relative to target preparation, bombardments and final isolation of the induced radio-products in forms suitable for animal or human tracer studies. The primary effort of this branch over the past fiscal year has been devoted to developing rapid analytical techniques for the determinations of stable carbon-13, oxygen-18, and nitrogen-15 as single tracers or in combination (i.e., C-13/O-18, N-15/O-18). Developmental techniques for the analysis of O-18, C-13 and N-15 have been essentially completed and manuscripts are in progress. The work dealing with O-18 analysis has been published. These methods will be used to study the fundamental processes of carbon fixation in photosynthesis as well as the fundamental studies of environmental impact upon plant and animal species from excessive exposure to CO and NO2 pollutants. This is essentially analytical service in support of other UCLA programs.
Keywords: coal industry; geothermal energy; land pollution; labelled compounds; radioactivation; tracer techniques; radiochemical analysis; carbon 13; oxygen 18; nitrogen 15; quantitative chemical analysis; qualitative chemical analysis; health hazards; metals; toxicity; animals; photosynthesis; plants; carbon monoxide; nitrogen dioxide.

106613 Distribution of Trace Elements in Biological Systems. Alexander, G.W. (Univ. of California, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000657. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$51,000.
Related energy source: Coal(40); nuclear fission(30); geothermal(30) **R and D categories:** Pollutant measurements technology.

The primary goal of this project is to study the distribution and interrelationship of the elements present in biological systems. Of fundamental importance to this goal is the development of efficient and accurate analytical systems for the multielement analysis of biological tissues and fluids important to environmental research. In an attempt to meet these requirements, an emission spectrometric analytical system has been developed which requires little sample preparation, is simple to operate, and is capable of determining some 29 elements important to the study of plant and animal tissues. This system has been in operation with continued development for 10 years. A new system is being developed for determining trace and ultratrace levels of elements in biologically important fluids. As with the earlier system, efficient multielement analysis is our goal. The new system is being designed to determine 40 to 50 elements in the following types of fluids: (1) ground water from geothermal areas, (2) soil extracts, (3) hydroponic media, (4) sewage water, (5) wastewater transported pollution from power plants, and (6) liquid biological samples such as urine, blood, amniotic and spinal fluids.
Keywords: elements; bioassay; biological materials; emission spectroscopy; ground water; soils; sewage; waste water; distribution.

106614 Ecology of Desert Arthropods. Edney, E.B. (Univ. of California, Lab. of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000682. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$138,000.
Related energy source: Coal(50); geothermal(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Work will be directed towards (1) determining the significance of soil arthropods in desert ecosystems, particularly as to the part they play in decomposition, and (2) measuring the effects of aspects of pollution from direct coal combustion and from geothermal development on the abundance and distribution of these organisms. Studies will be done on two groups, microarthropods and Tenebrionid beetles, and on two kinds of pollutants, fly ash from coal and excess salinity from geothermal brine. The program will include work in the field (Nevada Test Site, and East Mesa in the Imperial Valley), to observe effects in real situations, and in the laboratory to identify the mechanisms of any effects observed. When standard conditions for assay have been developed, we will be able to assay the effects on arthropods of pollutants from other sources throughout the arid southwest U.S. Later in the program work on the effects of gaseous pollutants (particularly SO2) on desert soil arthropods will be commenced. Work on the fundamental processes of water and electrolyte balance will continue, and will provide a theoretical basis for the applied aspects of the program.
Keywords: arthropods; terrestrial ecosystems; deserts; ecology; fly ash; brines; geothermal fluids; biological effects; spatial distribution; abundance; nevada test site; imperial valley; sulfur dioxide.

106615 Nutrient and Radionuclide Cycling. Romney, E.M. (Univ. of California Lab. of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000683. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$133,000.
Related energy source: Coal(20); nuclear fission(40); geothermal(40) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to gain a better understanding of the following processes involving environmental pollutants: (1) radionuclide cycling in the desert ecosystem with emphasis on the transuranic elements Pu-239/Pu-240 and Am-241; and (2) stable element cycling in soils and vegetation with emphasis upon trace elements of concern as environmental pollutants when released in the burning of fossil fuels and in the development and application of geothermal energy resources as a source of power generation. Several interacting studies form the basis of this research program. Work is proceeding along the following lines in response to mission needs of DOE: (a) define the manner in which plants function in the vegetation-carrier transport of plutonium and other transuranic elements through the food chain from contaminated soil; (b) characterize the patterning, association, and distribution of desert vegetation as influenced by nutrient gradients and other edaphic factors; (c) investigate the cycling of non-nuclear trace element pollutants in soils and vegetation; and (d) establish baseline assessments of such elements in natural ecosystems near geothermal resource areas (KGRA's) in the Imperial Valley, CA. Plant concentrations indicate that Am is more mobile than Pu in this desert environment.
Keywords: fossil-fuel power plants; geothermal power plants; nuclear power plants; chemical effluents; radioactive effluents; environmental effects; terrestrial ecosystems; deserts; metals; mineral cycling; radionuclide migration; radioecological concentration; ecological concentration; plutonium 239; plutonium 240; americium 241; trace amounts; soils; plants; food chains; environmental transport; population dynamics; radionuclide kinetics.

106616 Plant Ecophysiology. Wallace, A. (Univ. of California, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000692. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$112,000.
Related energy source: Coal(20); nuclear fission(40); geothermal(20); conservation(20) **R and D categories:** Environmental effects assessment.

Plant ecophysiology of desert and other plants to a large extent involves basic research at both plant and ecosystem levels of native vegetation in deserts. Baseline data for environmental impact is provided. Multitechnology is involved in that desert areas of concern are involved in coal burning, nuclear fission, and geothermal activities. Two of the activities in the project (nitrogen fixation with N15 and N13 as tools in deserts and use of reclaimed sewage water in hydroponic crop culture) also relate to energy conserva-

tion. Desert ecophysiology studies include survival, succession, primary productivity both above and below ground, interactions of species in populations, and comparative mineral status. The results from these basic studies are being used in a cooperative study to develop useful and practical guides to arid land restoration procedures. The last activity is expanded to trace metal pollutants in both desert and economic plants. Frequency distribution phenomena for trace metals in different populations of different areas are being developed. Threshold phytotoxicity for a wide range of elements is being developed with consideration for interactions. A large effort in cooperation with others is devoted to ecological and agricultural aspects of transuranium elements of importance in the nuclear fuel cycle.
Keywords: plants; arid lands; ecology; baseline ecology; nitrogen fixation; waste product utilization; sewage; waste water; irrigation; land reclamation; elements; trace amounts; tissue distribution; toxicity; transuranium elements; environmental effects.

106617 Environmental Physiology of Desert Vertebrates. Nagy, K.A. (Univ. of California, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 000694. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$84,000.
Related energy source: nuclear fission(80); geothermal(20) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to measure the energy and material budgets of several key vertebrate species in desert ecosystems while they are living normally in the field by: (a) determining minimum dietary requirements for energy, electrolytes, minerals, nitrogen and water, and the roles of each relevant organ in maintaining balance, and (b) determining the influence of season and year to year variation in climate (rainfall primarily) on animal survival; and (2) to make identical measurements on animals living in polluted areas (gamma radiation, geothermal) to detect any pathological conditions. Field studies involve measurements of energy and material fluxes with doubly-labeled water, diet analysis, behavior, and reproduction. Laboratory studies involve itemization of avenues of energy and material fluxes in feeding experiments, development and testing of measurement procedures, and determination of animal's minimum dietary requirements.
Keywords: vertebrates; physiology; ecosystems; mineral cycling; deserts; gamma radiation; geothermal energy; biological radiation effects; biological effects; diet; behavior.

106618 Membrane Oxidation. Mead; Tiern. (University of California, Los Angeles, CA). **Project number:** 002656. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary objective of this research is to determine the pulmonary effects of atmospheric pollutants, particularly oxidants (NO2 and O3), on the lung and to determine how these effects may be modified or prevented. The research will be divided into several concurrent studies, each furnishing complementary information. First, basic studies on model membrane systems will extend information obtained previously on very simple models. The systems used will consist of phospholipid mono- and bilayers spread on water and phospholipid vesicles derived from membranous and other sources. The information gained in these studies and from experiments on the in vitro oxidation of membrane preparations will be applied to studies of the in vitro perfusion in rays using O3 and NO2 at close to expected levels. We hope to ascertain (1) the role of lipid peroxidation in lung oxidant injury; (2) the role of tocopherol and other protective agents in preventing lipid peroxidation and radical chain processes in lung; (3) the role of glutathione peroxidase and superoxide dismutase in protection against oxidant toxicity; and (4) the role of the pentose shunt pathway in providing reducing equivalents to replace those lost by oxidation. Finally, we hope to apply knowledge gained in these studies to suggestion of practical means of protection against this injury.
Keywords: cell membranes; oxidation; lungs; air pollution; health hazards; nitrogen oxides; ozone; inhalation; physiology; dynamic function studies.

106619 Soil Chemistry of Transuranic Elements. Nishita, H. (University of California, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 001023. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are: (1) to delineate the various factors that influence the solubility, precipitation, fixation, ion exchange, and colloid formation of Np, Pu, Am, and Cm; and (2) to determine the chemical and biological availability of Np, Pu, Am, and Cm in soils and to correlate the chemical availability to biological availability. The experiments will be done by laboratory chemical and physical measurements. The plant uptake experiments will be done in the plant growth chambers and in the greenhouse. Some field work is anticipated at the Nevada Test Site.
Keywords: transuranium elements; soil chemistry; radioecological concentration; radionuclide kinetics; soils; neptunium; plutonium; americium; curium; radionuclide migration.

106620 Lifetime Effects of I-129. Book, S.A. (University of California at Davis, Davis, CA). **Project number:** 001399. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Iodine-129, with a physical half-life of 16 million years, must be considered to be important in the long-term processing, handling, storage and disposal of spent fuel rods from light-water fission reactors. As an isotope of iodine it is readily incorporated into biological systems, and may, like the relatively short-lived 131-I, reach human populations by the atmosphere-vegetation-cow-milk-man pathway. Because of its long half-life, however, it may also pass through other pathways uncommon to 131-I, such as soil-vegetation-man, and vegetation-meat-man. Little information exists on the metabolism and effects of 129-I. Therefore, we have proposed to investigate 129-I in mammals, studying its metabolism by its target organ, the thyroid gland, and the effects from its chronic, low-level ingestion. The effects of exposure to 129-I, as demonstrated by changes in thyroid function, life shortening, and tumorigenesis, require definition in order to adequately predict the actual hazards to human health resulting from processes at the end of the fission fuel cycle. The life time exposure of rats to high levels of dietary 129-I, as utilized in this study, will provide this requisite information.
Keywords: iodine 129; biological half-life; storage; materials handling; fuel rods; reactors; human populations; thyroid; biological radiation effects; life span; health hazards; rats.

106621 Growth of Bone Marrow in Modified TC System. Wilson, F.D. (University of California at Davis, Davis, CA). **Project number:** 001402. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The relative biological effects of a variety of radionuclides and external forms of radiation will be investigated in vivo and in vitro using a modified bone marrow culture system that allows for the simultaneous quantitation of granulocyte-monocyte progenitors, candidate stromal progenitors, and progenitors of T and B lymphocyte pathways. Therefore, studies can be done on both hematopoietic parenchymal elements (i.e., stem cells and their differentiation products), as well as on the supportive elements of the marrow and lymphoid organs. The investigation of the interaction between these various cell populations in vitro and the effects of radiation injury on such interactions will also be investigated using murine, canine and human models. The clonogenic basis of these systems also conceptually allows for studies on the process of education of undifferentiated cells by cellular interactions (micro-environmental inductive influences). In addition, since the assays address the quantitation of basic cellular mechanisms involved in the pathological reaction of the body to injury (i.e., the inflammatory response (CFU-C, PFU-C), immunological factors (CFU-L), and the reaction of host cells to neoplastic populations (CFU-C, CFU-L, and PFU-C) the techniques are as applicable to toxicological studies on non-nuclear as to nuclear technologies). In view of the expanded role of DOE to include studies on the potential hazards of fossil fuel utilization for energy production, we have expanded the scope of our studies to include pilot studies on the in vitro effects of toxic materials associated with coal combustion on the various progenitor populations of interest.
Keywords: bone marrow; radioisotopes; radiations; biological radiation effects; lymphocytes; stem cells; pathogenesis; immune reactions; toxic materials.

106622 Canine Transfer Factor. Shifrine, M. (University of California at Davis, Davis, CA). **Project number:** 001403. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Recent reports from Lawrence's Laboratory and others indicate the requirement of precommitted cells as targets for the augmentation of lymphocyte proliferation by TF, i.e., TF acts as a non-specific adjuvant. This idea is slowly being accepted as the dogma. In fact, all available data on the specificity of TF are subject to criticism. It still remains to be proven that TF is a non-specific adjuvant, determine its molecular composition and find out whether it is an efficacious immunotherapeutic agent. Among the possible candidates for TF is theymopoietin (TP) because of its putative activity and because it is a dialyzable molecule. It was thought to be produced only in thymic epithelial cells and thus was excluded from

previous studies as a TF. However, recently it was reported that thymosin is present in circulating T lymphocytes prompting studies on the effect of TF on augmentation of the immune response in dogs. Prelimimary studies suggest that there is a definite albeit marginal effect. Our plans for future studies are aimed at determining whether TF, in the dog, is specific or, if not specific, whether TP (which is available for experimental purposes) could substitute for TF function.
Keywords: lymphocytes; cell proliferation; thymus; dogs; immune reactions; hormones; biological effects.

106623 Combustion Particulates: Toxicity and Carcinogenicity. Fisher. (University of California at Davis, Davis, CA). **Project number:** 001592. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$310,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Associated with the energy problems now facing the nation is the critical question of the relative cost to human health of the major, viable, electrical power producing technique, coal combustion. This proposal is for a study on the biologic effects (injury and repair) of exposure to particulate and gaseous emissions associated with coal combustion in electrical power generation. In our initial studies, we will evaluate the biological distribution and kinetics of deposited particulates in vivo and in vitro, using both chemical and nuclear techniques. These initial studies are directed toward the development of sensitive biologic indicators of particulate exposure with an emphasis on the effects of exposure on the immune system, with detailed study of pulmonary macrophages, macrophage progenitors, lymphocytes as well as their interactions and their role in subsequent pathogenesis. We also will study possible toxic and carcinogenic effects on mammalian cell systems and mutagenesis in the Ames Salmonella test system. These studies will provide information necessary for the assessment of late effects (2 to 3 years post-exposure) of particulate inhalation in rodents. In the initial phase of this study we will (1) evaluate the distribution dynamics of soluble and insoluble particulates in rodents and non-human primates using radiotracer-labeled materials, (2) obtain and characterize fly ash for animal exposures, (3) identify relevant biologic mechanisms of damage associated with particulate exposure, and (4) study potential toxic and carcinogenic effects of particulate exposure in cell cultures. The expertise and information derived from the study will allow us to effectively study the biological consequences of exposure to dogs, non-human primates and rodents using fly ash aerosols (alone and in combination with oxides of nitrogen and sulfur) of well-defined physical and chemical properties similar to those released from the stacks of coal-fired electrical plants.
Keywords: fossil-fuel power plants; health hazards; electric power; combustion; aerosols; particles; power generation; biological indicators; boiler fuel; fly ash; dogs; man; rodents; nitrogen oxides; sulfur oxides; flue gas; coal; petroleum.

106624 Embryotoxicity in Cultured Embryos. Pedersen, R.A. (University of California, Laboratory of Radiobiology, San Francisco, CA, 94143). **Project number:** 001913. **Contract:** EY-76-C-03-1012. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

Mouse embryos are exposed to toxic substances under controlled culture conditions to determine mechanisms of damage to developing systems and to establish an embryo culture system for identifying and analyzing the teratogenic effects of fossil fuel pollutants. The tissue-specific patterns of gene expression as protein synthesis are being determined by two dimensional gel electrophoresis. Studies are planned in which embryos will be exposed to select fossil fuel pollutants (benzo(a)pyrene and 3-methyl cholanthrene) and effluents of pilot coal conversion processes to analyze their effects on early mammalian development.
Keywords: embryos; mice; benzopyrene; 3-methylcholanthrene; fossil fuels; pollution; synthetic fuels; biological effects; teratogenesis; tissue cultures.

106625 Plant Environment Interactions. Nobel, P.S. (UCLA, Lab. of Nuclear Medicine and Radiation Biology, Dept. of Environmental Biology, Warren Hall, Los Angeles, CA, 90024). **Project number:** 001915. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$32,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objective is to understand in quantitative terms the response of desert plants to their natural environment. Understanding the ecophysiology under natural conditions will not only allow us to understand how plants survive in arid regions, but also will allow us to predict the responses to new, environmental stresses. Transpiration and photosynthesis are being measured with a Siemen's null-point compensating closed-circuit gas exchange system. Soil water potential, temperature, wind velocity, rainfall, and absolute humidity are being monitored. Plant morphology is being examined with a phase contrast microscope using sectioned material.
Keywords: deserts; plants; transpiration; photosynthesis; arid lands; environmental effects; biological stress; terrestrial ecosystems.

106626 ESR Studies of Thiyl Free Radicals in Relation to Bioeffects of Radiation. Wolf, W. (University of Southern California, Radiopharmacy Program, 1985 Zonal Avenue, Los Angeles, CA, 90033). **Project number:** 006284. **Contract:** E(04-3)-113. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The object of the program is to study thiyl (RS) free radicals (and other free radical species generated thereof) produced upon the oxidation of cysteine and cysteinyl containing compounds (including proteins) and of other mercaptans of biological interest in order to obtain further information that would allow a better understanding of the role of thiols as radiation protecting agents. The RS free radicals are produced by mixing in a stopped flow system designed in this laboratory and recording the ESR cavity and spectra.
Keywords: thiyl radicals; electron spin resonance; cysteine; radioprotective substances; biological radiation effects; thiols; radiosensitivity effects.

106627 Marine Geochemistry Research. Goldberg, E.D. (Univ. of California, Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 006331. **Contract:** E(04-3)-34. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental transport and conversion of pollutants.

The history of atmospheric fallout of transuranics (238Pu, 239Pu, 240Pu, and 241Am) will be sought from the Greenland Glacier and from southern hemispheric coastal marine sediments to complement our records from northern hemispheric coastal waters. The relative amounts of transuranics found in sediments which have been remobilized from crustal materials by winds and rivers are compared to those amounts which have directly fallen out from the stratosphere. Also, the chemical forms (dissolved, particulate or colloidal state; charges on dissolved phases) of the transuranic nuclides and of 210Pb, 210Po, 238U, and 232Th in coastal marine waters will be investigated. The sorption of these nuclides upon a variety of solid phases (seaweeds, anion and cation exchange resins) will be investigated on the basis of their isoelectric points and beta surface areas. Finally, a low-level beta counting system (scintillation counter with two detectors in coincidence with an anti-coincidence guard ring) for the measurement of 241Pu in sediment, water and biological samples from ocean systems will be developed.
Keywords: transuranium elements; fallout; air pollution; plutonium 238; plutonium 239; plutonium 240; americium 241; lead 210; polonium 210; thorium 232; sediments; coastal waters; glaciers; greenland; environmental transport; chemical state; sorption; seaweeds; ion exchange materials; scintillation counters; design; radionuclide migration.

106628 Study of Dynamic Features Controlling the Coastal Environment Near the San Onofre Power Plant. Folsom, T.R. (Univ. of California, Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 006330. **Contract:** E(04-3)-34. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

It is proposed to complete the testing of the model that has been developed for predicting rates of dispersal of fallout contamination in surface waters lying west of California. Final comparisons are being made between concentrations predicted by applying this model to what actually has been measured in the North Pacific. Final publication will be in two forms. A summary and interpretation of the Cs-137 concentrations measured in North Pacific near-surface is being prepared for publication this fall in the Quarterly Report of the Environmental Measurements Laboratory (EML) of the Department of Energy. This will bring earlier records collected in the HASL report series up to date. Also a comprehensive review and interpretation of our North Pacific fallout records is to be completed as a professional contribution to chemical and physical oceanography of the North Pacific. The numerous measurements we have made of moving fallout distributions have thrown some new light on the characteristic behavior of surface waters of this ocean.
Keywords: san onofre-1 reactor; san onofre-2 reactor; san onofre-3 reactor; environmental impacts; fallout; radionuclide migration; mathematical models; california; cesium 137.

106629 Distribution and Fate of Biogenic and Petroleum-Derived Substances in Marine Sediments. Kaplan, I.R. (Univ. of California,

Dept. of Geology, Los Angeles, CA, 90024). **Project number:** 006334. **Contract:** E(04-3)-34P.A134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to evaluate the nature, source and fate of organic material on the outer contintal shelf (OCS). The effort will be largely devoted to four tasks. Comparisons will be made between aromatic hydrocarbons in OCS sediment (surface and at depth) with those at the base of the continental margin (Contiental Rise) and beyond in an attempt to understand transport mechanisms. A detailed study will be performed on hydrocarbons, insecticides and other specific markers which will help trace the anthropogenic input onto the OCS from sewage effluent and storm runoff. Trace metals will be measured in the storm runoff samples and compared with studies already performed on sewage effluent. An attempt will be made to determine a correlation between trace element enrichment and organic markers of pollutants. Isotopic studies will continue on the food web in an attempt to better characterize the metabolic relationships among the organisms.
Keywords: continental shelf; sediments; aromatics; environmental transport; elements; trace amounts; runoff; water pollution; comparative evaluations; quantity ratio; aquatic organisms; food chains; metabolism.

106630 Research on Dynamics of Tundra Ecosystems and Their Potential Response to Energy Resource Development. Miller, P.C. (San Diego State University Foundation, San Diego, CA, 92182). **Project number:** 006400. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$300,000.
Related energy source: Coal(40); oil and gas(60) **R and D categories:** Environmental effects assessment.

The objective is to develop a modeling approach to the question: what are the ecological effects (costs and benefits) of perturbations that can be expected from the construction and utilization of energy development in the arctic. To be called an ecologic effect, the response in some ecosystem property must be distinguishable from the normal fluctuation in nature, caused by oscillations inherent in the ecosystem or by natural changes in climate or geology, and must become apparent within a reasonable length of time after the perturbation. Other objectives are: to extend and validate a quantitative model of ecosystem processes developed for the arctic wet meadow ecosystem, and to apply this model to four national tundra types and to tundra systems perturbed by fertilization, species, barge, and oil spill.
Keywords: tundra; arctic regions; terrestrial ecosystems; energy source development; biological models; oil spills; nutrients; environmental impacts.

106631 Observations on Immunohemopoietic Marrow. Crosby, W.H. (Scripps Clinic and Research Foundation, La Jolla, CA). **Project number:** 006613. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The aim of this project is to make direct observations on hemopoietic bone marrow's microcirculation and its hemopoietic function. The unique microcirculation of marrow appears to be essential to the maintenance of hemopoietic proliferation. This objective shall be achieved by transplantation of marrow to extramedullary sites rendering them amenable to various manipulation and microscopic observation. Rat's omentum and hamster's cheek pouch appear to be suitable sites for this purpose. The transplant is, however, surrounded by a shell of bone which prevents illumination and observation.
Keywords: bone marrow; blood formation; capillaries; rats; hamsters; bone cells; blood circulation; immunity; cell proliferation; biological functions; blood.

106632 Studies of the Repair of Radiation-Induced Genetic Damage in Drosophila. Boyd, J.B. (University of California, Los Angeles, CA). **Project number:** 006673. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$43,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to continue selection and characterization of autosomal mutants. Since only 1/5 of the total genome on the x chromosome has been covered, this work is essential to provide mutagenized autosomal stocks from the San Diego Laboratory. These stocks will be screened for mutants that are sensitive to either methyl methanesulfonate or nitrogen mustard. The recovered mutants will then be tested with the autosomal mutants which we have previously recovered to determine which chromosome they are linked to. The same series of characterization experiments that has been applied to the x-linked mutants will then be applied to the new mutants. A full scale attempt to establish permanent cell cultures of critical mutants will be initiated.
Keywords: drosophila; mutants; animal breeding; sensitivity; methyl methanesulfonate; nitrogen mustard.

106633 Study of the Atmospheric Effects That Might Be Caused by Waste Heat Rejection from Large Electrical Power Generating Facilities. Koenig, L.R. (Rand Corp., 1700 Main Street, Santa Monica, CA, 90406). **Project number:** 007042. **Contract:** EY-76-C-03-1191. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$104,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The objective of this study is to develop the means for predicting the effects on the atmosphere resulting from the injection of large amounts of heat and moisture. One approach is to develop numerical models to simulate the physical processes leading to possible weather changes. A second approach is to identify analogs such as heat islands and to study their atmospheric effects.
Keywords: energy parks; environmental effects; waste heat; surface air; climates; meteorology; weather; thermal power plants; thermal effluents; mathematical models; simulation.

106634 Effect of Habitat Conditions on Spatial Parameters of Shorebird Populations. Pitelka, F.A. (University of California, Dept. of Zoology, Berkeley, CA, 94720). **Project number:** 007223. **Contract:** 79-EV70256. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$74,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to use shorebirds as indicators of environmental quality based on the fact that shorebird species differ in their habitat use strategies. Each is finely tuned to a distinct pattern of resources, and each, therefore, is differently susceptible to a given perturbation. Variability in the Arctic ecosystem and energy activity dictates a comparative approach. Shorebird communities will be examined at three locations on the Arctic coast: Barrow, Wainwright, and Prudhoe Bay to determine the abundances and habitat-use patterns of each species and the species-typical patterns of space utilization. Species will be studied along an array of kilometer-long transects and in large (17 to 25 ha) census plots.
Keywords: terrestrial ecosystems; coastal regions; shores; birds; population dynamics; arctic regions; biological variability.

106635 Physical Characteristics of Effluents. Raabe, C. (Univ. of California at Davis, Davis, CA). **Project number:** 002410. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$155,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

These investigations are aimed at providing pertinent and useful information concerning aerosols and have characteristics that will contribute to understanding the potential biological effects of particulate and gaseous products of energy technologies. This research also provides essential supporting information for current planned inhalation studies with respect to choice and generation of suitable exposure atmospheres, as well as developing methods and systems for exposing experimental animals. In addition, these studies will provide suggestions for technology development for effluent abatement and point to new areas for prevention and therapy research. As may be required and appropriate, based upon the needs of current or planned biomedical research, these studies encompass six, not necessarily simultaneous, different areas of research. These areas are: (1) field studies as may be appropriate to evaluate specific characteristics of particulate and gaseous products of energy technologies; (2) generation of aerosols and gases as required for current and planned; (3) delivery and exposure systems for inhalation studies; (4) characterization of atmospheres containing aerosols and gases; (5) behavior of aerosols and aerosol-gas mixtures; and (6) fundamental studies directed to providing needed physicochemical information related to the deposition and clearance of inhaled aerosols and/or potentially toxic gases.
Keywords: coal; combustion; flue gas; aerosols; physical properties; lungs; health hazards; air pollution; sampling; chemical properties; fly ash.

106636 Cooling System Effects. Corey, T.C. (Du Pont de Nemours (E.I.) and Co., Savannah River Plant, Aiken, SC, 29801). **Project number:** 000669. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$195,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The operation of power plant cooling systems involves a series of events which influence associated aquatic systems. The objective of the Cooling Systems Effects Program is to understand these effects for representative aquatic systems and several different

aspects of cooling system operation available for study at the Savannah River Plant. Aspects of the recirculatory cooling process are being examined using the Par Pond reactor cooling reservoir system and existing data from it for comparison with once-through systems. The Par Pond system, the other reactor cooling systems on the SRP site, and the Flowing Streams Laboratory afford the opportunity to compare a large array of temperatures, flows, and aquatic biota under the influence of different cooling system operations. SRL studies are focused on in situ measurements of the process responses of lower food chain components and micro-organisms to stresses associated with cooling system operation. The result of these studies will be the formulation of response curves describing the manner in which crops, dominant species, and metabolic trophic transfer processes change as a function of temperature elevation and other aspects of the cooling process. Such measurements will be useful in evaluating the environmental effects in future siting and design of power plants and have special applicability to power plant cooling systems elsewhere in the southeastern United States.
Keywords: cooling systems; aquatic ecosystems; biological effects; savannah river plant; thermal effluents; temperature effects; biological stress; food chains; microorganisms; thermoregulation; tolerance.

106637 **Air Transport of Pollutants.** Crawford, T.V.; Weber, A.H. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 000672. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: Coal(20); nuclear fission(80) **R and D categories:** Environmental transport and conversion of pollutants.

The major objective of the program is to develop (or adapt), test, apply, and validate mathematical models to calculate the transport, diffusion, resuspension, and deposition of atmospheric pollutants released from one or more point sources. Atmospheric transport processes are the primary means by which radionuclides and other pollutants are transported beyond the SRP site boundary. Because SRP is sharing the environment of the southeastern United States with other nuclear facilities, processes that influence the transport of pollutants at distances of 10 to 1000 km are of primary interest. Atmospheric dispersion models will be developed for the SRP site with the cooperation of appropriate modeling efforts at other DOE sites. Meteorological data from an existing instrumented TV tower and seven-tower network will be used to improve knowledge of the transport and diffusion characteristics within the planetary boundary layer. Atmospheric experiments will be planned and executed to test the models for predicting atmospheric dispersion in the SRP environment. Studies will be made of continuous releases from multiple sources and on instantaneous releases from a single point source. The effect of vertical transport, lids, shear, persistence, and low wind speeds on downwind concentrations of pollutants will be studied. Another objective of this program is to combine data generated from the experimental and aircraft programs with data collected under several other programs at the Savannah River Laboratory. The combined data base will be used to validate models which are used to calculate environmental effects of routine releases to the atmosphere and possible accidental releases.
Keywords: savannah river plant; radioactive effluents; stack disposal; radioactive aerosols; environmental transport; earth atmosphere; plumes; diffusion; radionuclide migration; mathematical models; meteorology; data analysis.

106638 **Forest Management.** Irwin, J.G. (Forest Service, Aiken, SC). **Project number:** 000979. **Contract:** EY-76-A-09-0056. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$545,000.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The Savannah River Forest Station conducts a forest management program to produce forest products, enhance environmental diversity, protect endangered species, conserve other species, provide quality habitats for native wildlife, improve aesthetics, protect soils and watersheds, and maintain a healthy forest. In order to meet those goals, compartment prescriptions are written and carried out on 10% of the forest annually, including maintenance methods such as harvesting of trees and prescribed burns.
Keywords: savannah river plant; forestry; research programs.

106639 **Forest Management.** Irwin, J.G. (Du Pont de Nemours (E.I.) and Co., P.O. Box A, Aiken, SC, 29801). **Project number:** 000989. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Du Pont support costs provide for services such as health, forest fire control, computer services, vehicle and equipment maintenance, secondary road construction, reconstruction and maintenance, building maintenance, utilities, and supplies furnished to the U.S. Forest Service for operation of the Forest Management Program. Correction of eroded secondary roads, spoil piles and borrow pits is accomplished annually through Du Pont support to the Forest Management Program.
Keywords: forestry; savannah river plant; maintenance; research programs.

106640 **Ocean Transport of Contaminants.** Hayes, D.W. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 001301. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: Coal(40); nuclear fission(60) **R and D categories:** Environmental effects assessment.

The objective of this program is to systematically develop the necessary understanding of the environmental processes that govern the transport of energy related substances cycling into and through the estuarine, tidal marsh, and nearshore region of the South Atlantic Bight. Aqueous discharges from the Savannah River Plant operations lead ultimately to radionuclides entering the Savannah River system. Plutonium and tritium from these low level releases provide a unique opportunity to study the cycling and transport of these radionuclides in a southeastern river system. The tritium concentration in the Savannah River is approximately 10 times greater than surrounding rivers, thereby uniquely labeling the river and readily permitting the tracing of its movement in the nearshore region. This information, along with the Savannah Navigational Light Tower Oceanic and Atmospheric System data, will permit quantification of processes affecting nearshore transport. Measurements in the Savannah River system will help to identify the distribution of radionuclides (principal focus will be on plutonium) from upriver nuclear operations in the local marine system. Transport processes will be quantified using data collected in the program (i.e., turbulence parameters, stress and drag coefficients, Richardson's numbers, etc.).
Keywords: plutonium isotopes; tritium; environmental transport; atlantic ocean; coastal waters; estuaries; marshes; savannah river; radionuclide migration; nuclear facilities; radioactive effluents; mathematical models.

106641 **Study of Atmospheric Releases.** Pendergast, M.M. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 001337. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: Coal(10); nuclear fission(60); nuclear fusion(30) **R and D categories:** Environmental effects assessment.

This program will adapt, evaluate, and validate methods of predicting the consequences of accidental releases of major contaminants to the atmosphere of the southeastern United States. The information provided will be a major input to decision makers who must take consequence-limiting action. Implicit in the objective is the development of tools and communications to permit information to be developed in a timely fashion. The Atmospheric Release and Advisory Capability (ARAC) Site Terminal and the ARAC concept itself as support to SRP will be evaluated. Lawrence Livermore Laboratory (LLL) developed and was responsible for making available the system which has been installed at SRP. As displays are developed which would support the SRP Emergency Operating Center, efforts will be coordinated with the Health Physics personnel of SRP to ensure that the displays will be useful to nuclear industry as a whole. As development proceeds and computer generated displays are made, Health Physics personnel will be trained to use computer systems and interpret the displays.
Keywords: savannah river plant; chemical effluents; radioactive effluents; stack disposal; air pollution; earth atmosphere; radioactivity; radiation monitoring; monitoring; forecasting; decision making; data acquisition systems; display devices; computers; mathematical models; risk assessment; environmental effects.

106642 **Radioecology of Actinide Elements.** Smith, M.H. (University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 001338. **Contract:** EY-76-C-09-0819. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$422,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Beginning in FY 1979, the scope and direction of the program will be reorganized. In the past, the main emphasis has been on Pu cycling in agricultural ecosystems. In the future, the objectives will be to: (1) expand the studies of transuranics to aquatic ecosystems with more emphasis on the transplutonic elements; (2) initiate studies of U and Th in aquatic ecosystems (which explains the change of title); and (3) reduce the effort in agricultural and natural terrestrial ecosystems. Analysis of Pu and Am concentrations in the backlog of samples from the agricultural studies will be continued. These changes are justified based on: (1) the progress in past agricultural studies; (2) the limited progress in aquatic studies due to changes in staff; and (3) the need for information on the U and Th fuel cycle

which is required because of the continued operation and construction of uranium-fueled nuclear power plants and which has been made more important by the recent Presidential decision to deemphasize the Pu fuel cycle. Although the emphasis of the programs will shift, the basic experimental design practices used in the past will be followed. It is intended to: (1) place primary importance upon field studies utilizing the unique habitats and source terms on the SRP; (2) augment these field studies with laboratory and greenhouse experiments; and (3) design these field, laboratory and greenhouse studies so that the results are applicable on a regional scale. **Keywords:** actinides; radionuclide migration; uranium; thorium; aquatic ecosystems; plutonium; americium.

106643 Cycling of Long-Lived Radionuclides. Corey, J.C. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 001339. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$290,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

This program currently is designed to quantify the parameters needed to predict the amount of transuranics entering man. The nuclear fuel reprocessing activities at Savannah River are the source term for the research. The four major program areas are agricultural crop, source term characterization, resuspension, and aquatic transport. The agricultural crop studies are aimed at determining the transuranium content of important agricultural crops in the southeastern U.S. when grown adjacent to an operating nuclear fuel reprocessing facility. The study will determine the relative importance of direct deposition on the foliage from either atmospheric deposition or resuspension vs. root uptake from the soil. The source term characterization study, in the plutonium processing and off-gas areas, is determining the general characteristics of plutonium-bearing particles. Resuspension rates for various soil conditions will be determined for agricultural and construction activities in order to estimate inhalation rates during these activities. Aquatic transport measurements of the behavior of transuranics in fresh water streams will examine the contribution of drinking water and consumption of fish and other aquatic life to the transuranics entering man. The program objectives will be broadened to evaluate the cycling and fate of long-lived radionuclides that would be released by plants reprocessing nuclear fuels or by nuclear waste management facilities. Nuclides of interest include Th, U, Pu, Cs, Tc, C, and I. Each of these elements have long-lived radioisotopes (greater than 10,000 years) and hence contribute to the dose-to-man for many generations.
Keywords: savannah river plant; fuel reprocessing plants; radioactive effluents; transuranium elements; environmental transport; radioecological concentration; root absorption; foliar uptake; terrestrial ecosystems; soils; aquatic ecosystems; food chains; radionuclide migration; crops; radionuclide kinetics; man; environmental exposure pathway.

106644 Management of Natural Resources. Smith, M.H. (Savannah River Ecology Lab., Drawer E, Aiken, SC, 29801). **Project number:** 001905. **Contract:** EY-76-C-09-0819. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Our objectives are to study the effects of various management practices on the natural resources of the Savannah River Plant. Special emphasis has been placed on the endangered species of the site, particularly the American alligator and the red-cockaded woodpecker. Observations on wildlife species, aquatic habitats and elemental cycles in pine forests are also made. These include density estimates, elemental concentrations and other aspects of the life history and genetics of the target species. Genetic analysis is conducted by the use of horizontal starch gel electrophoresis. Density estimates are calculated in a variety of ways including a removal plot technique. Element analyses are conducted by atomic absorption and arc spectrophotometry. Trees are cored to determine growth increments, and shifts in growth patterns of slash pine have been studied after the removal of pine litter. Shifts in animal and plant populations are expected as a result of certain forestry management programs. These changes occur both at the population and individual level.
Keywords: management; savannah river plant; environmental effects; birds; alligators; pines; genetic effects; genetics; population dynamics.

106645 Cycling of Heavy Metals and Other Stable Elements. Smith, M.H. (Univ. of Georgia, Savannah River Ecology Lab., Aiken, SC, 29801). **Project number:** 001906. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$170,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

This research program to investigate the cycling processes of the southeastern coastal plain is designed to determine: (1) the availability of stable elements to the biota; (2) the role of primary producers, consumers and detritivores in cycling processes; (3) the factors which limit rate processes; (4) the importance of interactions among energy flow, thermal environments and cycling processes upon the rate of biomass accumulation and transfer; (5) the extent to which transfer coefficients are modified by population processes that influence the temporal or spatial turnover to compartmental standing crops; and (6) the validation of models of these cycling processes at various sites on the southeastern coastal plain. Emphasis is directed toward land use planning. The SRP provides numerous opportunities to study the interaction of heavy metal and other stable element cycling between the biotic and abiotic components of the environment. The broad variety of available habitats includes reservoirs, ponds, streams, abandoned agricultural land, forest plantations and several forest types. Some of these have received various production reactor and industrial pollutants from plant operations for many years. This region receives high rainfall but possesses little organically-enriched soil. The rapid leaching rates from the porous sandy soil have resulted in relatively tightly mineral loops in the biota which reduce nutrient loss. Many minerals which are normally held in the organic or clay fraction of the soil are concentrated in the biota, establishing a unique aspect of mineral cycling which cannot be investigated in other geographical regions.
Keywords: metals; mineral cycling; biomass; biological models; ecosystems; population dynamics.

106646 Cycling of Radioisotopes. Smith, M.H. (Savannah River Ecology Lab., Drawer E, Aiken, SC, 29801). **Project number:** 001907. **Contract:** EY-76-C-09-0819. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$110,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Three areas of radionuclide movement have been emphasized: (1) the development of models of radionuclide cycling; (2) the transport and dispersal of radionuclides in aquatic and terrestrial ecosystems; and (3) understanding the mechanisms involved in uptake of radionuclides in aquatic and terrestrial ecosystems. Various radionuclides were released from reactor operations on the Savannah River into natural ecosystems on the site. Soil, water and biological samples are collected and subjected to analysis for beta and gamma emitters. Concentration factors within natural food chains are calculated. Both plants and animals are used in the research. Frequency distributions for the various isotopes are normally skewed and the third and fourth moments of the distributions may be indicative of ecosystem functioning. The distributions are frequently log normal. Consistent patterns of biodilution or biomagnification are not found for the concentrations of any isotope within all food chain studies.
Keywords: radionuclide migration; aquatic ecosystems; terrestrial ecosystems; radioecological concentration; biological accumulation; food chains; radioisotopes; uptake; savannah river.

106647 Synergisms and Interactions in Ecological Systems. Smith, M.H. (Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 001909. **Contract:** EY-76-C-09-0819. **Supported by:** Department of Energy; Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$129,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Research programs will continue to use both field and laboratory multivariate approaches to determine environmental stress on biological systems. The research will be designed to understand the underlying functional and structural relationships between stress variables and biological responses (individual, population, or community level). To accomplish this effectively and convincingly, the research investigations must work toward a thorough understanding of the biological systems that are being studied. This required laying a solid foundation and framework of basic ecology. The foundation must always precede the interpretative experiments that provide the more obvious, immediately applicable answers to complex environmental questions. On many fronts where the foundation has already been developed, appropriate studies can be continued. In many areas the foundation is still in its infancy and must await the maturity that can only come through continued basic research. A combination of programs between these two stages of development constitute the present research in this area.
Keywords: aquatic ecosystems; synergism; biological stress; mathematical models; biological models; thermal pollution; water pollution; genetic variability; metabolism.

106648 Effects of Energy Production on the Function of Aquatic Environments. Smith, M.H. (University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 001910. **Contract:** EY-76-C-09-0819. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$113,000.

Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Important questions related to ecological stress will be addressed, such as: (1) what determines vulnerability to particular environmental insults; (2) which individuals, populations or communities possess the greatest resistance to disruption; (3) what functional features of populations or communities are responsible for environmental elasticity or resiliency; (4) how can critical functional aspects of an environment be quantitatively measured and evaluated prior to perturbation so that meaningful comparisons can be made thereafter; and (5) can models be constructed which successfully predict how particular ecosystems will function under a given set of environmental alterations. Also, basic questions which center around why and how natural communities, populations, and individuals function as they do must be asked. Research at the SRP and elsewhere has produced information concerning the effects of stress created by reactor effluents upon the physiology of individual organisms and on populations of certain species. In the past at SREL, effects of thermal stress and post-thermal recovery have been examined primarily in the field but this work has been complemented with laboratory experiments. Most of the studies have been at the organism or population level, although the examination of selected community characteristics has also been undertaken. With the capability of diverting and controlling the temperature and effluent flow from a reactor into an otherwise natural habitat (Castor Creek), it is anticipated that the understanding of the ecosystem vulnerability will be greatly enhanced and that the population studies will be strengthened through field experimentation. This project will greatly augment the present capabilities for ecological studies of the responses to stress in aquatic systems.

Keywords: aquatic ecosystems; nuclear power plants; chemical effluents; thermal effluents; water pollution; savannah river plant; baseline ecology; mathematical models; environmental impacts.

106649 National Environmental Research Park. Cahoon, E.J. (Savannah River Operations Office, P.O. Box A, Aiken, SC, 29801). **Project number:** 002148. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.

Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The National Environmental Research Parks are protected lands set aside for ecological research, for study of the environmental impacts of energy developments, and for informing the public of the environmental and land use options open to them. Practical studies related to management of natural resources (forests, wildlife, endangered species, water, soils) are an important use of the Parks. However, the energy-related activities conducted at each Park are a prime resource to provide effects for environmental studies. In addition, natural ecosystems are protected to serve as bases for comparison with land affected by human activities. Most progress toward NERP goals results from research and energy activities funded outside the NERP program by DOE, other federal agencies, and universities. SR NERP program funds are dedicated primarily to information exchange, fostering cooperation in research planning and goal setting, and developing background information on the SR NERP which will permit use of the site as a basis for developing regional environmental predictions. A small portion of the funds is used to aid visiting scientists with administrative requirements and to provide equipment and facilities for use at the NERP. An expanded program is projected in this budget in order to make best use of the increased interest in the SR NERP which has developed during the six years since its designation in 1972. The new energy activities projected for the SRP site in the areas of waste management, energy conservation, and biomass production will also result in new opportunities for environmental effects studies in this budget period.

Keywords: savannah river plant; ecology; environment; terrestrial ecosystems; aquatic ecosystems; management; environmental impacts; forecasting; waste management; energy conservation; water pollution abatement; air pollution abatement; land pollution abatement.

106650 Radioactive Tracer Studies of Soil and Litter Arthropod Food Chains. Crossley, D.A. Jr. (University of Georgia, Department of Entomology, Athens, GA, 30602). **Project number:** 006353. **Contract:** EY-76-S-09-641. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.

Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This program concerns the regulation of decomposer systems by soil-litter arthropods. Radioactive tracers are used to estimate rates of nutrient element flow in soil-litter arthropod food chains. Development and testing of mathematical models allows for interpretation of radioisotope retention curves as biological phenomena. In particular, assimilation rates for nutrients can be measured more accurately. Current research is using radiotracer kinetics to resolve the interactions between microflora and arthropods in the decomposition process. Electron microprobe techniques, in conjunction with scanning electron microscopy, are being used for measurement of nutrient element content of microarthropods (mites annd collembolens). Field work is continuing with island ecosystems on granitic outcrops, in which input-output budgets are developed. Response to perturbation is measured as disruption to nutrient balance within the island ecosystems.

Keywords: forest litter; arthropods; food chains; nutrients; mineral cycling; radionuclide migration; mathematical models; predator-prey interactions; soils; microorganisms; energy budgets.

106651 Continental Shelf Processes Affecting the Oceanography of the South Atlantic Bight. Atkinson, L.P. (Skidaway Institute of Oceanography, P.O. Box 13687, Savannah, GA, 31406). **Project number:** 007000. **Contract:** EY-76-S-09-0889. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$106,000.

Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Pollutant measurements technology.

Funding is requested to continue our field research program in the Georgia Bight and to complete analyses of recently acquired data. The proposed research is consistent with the 5 year plan for the South Atlantic Bight prepared by the program coordinator. Monthly field studies will continue in the Georgia Bight with major cruises scheduled quarterly. The monthly cruises provide a long term data base for studies of an oceanographic section off Savannah. Quarterly cruises will be event oriented and focus on features such as shelf break eddies or alongshore distribution of fresh water. Cruises will be for the following purposes: (1) to determine the contribution of atmospheric forcing, air-sea interaction, Gulf Stream influence and thermohaline effects on inner-, mid-, and outer-shelf circulation, and exchange processes; and (2) to determine the specific trajectories of water due to discrete events when encountered, such as (a) Gulf Stream meanders and eddying events, (b) fluctuations in density discontinuities, and (c) passage of cold fronts.

Keywords: continental shelf; atlantic ocean; mathematical models; nitrates; data acquisition; data base management; nutrients.

106652 Trace Element Geochemistry of South Atlantic Bight. Windom, H.L. (Skidaway Institute of Oceanography, P.O. Box 13687, Savannah, GA, 31406). **Project number:** 007001. **Contract:** EY-76-S-09-0890. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$98,000.

Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine the rate and modes of input of trace elements to the Georgia Bight continental shelf environment and their residence time there. Seasonal sampling of major rivers and the air for the trace elements of importance will be conducted to determine input rates. Temporal and geographic sampling of continental shelf waters for the same elements will then be conducted. Emphasis is presently being placed on As, Se, Sb, Cd and other volatile trace elements that are mobilized by high temperature energy related processes.

Keywords: atlantic ocean; geochemistry; trace amounts; continental shelf; seasonal variations; sampling; ecological concentration; arsenic; selenium; antimony; cadmium.

106653 Continental Shelf Processes Affecting the Oceanography of the South Atlantic Bight. Pietrafesa, L.J. (North Carolina State University, Department of Geosciences, Raleigh, NC, 27607). **Project number:** 007076. **Contract:** E(38-1)-902. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$132,000.

Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The overall long range objective is the determination of physical/dynamical processes controlling or affecting the flux of nutrients onto and their subsequent distribution on the continental shelf. The purpose of the physical dynamics part of the overall program is to describe the physical oceanographic nature of the South Atlantic Bight. The development of lateral and vertical plane circulations, current shear and sea level and hydrographic parameter changes and the time scales involved in their persistence and decay are being studied. Currents, temperature, conductivity, wind and sea level have been monitored in a time series fashion by North Carolina State University and hydrographic surveys will be directed by Skidaway with the help of NCSU. The hydrographic surveys offer a comprehensive attack on the surface and subsurface density character in Onslow Bay. The CTD-Rosette and XBT stations are gridded to maximize the information, given the hardware, shiptime and numbers of personnel involved, necessary to sense and monitor intrusions and other phenomena. The hydrographic surveys complement and necessarily enhance the current meter observations.

Keywords: atlantic ocean; continental shelf; oceanography; nutrients; distribution; water currents; temperature measurement; electric conductivity; wind; mathematical models.

106654 Biological Processes in the Water Column of the South Atlantic Bight. Paffenhofer, G. (Skidaway Inst. of Oceanography, Savannah, GA). **Project number:** 007153. **Contract:** E(38-1)-936. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: Coal(75); solar(25) **R and D categories:** Pollutant characterization and analysis.

Depending upon the latitude and season, either solar radiation or the availability of inorganic nutrients appear to control the productivity of marine phytoplankton. Nutrients are probably the limiting factor through much of the year along the southeast coast. There are two major sources of these nutrients in this area: (1) runoff and exchange from rivers and estuaries; (2) intrusions of nutrient rich water from mid-depths of the Gulf Stream. There are at least three other minor or unevaluated nutrient sources: (1) direct rainfall; (2) regeneration; (3) N/sub 2/-fixation by blue-green algae. These authors propose an intensive study of the impact of Gulf Stream intrusions on changes in the phytoplankton production and the resulting changes in the zooplankton densities and species composition. In conjunction with Atkinson's nutrient determinations, they will make a series of biological measurements (chlorophyll-a, particulate spectrum analysis and light profile) on a grid of stations in Onslow Bay. From these determinations they will have a measure of the phytoplankton standing crop and the food available for zooplankton. On each cruise, three stations will be selected for intensive and additional measurements. The latter would include phytoplankton species composition, phytosynthetic rates, particulate organic carbon analyses, particulate organic nitrogen analyses, and zooplankton. The results indicate that: (1) intrusions moving onto the continental shelf can exist as distinct water masses for 2 weeks or even longer; (2) following a given intrusion with drogues is fully feasible; (3) our previous assumption that intrusions are characterized by one or few dominant phytoplankton species cannot always be supported; and (4) ostracods and cyclopoid copepods rather than calanoid copepods may dominate the zooplankton population.
Keywords: phytoplankton; nutrients; inorganic compounds; population dynamics; photosynthesis; atlantic ocean; seawater; productivity; nitrogen fixation; biological models.

106655 Research Aircraft Program. Schubert, J.F. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 000976. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(10); nuclear fission(80); nuclear fusion(10) **R and D categories:** Pollutant characterization and analysis.

The objectives of this program are to provide research aircraft and data analysis support for the testing of atmospheric dispersion models. The data bases will include: the concentration of pollutants in the atmosphere surrounding SRP measured by the aircraft; pollutant concentration data from ground and tower sampling stations; the release rate of pollutants from the plant stacks; and all relevant meteorological data from the plant towers, the WJBF-TV tower, the National Weather Service, and other sources.
Keywords: savannah river plant; chemical effluents; radioactive effluents; stack disposal; air pollution; earth atmosphere; radioactivity; radiation monitoring; aerial monitoring; meteorology; data acquisition; data analysis; aircraft; aerosols; sampling; mathematical models; krypton 85; cesium 137; plutonium 239; environmental transport.

106656 Cooperative Forest Management Research. (Forest Service, Aiken, SC, 29801). **Project number:** 002150. **Contract:** EY-76-A-09-0056. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: conservation(100) **R and D categories:** Environmental effects assessment.

The objective of this activity is to accomplish research having direct application to the SRP Forest Management Program and to forest management in the Southeast. The research will eventually result in the potential to produce greater useable biomass with a lower energy expenditure per unit produced. The total study mix during FY 1978 will include the following: (1) the role of artificially produced mycorrhizae and ash, sludge, and bark in land reclamation and hardwood regeneration; (2) field tests of southern pine genotypes exhibiting in vitro resistance to southern fusiform rust (Cronartium fusiforme); (3) utilization of logging residues and small woody vegetation that are currently considered waste products; (4) endangered species surveys and habitat quantification on SRP; (5) refinement of existing models for fire weather prediction and smoke dispersal; and (6) quantification of the influence of pine plantation management on natural succession.
Keywords: savannah river plant; forests; management; land use; land reclamation; waste product utilization; endangered species; habitat; forestry; weather; forecasting; environmental effects.

106657 Coordination: Southeast Continental Shelf Studies. Menzel, D.W. (Skidaway Institute of Oceanography, P.O. Box 13687, Savannah, GA, 31406). **Project number:** 007061. **Contract:** EY-76-S-09-0901. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$211,000.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

This is an effort to coordinate research funded by Division of Biomedical and Environmental Research in the South Atlantic Bight. This broad geographic, four state, coastal area encompasses the Carolina Capes and Florida shelf areas where future offshore nuclear power plants may be sited. Exploration for oil-gas is also projected following the recent lease sale of offshore sites off the Georgia Embayments. With such energy related activity it is important to focus our oceanographic research program on applied problems relating to water circulation, biology and the dispersal of pollutants. This contract does that by holding workshops among contractors, arranging for sharing of large pieces of equipment, maximizing the available shiptime in the area, and coordinating research activities in general.
Keywords: oceanography; aquatic ecosystems; coastal waters; atlantic ocean; continental shelf; water quality.

106658 Air/Earth Cycling of Pollutants. Murphy, C.E. (DuPont de Nemours (E.I.) and Co., Savannah River Plant, Aiken, SC, 29801). **Project number:** 003185. **Contract:** AT(07-2)-1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$205,000.
Related energy source: Coal(20); nuclear fission(40); nuclear fusion(40) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this program is to measure the rate of exchange of pollutants between the atmosphere and terrestrial ecosystems and to follow the cycling of pollutants which may be of continuing concern in these ecosystems. Initial emphasis has been on tritium uptake and cycling. Energy and water balance studies are being used as field techniques to define tritium uptake and cycling. Exposure of plants and soils in controlled environments are planned in the future. The results of the experiments will be used to validate existing models of uptake and cycling of materials in ecosystems, and to prepare new models where needed.
Keywords: tritium; root absorption; foliar uptake; radioecological concentration; earth atmosphere; terrestrial ecosystems; soils; radionuclide migration; plants; radionuclide kinetics; mathematical models; air pollution; land pollution; environmental transport.

106659 Earth's Surface, Radioactivity and Other Studies of Radioactive Debris. Hardy, E.P. Jr. (Environmental Measurements Laboratory, New York, NY, 10014). **Project number:** 000528. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$165,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective of these projects is to document the deposition rate and accumulation of initially airborne particles on the surface of the earth. This information is used to develop mechanisms and models for predicting contamination patterns following a release of radioactive debris to the atmosphere. The monthly strontium-90 fallout rate is measured by sampling total deposition at 72 land stations using high-walled stainless steel pots or funnel-ion exchange column collectors. Soils are collected in selected geographical areas for determining the lateral and vertical distribution of natural and artificial radionuclides. Wet and dry fallout are sampled on a monthly basis at a regional station 35 miles due west of lower Manhattan, and at two remote baseline stations, Mauna Loa, Hawaii, and American Samoa. Input from Chinese nuclear tests are maintaining the global budget of Sr-90, and hence, the deposition rate at a nearly constant level. Data are supplied to UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) for updating the global population radiation dose from weapons test radionuclides.
Keywords: land pollution; water pollution; radioactive aerosols; radioecological concentration; radionuclide kinetics; contamination; fission products; air pollution; deposition; radionuclide migration; strontium 90; soils; regional analysis; hawaii; new york; islands; environmental effects; plutonium; fallout; surface air; radiation monitoring.

106660 Radioactivity in Surface Air. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 000529. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The EML (Environmental Measurements Laboratory) Surface Air Sampling Program provides data on the latitudinal distribution of nuclear weapons debris, arrival times of fresh debris, and transfer of this debris between hemispheres. These radionuclide concentrations in surface air are related to measurements of deposi-

tion on the earth's surface. Lesser efforts are devoted to releases from nuclear facilities. Particulates in surface air are sampled continuously on Microsorban filters at about twenty sites covering the latitude spread from 77 degrees N to the South Pole. The samples are combined into monthly composites and split; half for nondestructive assay by germanium diode gamma spectrometry and half for radiochemical analysis. The routine program involves analyses for beryllium-7, strontium-90, zirconium-95, cesium-137, cerium-144, lead-210 and plutonium-239. Air concentrations and dispersion of plutonium-239 in the vicinity of Rocky Flats, Colorado, are being observed on a routine basis at three downwind locations from the plant. Results from Surface Air Sampling Program are used to update the incremental human radiation dose from weapons testing residuals. Plutonium-239 data from Rocky Flats are used to assess the level of and migration of plutonium-239 in the vicinity of Rocky Flats. Air concentrations were used to assess the radiation dose to local population.
Keywords: surface air; radioactivity; sampling; fallout; fission products; radioecological concentration; deposition; radiochemical analysis; radionuclide migration; translocation; beryllium 7; strontium 90; zirconium 95; cesium 137; cerium 144; lead 210; plutonium 239; nuclear energy; environmental effects; radioactive aerosols; radiation monitoring; gamma spectroscopy.

106661 Radioactivity in Stratospheric Air. Hardy, E.P. Jr. (Department of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 000530. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$165,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objectives of this program are: to document the concentrations of radioactivity in the stratosphere as a function of latitude, altitude, and season; to compute stratospheric burdens of critical tracers; to develop and test stratospheric transport models; and to provide basic data for other scientific programs in studying the ultimate deposition of these tracers in the environment. Two separate projects are involved: the High Altitude Balloon Sampling Program and Project Airstream involving aircraft sampling. The balloon program provides samples from 20 to 27 km at 65, 33, and 9 degrees N several times a year. The aircraft sampling extends from 75 degrees N to the equator in the western hemisphere and ranges in altitude from 12 to 19 km. At least three aircraft missions are flown per year. The filters are analyzed for long-lived fission products, plutonium isotopes, and radon daughter products. Weapons related radionuclide data are used to update the surface deposition model and assess the radiation dose contribution to man.
Keywords: stratosphere; radioactivity; fission products; plutonium isotopes; radon; daughter products; aerial monitoring; balloons; aircraft; chlorinated aliphatic hydrocarbons; fluorinated aliphatic hydrocarbons; monitoring; tracer techniques; mathematical models; air pollution; diffusion; ozone; human populations; radiation doses.

106662 Radioactivity in the Biosphere. Hardy, E.P. Jr. (Dept. of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 000684. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$494,000.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

Several programs involving sampling and analysis of biological materials are carried out in order to investigate the transfer to man of radionuclides. Primary objectives are to correlate human body burdens with intake levels, to evaluate the long-term behavior of radionuclides in the environment and in man, and to determine the dose commitments from nuclear power production. Radionuclides from nuclear weapons testing provide the major tool for our studies. The nuclides investigated include plutonium, americium; strontium-90, cesium-137, and tritium. Quarterly estimates of strontium-90 intake in total diet in New York City and San Francisco are determined from analyses of nineteeen representative food items purchased every three months. Since 1961, specimens of human vertebrate have been obtained in the New York and San Francisco areas, while daily milk and tapwater sampling in New York City has been carried out since 1954.
Keywords: biosphere; land pollution; water pollution; biological materials; radiochemical analysis; radioecological concentration; environmental exposure pathway; radioisotopes; radionuclide migration; man; body burden; health hazards; plutonium; americium; strontium 90; cesium 137; tritium; forecasting; fission products; radioactivity; skeleton; food; ingestion; diet; soils; fallout; radiation monitoring.

106663 Radiochemical Development Studies. Welford, G.A. (Dept. of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 000685. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$84,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

The objective of this project is the development of improved radiochemical, radiometric and analytical procedures to determine the levels of radionuclides, particularly the transuranium elements, in biological and environmental matrices. These analyses must be capable of isolating and determining these transuranic nuclides in large quantities of soil, water, tissue, food and excreta samples. The method once developed must withstand extensive evaluation by analyzing actual samples over extended periods of time so that reliable accuracy and precision statements are possible. We will investigate and apply both classical and new analytical techniques to radioanalytical problems.
Keywords: radiochemical analysis; radioecological concentration; transuranium elements; biological materials; ecosystems; plutonium; americium; urine; soils; water; food; skeleton; tritium; radiometric analysis; environmental materials; chemical analysis.

106664 Analysis of Samples of Surface Ocean Water. Volchok, H.L. (Dept. of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 000686. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$5,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

Woods Hole Oceanographic Institution (WHOI) is funded by DOE to carry out extensive research utilizing strontium-90, cesium-137 and plutonium in sea water and ocean sediments. HASL arranges contracts with commercial laboratories for the radiochemical analyses of the sea water. Recently, additional samples generated under the GEOSECS program (funded by the National Science Foundation) have been combined with the routine WHOI project. Commercial laboratories claiming the ability to quantitatively analyze sea water for low concentrations of strontium-90, cesium-137 and plutonium, are qualified by HASL. This involves submission of blank, duplicate and known samples and subsequent evaluation of the results. Requests for proposals from qualified laboratories are then evaluated by a panel and a contractor is selected.
Keywords: seawater; strontium 90; cesium 137; plutonium; sediments; radionuclide migration.

106665 Analytical Development Studies. Welford, G.A. (Dept. of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 001778. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$219,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

The objectives of this program are to develop methods of analysis for selected trace elements, anions, organic and gaseous pollutants in environmental and biological materials; and to determine the reliability of the selected method for the specific pollutant with variations in major and minor constituents. Individual pollutants will be investigated based on potential toxicity to man, reported levels of environmental contamination, and reported reliability of existing methods and measurements. Methods to be developed will be subjected to extensive evaluation by analyzing actual samples over extended periods of time so that accuracy and precision statements are possible. Both classical and newer analytical techniques for isolating the material and sensitive instrumentation for determination will be investigated.
Keywords: environmental materials; biological materials; air pollution; toxicity; aerosols; soils; food; chemical analysis; trace amounts; elements; anions.

106666 Energy-Related Pollutants in the Biosphere. Hardy, E.P. Jr. (DOE, Environmental Measurements Laboratory, 370 Hudson Street, New York, NY, 10014). **Project number:** 001779. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$783,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to measure and evaluate trace metal concentrations in various biological materials and systems with specific emphasis on the pathways to man and the levels in diet and human tissue. Human metabolic balance experiments utilizing the cadmium, copper, manganese, nickel, lead and zinc naturally present in the diet are carried out on a cooperative basis with Dr. Herta Spencer of the Hines Veterans Administration Hospital near Chicago. Trace element concentrations in various trophic levels of the food web leading to man will be determined in an area where a coal-fired fossil-fuel plant is to be constructed. Sediment cores from four lakes were chronologically sectioned and analyzed for trace metals to obtain a history of anthropogenic pollution. Results will be available in FY 1979. The cores were taken by the Woods Hole Oceanographic Institution as part of a joint project.
Keywords: biosphere; trace amounts; air pollution; fossil fuels; environmental effects; environmental exposure pathway; man; zinc; me-

tabolism; health hazards; cadmium; copper; manganese; nickel; lead; fossil-fuel power plants; water pollution; land pollution; pollution; food; tissues.

106667 Documentation of Natural Activity Levels in the Biosphere. Welford, G.A. (Department of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 001780. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$83,000.
Related energy source: Coal(20); nuclear fission(80) **R and D categories:** Environmental transport and conversion of pollutants.

This project was undertaken to document the naturally occurring radioactive nuclides in man and his environment. Measurements of natural radionuclides including radium-226, lead, and polonium-210 in wet, dry, and total fallout in the urban environment will be performed. Analyses will be made of World Health Organization human bones for radium-226 and stable calcium. Measurement of samples from areas around coal-fired power plants to document their discharge of natural radionuclides is also performed.
Keywords: fossil-fuel power plants; radioactive effluents; radiation monitoring; urban areas; fallout deposits; radium 226; lead 210; polonium 210; radiation monitoring; man; skeleton; radioactivity; radium 226; radiometric analysis; calcium.

106668 Non-Nuclear Pollutants in Surface Air. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 001781. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$237,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The EML (Environmental Measurements Laboratory) Surface Air Sampling Program provides stable lead particulate concentrations through the entire range of pollution levels from the global baseline concentrations observed at Mauna Loa, Hawaii to some of the most highly contaminated urban centers in both hemispheres. Measurements of sulfate, nitrate and a number of trace metals will be initiated at selected sites. The basic aim is to document the air concentrations of energy-related pollutants as part of the input information required to assess their impacts on the environment and man. Twenty stations extending from 77 degrees N to the South Pole collect particulates on Microsorban filters. Similar air sampling is carried out at a regional station 35 miles west of lower Manhattan. Measurements of industrial gaseous pollutants will be initiated at the regional site. EML will evaluate, supervise the manufacture, and field test special gas chromatographic-electron capture analyzers developed by NOAA for planned releases of atmospheric tracers. The air samplers at some of the regional and global baseline stations have been modified to collect as a function of wind direction so that only clean air, unperturbed by local sources, is sampled. Techniques and capabilities developed in this program will be applied to the Multistate Atmospheric Power Production · Pollution Study (MAP3S).
Keywords: surface air; air pollution; fossil fuels; lead; diffusion; air samplers; design; sulfates; nitrates; health hazards; trace amounts; elements; regional analysis; global aspects; environmental transport.

106669 Cytogenetic Basis of Resistance to Radiation-Induced Sterility in Insect Species with Holokinetic Chromosomes. LaChance, L.E. (Metabolism and Radiation Research Lab., Fargo, ND, 58102). **Project number:** 006519. **Contract:** P7603214. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$36,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives of this research are to understand the radiation biology, genetics, and reproduction in lepidopteran insects. The secondary objective is to attempt to apply this knowledge as a population control measure in this group of highly destructive insects. Lepidopterans have an unusual genome which makes the studies of radiation biology and genetics somewhat unique. This mulitfaceted program includes studies on whether the sterility of hybrids derives from a cytoplasmic agent carried in H. subflexa, the reproductive biology of lepidopteran species, and developmental biology of insects.
Keywords: radiosterilization; insects; radioinduction; pest control.

106670 Flow of Energy and Cycling of Elements and Effects of Environmental Change in Estuarine and Nearshore Oceanic Ecosystems. Cross, F. (National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Beaufort, NC, 28516). **Project number:** 006536. **Contract:** E(49-7)-5. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$418,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The long-range objectives of this research effort are to understand the relation between fishery productivity and structure and function of near-shore estuarine ecosystems and to assess the effects of energy-related activities on these ecosystems. The research is divided into three sections: (1) flux, chemical speciation and toxicity of trace elements in estuarine and coastal waters, the primary objective of which is to understand the environmental behavior of trace elements in estuarine and coastal waters to predict their fate and biological effects when released into these ecosystems; (2) structure and function of coastal and estuarine ecosystems, the objective of which is to continue a unified study on the principles governing the operations of estuarine and coastal ecosystems, especially on the Newport River Estuary; and (3) effects of environmental conditions on survival and production of marine organisms, the objective of which is to gain a better understanding of the ways environmental factors alter production rates of important estuarine and marine organisms.
Keywords: mineral cycling; aquatic ecosystems; fishing industry; chemical effluents.

106671 Project Ashcan. Falkonski, S.J. (Air Force Geophysics Lab., L.G. Hanscom Field, Bedford, MA, 01750). **Project number:** 006542. **Contract:** 80-EV10083. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$367,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective is to document the concentrations of selected aerosols and gases in the stratosphere as a function of latitude, altitude and season in the northern hemisphere. Balloon-borne particulate and gas samplers are flown to altitudes of 70,000, 80,000, and 90,000 ft from Alaska and Panama annually and from New Mexico seasonally except winter. Schedules are coordinated with Project Airstream, the aircraft-borne sampling program, which together with Project Ashcan, constitutes the DOE High Altitude Sampling Program. Filter papers are sent to the DOE Environmental Measurements Laboratory for analysis of particulate radioactivity. Exposed molecular sieve is analyzed at Argonne National Laboratory. Interpretative analysis of data is by EML and the Air Resources Laboratory, NOAA.
Keywords: balloons; aircraft; air pollution; fallout; aerial monitoring; radiation monitoring; earth atmosphere; sampling.

106672 Airlift Support of Project ASHCAN. (Military Airlift Command, OCS Controller, Scott Air Force Base, IL, 62225). **Project number:** 006544. **Contract:** EX-76-A-28-2935. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$72,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

Aerial recovery support is required to catch sampling payloads released from stratospheric balloons following sampling flights launched from Panama and Alaska under Project ASHCAN.
Keywords: sampling; balloons; aerial monitoring; panama; alaska; air pollution; stratosphere.

106673 Atmospheric Transport and Dispersion of Pollutants and Related Meteorological Studies. Ferber, G.J. (NOAA, Air Resources Laboratory, Silver Spring, MD, 20901). **Project number:** 006547. **Contract:** EX-76-A-28-0004. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$500,000.
Related energy source: Coal(35); nuclear fission(65) **R and D categories:** Environmental transport and conversion of pollutants.

The research is directed toward improving techniques for predicting the distribution, transport, and deposition of atmospheric pollutants using radioactive debris and emissions as tracers. The transport scales considered range from local to global and include both the stratosphere and troposphere processes. Current emphasis is on the verification of regional trajectory models on scales of 100 to 1000 km using Kr-85 released from Savannah River Plant and inert fluorocarbon tracers and sophisticated sampling techniques. This project also provides technical assistance to the high altitude sampling program, model development and long term distributions and inventories of nuclear weapons debris and the MAP3S Precipitates Chemistry Network.
Keywords: fallout; earth atmosphere; deposition; aerial monitoring; balloons; aircraft; mass transfer; air pollution; mathematical models; stratosphere; meteorology; global aspects; tracer techniques; fission products; fallout; fossil fuels; krypton 85; organic fluorine compounds.

106674 Project Airstream. Calio, A.J. (NASA, Washington, DC, 20546). **Project number:** 006807. **Contract:** 79-EV10043. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$550,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The objective is to document the concentrations of selected aerosols and gases in the stratosphere and upper troposphere as a function of latitude, altitude and season in the northern hemisphere.

Project Airstream uses a WB-STF aircraft as a sampling platform. Missions are flown in spring, summer and fall. The latitude coverage extends from 75 degrees N to the equator. Four altitudes are sampled, ranging from 40K ft to 63K ft. Vertical profiles at Panama, Alaska and Texas provide tropospheric samples. Filters and whole air samples are analyzed by the DOE Environmental Measurements Laboratory or subcontractors. Tritium analysis is done by the University of Miami. Interpretative analysis of data is done by EML and the Air Resources Laboratory, NOAA.
Keywords: aerial monitoring; sampling; air pollution; aircraft; tritium; earth atmosphere; radiation monitoring.

106675 Health Effects: Krypton. Kirk, W.P. (EPA, Health Effects Research Lab., MD-72, Research Triangle Park, NC, 27711). **Project number:** 007194. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$46,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To define the biological hazard from Kr-85 released to the environment, experimental animals are being exposed to a cloud of Kr-85. The study will evaluate the long-term effects of acute exposure in guinea pigs and acute and chronic exposure of rats. The distribution, rate of removal, the dose to several organs, and the acute LD/sub 50-30/ for inhalation exposure were determined in guinea pigs. Following this evaluation, rats, Chinese hamsters and guinea pigs were exposed in beta-infinite geometry to determine the acute LD/sub 50-90/. Life time observation to evaluate long term hazards is in progress on guinea pigs surviving the LD/sub 50/ study and rats exposed in a skin-tumor induction study. Rats will be exposed in utero and chronically postnatally to Kr-85 in beta infinite geometry at multiples of the occupational MPC/sub a/. Preliminary data indicate an excess of lymphocytic leukemias in female guinea pigs.
Keywords: krypton 85; delayed radiation effects; rodents; chronic exposure; acute exposure; inhalation; radionuclide kinetics.

106676 Non-Nuclear Pollutants on the Earth's Surface. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 002477. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$241,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to measure the deposition rates on non-nuclear energy-related pollutants in urban, rural, and remote areas and to separate the wet and dry components. The fate of an atmospheric pollutant is influenced by many factors, including its distribution with altitude, chemical form, particle size distribution, and precipitation chemistry. Measurements of this type are required to test models and to develop relationships that can be used to predict behavior of pollutants in the environment.
Keywords: air pollution; urban areas; rural areas; deposition; particles; aerosols; particle size; measuring methods.

106677 Biogeochemistry of Petroleum Components at the Sediment Water Interface. Teal, J.M. (Woods Hole Oceanographic Institution, Woods Hole, MA, 02543). **Project number:** 007300. **Contract:** EE-77-S-02-4256. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOI-$110,000; DOE-$69,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to determine principal processes that control the distribution of hydrocarbons, such as adsorption--desorption between sediments and water, diffusion between pore waters and overlaying water, physical mixing of sediment and overlaying water, and biological activities (bioturbation, ingestion, and metabolism). Simple mixing experiments will be conducted and current velocities will be varied over experimentally enclosed sediments to form a background for comparison of hydrocarbon distribution and composition to biological activity. Biological effect will be measured by using benthic systems isolated in enclosed chambers, first in the laboratory, then in the field at Buzzards Bay and the New York Bight. Factors will be introduced consecutively to elucidate the role of each. A determination will be made as to the chemical compartments in which the hydrocarbons are located, how tightly they are bound, and how extraction by organisms compares with solvent extraction. Clarification will be made of the role of benthic animals changing the composition of the hydrocarbons and redistributing hydrocarbons at the mud-water interface.
Keywords: aquatic organisms; hydrocarbons; metabolism; sediments; seawater; atlantic ocean; coastal waters; new york; continental shelf; benthos; water currents; velocity; depth; ecological concentration; petroleum products; biochemistry; biological effects.

106678 Ecological Baseline Investigations Along the Yukon River--Prudhoe Bay Haul Road, Alaska. Brown, J. (Army Corps of Engineers, Cold Regions Research and Engineering Lab., Fort Wainwright, AK). **Project number:** 007503. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant measurements technology.

A series of ecological and environmental studies are carried out along the Yukon River-Prudhoe Bay haul road in order to establish a baseline and background for complementary studies. The series of studies include: Project 1, investigations of weeds and weedy vegetation along the Yukon River-Prudhoe Bay haul road including supplemental seed germination and plant studies; Project 2, vegetation mapping and response to disturbances along the haul road including observations of successional and impact responses; Project 3, botanical reconnaissance of the haul road (collections will be extended to snowbed communities and collection of seeds, initiation of synthesis of the cryptogamic plant collections and preparations of a descriptive statement on the Galbraith Valley cross section); Project 4, soil invertebrates as indicators of environmental change along the Yukon River-Prudhoe Bay haul road (samples will be collected from the previously-established sample sites and laboratory analyses will continue on all samples); and Project 5, distribution and properties of road dust along the northern portion of the Yukon River-Prudhoe Bay haul road. Continued biweekly and yearly dust sampling and the mineralogical and mechanical composition of the dust up to wind velocity and direction data will be continued. The chemical analyses of the dust and selected vegetation components including some analyses of trace and heavy metals will be performed.
Keywords: baseline ecology; prudhoe bay; alaska; seeds; germination; plants; inventories; aerosols; environmental effects.

106679 Non-Nuclear Pollutants in Stratospheric Air. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 001783. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$226,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are to document the concentrations of selected stable tracers (particulate and gases) in the stratosphere as a function of latitude, altitude and season; to inventory the stratospheric burdens of these materials; to examine vertical transport in the troposphere; to develop and test stratospheric transport models; and to supply basic data for other scientific programs in studying the ultimate deposition of tracers in the environment. Particulate and gas sampling is conducted by both aircraft (Project Airstream) and balloons (Project Ashcan) in the stratosphere on a seasonally repetitive basis in the northern hemisphere. Aircraft sampling extends from 75 degrees N to the equator at four altitudes up to 63K ft and balloons are launched in Alaska, Panama and New Mexico to 70, 80, and 90K ft. Data and interpretive analysis are routinely published and distributed to all member nations through the United Nations.
Keywords: stratosphere; air pollution; monitoring; balloons; stable isotopes; aircraft; sampling; tracer techniques; diffusion; aerosols; air; gases; environmental transport; sulfates; nitrates; chlorides; magnesium compounds; calcium compounds; potassium compounds; sodium compounds; ozone.

106680 Capture of Sulfur Dioxide and Oxygen by Condensation of Water in Droplets, Fogs and Aerosols. Matteson, M.J. (Georgia Inst. of Technology, Atlanta, GA, 30332). **Project number:** 007496. **Contract:** EE-77-S-05-5592. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to determine the sorption and description of SO2 and O2 during condensational growth of droplets, fogs and aerosols. Preliminary studies indicate that during rapid condensation concentrations do not follow Henry's Law. The resulting supersaturation may explain H2SO4 formation in plumes. Methods utilized include: (1) testing the effects of various dissolved salts on enhanced absorption of SO2; (2) determining whether the supersaturations levels observed with SO2 are also obtained with O2; (3) measuring the desorption rates following cessation of growth; and (4) investigating the phenomenon of enhanced absorption on single droplets and clouds of nuclei of known size and composition.
Keywords: sulfur dioxide; oxygen; absorption; droplets; aerosols; fog; vapor condensation; plumes; chemical reactions; supersaturation; salts; solubility; gaseous wastes; surface air.

106681 Partial Support--Ocean Services Board. Vetter, B.C. (Department of Navy, Arlington, VA, 20418). **Project number:** 006540. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of the Ocean Sciences Board are: to contribute to the advancement of the scientific understanding of the ocean by the maintenance of a continuing oversight of the health of ocean sciences and the stimulation of their progress as necessary; to foster the application of scientific knowledge to the wise use of the ocean and its resources; to assist in the formulation of policies that affect ocean science and the clarification of scientific issues that affect ocean policy in general; and to facilitate communication among ocean scientists and scientists from the basic disciplines and from related earth sciences. To achieve its objectives, the Board acts as the NRC (National Research Council) focal point for the identification and consideration of problems concerned with oceanographic research. The Board initiates and conducts timely studies as necessary, provides a broad NRC basis for advice on ocean science and ocean science related matters to concerned government agencies, and serves as a link between the national ocean science community and national and international ocean related groups. In this latter capacity, the Board serves as the U.S. National Committee to the Scientific Committee on Oceanic Research of the International Council of Scientific Unions.
Keywords: oceanography; research programs; planning; cost; water pollution; seas; chemical effluents; environmental transport; government policies.

106682 Analysis of Air Quality and Meteorological Baseline Data from Federally Leased Oil Shale Tracts in Colorado and Utah. Slinne, W.G.N. (Oregon State University, Corvallis, OR, 97331). **Project number:** 007343. **Contract:** EY-76-S-06-2227 TA31. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The object of this work is to collate, analyze and interpret the C-a, C-b, U-a, and U-b oil shale tract baseline data. Data sets will be correlated with meteorological conditions to determine commonality of the measurements and if present to determine causes of simultaneous or phase-lagged extremes measured at each site.
Keywords: utah; colorado; meteorology; air quality; oil shale deposits; environmental effects; data compilation; regional analysis; air pollution; monitoring; accuracy; economics.

106683 Sources of Ozone and Sulfates in the Northeastern U.S. Husain, L. (New York State Department of Health, Albany, NY, 12202). **Project number:** 007344. **Contract:** EE-77-S-02-4501. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to determine the source of anomolous high ozone readings which are observed at the remote Whiteface Mountain station and to see what correlations exist with simultaneously measured sulfate aerosols. Samples of air at the Whiteface Mountain site will be collected and analyzed for ozone, sulfate, natural radioisotopes of Be-7, P-32 and P-33 (tracers for stratospheric input) and trace elements. The results will be evaluated in terms of meteorology and trajectory models to determine the relative contribution of stratosphere ozone to observed ambient ozone concentrations. Correlations between sulfate and ozone will be derived to determine role of ozone in sulfate production and as a function of the ozone genesis.
Keywords: ozone; sulfates; montana; rocky mountain region; radioactivity; beryllium 7; phosphorus 32; phosphorus 33; meteorology; ecological concentration; natural occurrence; environmental transport; mathematical models.

106684 Fatty Acid Ecology of Plankton Communities. Jeffries, H.P. (University of Rhode Island, Graduate School of Oceanography, Kingston, RI, 02881). **Project number:** 007520. **Contract:** 79-EV04941. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$39,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The long range objective of this investigation is to explore the implications of measuring biochemical changes in marine communities stressed by pollutants. The intent of the study is to compare fatty acid distributions as indicators of change in planktonic communities distributed along a well known environmental gradient ranging from physically predictable, offshore waters and extends through progressively more variable inshore habitats. By sampling at monthly intervals over a two year period, we will be able to compare seasonal as well as spatial effects of the environmental gradient. Fatty acids have been selected because their structure is flexible, allowing modifications that are environmentally induced, perhaps to a degree that for marine organisms is unique. At the outset, a simple hypothesis will be tested. Fatty acid patterns are less variable in planktonic communities experiencing environmentally predictable changes than they are under situations that fluctuate widely, often without regularity or pattern. Later, the conceptual basis would be expanded to include biogeographic factors and pollutant interactions.
Keywords: plankton; biological stress; biological indicators; biochemistry; carboxylic acids; water pollution; lipids; biosynthesis.

106685 Effects of Acid Precipitation on Cation Transport in New Hampshire Forest Soils. Reiners, W.A. (Dartmouth College, Department of Biological Sciences, Hanover, NH, 03755). **Project number:** 007619. **Contract:** EE-77-S-02-4498. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$47,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

In this biogeochemical investigation, field and laboratory studies are being conducted to examine the processes which influence or control ion transport in ecosystems receiving acid precipitation. Specifically, these studies focus on chemical changes in water flowing through two contrasting, elevationally separated forest types on Mt. Moosilauke in the White Mountains of New Hampshire: (1) a cool, moist subalpine fir forest and (2) a lower elevation northern hardwoods forest. Although a major emphasis is being placed on the soil solution chemistry, we are also examining the solution chemistry of bulk precipitation, canopy throughfall, and spring water in each system. The specific objectives of this project are as follows: (1) to characterize the solution chemistry of bulk precipitation, throughfall, soil percolates, and ground water for the fir zone and hardwoods systems; (2) to determine the comparative contributions of carbonic acid, organic acids, and mineral acids in the leaching process of each system; and (3) to conduct laboratory experiments which would supplement field efforts, etc.
Keywords: new hampshire; air quality; acid rain; biogeochemistry; air pollution; land pollution; terrestrial ecosystems; leaching; aerosols; sulfur; environmental effects.

106686 Radon Transport Processes in Near Surface and Underground Environments. Wilkening, M.H. (New Mexico Institute of Mining and Technology, Socorro, NM, 87801). **Project number:** 007962. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$56,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

These investigations are expected to yield basic understanding of radon transport and useful information on 222-Rn flux at the air-earth surface with applications to uranium exploration, uranium mill tailings and the natural radiation environment in general. The influence of 222-Rn on the atmospheric electrical climate of underground systems has not been studied with the exception of ion densities and particulate concentrations in uranium mines. This part of the work is significant in internal dose assessment, plate-out of daughter products and some aspects of 222-Rn daughter transport processes. Research on transport processes and certain physical characteristics of 222-Rn and its daughters in near-surface and underground environments is proposed as follows: (1) transport of 222-Rn through the soil and rock matrix with emphasis on the roles played by diffusion, convection, and wind-induced pressure fluctuations; (2) air mass exchange as it relates to dilution of radon concentrations in partially closed systems; (3) equilibrium ratios of 222-Rn daughters to 222-Rn, and the daughter-ion fraction in closed or partially closed systems; and (4) the mode of variation of electrical parameters including ion concentrations, ion mobilities, polar conductivity, and space charge, if any, in underground environments.
Keywords: radon; radon 222; radionuclide migration; soils; rocks; aerosols; uranium mines.

106687 Fluid Dynamic Study of Open-Topped Greenhouses. Thompson, C.R. (University of California, Statewide Air Pollution Center, Riverside, CA, 92502). **Project number:** 007964. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to optimize open top greenhouses so that more realistic, reproducible and reliable pollution effects studies can be conducted. The approach will be to: (1) simulate transport processes between plant and ambient air; (2) exclude ozone from plant growth area; (3) simulate important growth parameters; and (4) use small growth chambers to vary fluid dynamic properties as these are monitored through smoke tests and hot wire anemometer measurements for turbulence and laminar flow regimes.
Keywords: greenhouses; air pollution; design; environmental effects; environmental transport; plants; earth atmosphere; ozone; simulation; plant growth; nutrients.

106688 Partial Support of the Man and Biosphere Program. Menter, S. (United States National Committee for Man and the Biosphere, Washington, DC, 20520). **Project number:** 007399. **Contract:** EX-76-A-28-3227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.

Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The MAB (Man and Biosphere) program is an intergovernmental, interdisciplinary, problem-solving effort focusing on the general study of the structure and functioning of the biosphere and its ecological regions, systematic observations of changes brought about by man in the biosphere, the study of the effects of these changes upon human populations, and the education and information needed on these subjects. Fourteen project areas have been selected. Projects 1 through 7 focus on particular kinds of geographic regions such as forests, arid lands, tundra, etc. MAB-8 concerns the development of an international network of biosphere reserves and MAB-9 through 14 focus on systems and processes such as urban ecosystems, pesticide, use, etc. Products are conferences and workshops, and many publications on state-of-the-art have been produced.
Keywords: human populations; biosphere; ecosystems; environmental impacts; biological models; education; social impact; pollution; urban areas; pesticides; reviews; health hazards.

106689 Development of Screening Method to Determine Potential Mutagenic and Carcinogenic Properties. Painter, R.B. (University of California at San Francisco, Laboratory of Radiobiology, San Francisco, CA, 94143). **Project number:** 002790. **Contract:** EY-76-C-03-1012. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$45,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to develop a rapid test to determine if DNA-damaging agents (potential mutagens and/or carcinogens) are present in energy-related effluents and other materials. Known and suspected agents are briefly incubated with human cells in culture. After removal of the agent, assays for rate of DNA synthesis are made as a function of time, using radioactive precursors of DNA. A decreasing rate of DNA synthesis after removal of the agent indicates the presence of damage in the DNA, whereas no response or an increasing rate of DNA synthesis indicates that no DNA damage occurred and that the agent used was not a mutagenic carcinogen. Validation with a large number of known mutagens and carcinogens and simplification of this test are under way. Recent results include the following: (1) more than 20 chemicals have been screened and the test continues to show promise (an excellent correlation with the Ames test has been demonstrated); (2) HeLa cells are superior to transformed xeroderma pigmentosum cells for the test; and (3) the test is positive even when a chemical that strongly inhibits DNA synthesis but does not damage DNA is in the same sample with a DNA-damaging agent.
Keywords: fossil fuels; combustion products; chemical effluents; biological effects; toxicity; carcinogens; mutagens; mutagen screening; cell cultures; hela cells; xp cells; dna; biosynthesis; inhibition; tracer techniques; screening; carcinogenesis; mutagenesis; risk assessment.

106690 Damaging Effects of Visible Light. Williams, T.P. (Florida State University, Institute of Molecular Biophysics, Tallahassee, FL, 32306). **Project number:** 007956. **Contract:** EP-78-S-05-6021. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$21,000.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The research of this project has both a basic and an applied goal. The basic objective is to understand the physiological basis of the phenomenon of light damage. The more applied objective is to provide information about the limits of light exposure which can be tolerated, without significant cellular damage. The research is currently being done using the albino and pigmented rat as a model system. A second path of research involves the isotopic evaluation of retinal metabolism as a function of the light regime of the experimental animal. Further investigation of damage at the molecular level is proposed. By identification of the intensity and duration threshold for retinal light damage we will better be able to define the safety requirements for harvesting of solar energy. A more basic understanding of the molecular basis of light damage should provide information which will allow predictive analysis of the effects of long duration light exposure as well as giving insight into the methods which can best be employed to safely harness solar energy.
Keywords: visible radiation; rats; biological effects; eyes; photosensitivity; risk assessment; solar energy.

106691 Carbon Dioxide Effects Research. Knox, J.B. (Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA, 94550). **Project number:** 003028. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

To assist the DOE carbon dioxide effects research program, LLL is using its zonal atmospheric model (ZAM2) and a simplified one-dimensional climate/carbon reservoir model to study the global climate response to increased atmospheric CO-2 concentrations. Although previous studies have shown that the surface temperature will increase, the intent here is to narrow the range of uncertainty by including the feedback effects on the global climate of the hydrologic balance, the vertical structure of the atmosphere, and meridional transport. The LLL family of radiative and kinetics models will be used to improve the understanding of long- and short-wave radiation with regard to varying atmospheric composition and to evaluate the temperature feedback effect of increased atmospheric CO-2 on stratospheric ozone.
Keywords: carbon dioxide; environmental impacts; ambient temperature; mathematical models; carbon cycle; climates; earth planet; ozone; electromagnetic radiation; feedback.

106692 Miniaturized Rapid-Response Sensor for Atmospheric Concentrations of Carbon Dioxide. Bingham, G.E. (Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA, 94550). **Project number:** 003032. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to develop a unique miniature carbon dioxide sensor that accurately detects fluctuations in ambient CO2 concentrations of about 1 ppM (v/v). Reducing the sensor volume and power consumption will allow real-time assessment of photosynthesis and carbon flux in portable systems and field environments. This will also allow the CO2 sensor to be built into the sample volume of most systems, eliminating inherent problems of manifold systems. The rapid-response and open cell design will allow further development of eddy correlation and other aerodynamic studies of the planetary boundary layer. Prototype has been developed. Field testing is to be completed in FY79. Designs are expected to be available for commercial fabrication in CY 1980.
Keywords: carbon dioxide; air pollution monitors; earth atmosphere; power demand; consumption rates; photosynthesis; carbon cycle; boundary layers.

106693 Partial Support of the Newly Formed Climate Research Board. Bierly, E. (National Research Council, Climate Research Board, 2101 Constitution Avenue, Washington, DC, 20550). **Project number:** 007799. **Contract:** EE-78-A-28-3265. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The objective is to provide advisory, review and evaluation services to the Federal Government in the field of climate. The National Research Council proposal entertains the possibility of undertaking studies for the Federal Government across a wide spectrum of climate problems that need to be considered in the development of the emerging national climate effort and the associated international climate program. The Panel on International Climate Programs would be established to assist the Federal Government in developing its role in the World Climate Program. The Panel on Decision-Making and the Effective Use of Climatic Information would review the effectiveness of the use of presently available climatic information in governmental decision-making and make recommendations for improvement. The Panel on Geosciences and Climate would examine the programs and research needs in geosciences and climate, with a view to recommending how the national effort might be improved.
Keywords: climates; global aspects; usa; government policies; decision making; organizing; geochemistry; air pollution abatement.

106694 Inhaled Pu Metabolism and Local Pulmonary Dose. Diel, J.H. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002660. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$235,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies are being conducted on the deposition, translocation, intraorgan localization and excretion of plutonium in animals which have been exposed via inhalation to aerosols of plutonium in forms which may occur as constituents of effluents or fugitive emissions from nuclear fuel cycle operations. Due to the extremely short range of radioactive emissions from plutonium, emphasis is placed on local dose and particle distribution for insoluble particles, especially in lung. Since the number of specific aerosols and conditions of inhalation is large, a factorial experimental approach is employed optimizing the amount of information obtained and enhancing its applicability to health protection problems. Primary factors of interest are animal species, particle size, particle activity and chemical form of plutonium. By studying similarities and differences among experimental animals it is possible to make a better estimate of the behavior of plutonium in humans. Use of monodisperse aerosols and pure chemical forms of different solubilities and other chemical properties

allows prediction of the behavior of different aerosols without the study of each individual aerosol. Simultaneous experiments with polydisperse aerosols are conducted for comparison purposes.
Keywords: plutonium compounds; aerosols; inhalation; biological radiation effects; translocation; biological localization; animals; lungs; radiation doses; radionuclide kinetics; solubility.

106695 Inhaled Transplutonium Metabolism and Dosimetry. Mewhinney, J.A. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002661. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Present radiation exposure guidelines for internally deposited actinide elements are largely extrapolated from experimental animal toxicity information on plutonium, although significant differences in the in vivo solubility of Am and Cm aerosols deposited in lung relative to Pu have been demonstrated. This project is being conducted to better assess the nature of these differences in in vivo solubility and subsequent translocation of material following inhalation of the transplutonium elements relative to Pu. In this project the interrelationships between transplutonium element aerosol deposition in the respiratory tract, redistribution of material deposited in respiratory tract to other organs and tissues and excretion from the body are being studied in order to calculate absorbed radiation dose to specific tissues. The initial deposition of inhaled transplutonium element aerosols is measured for well characterized aerosols having known size, shape and chemical form. The time course of lung retention and redistribution of material from lung to other organs and tissues will be determined. The relative role of mechanical clearance and particle solubility on retention and redistribution as influenced by particle size and chemical form is thus assessed. Using serial sacrifice of experimental animals, the time course of radiation dose to specific tissue and organs is determined.
Keywords: transplutonium elements; aerosols; inhalation; solubility; in vivo; translocation; comparative evaluations; respiratory system; radiation doses; radionuclide kinetics.

106696 Mixed Actinide Oxide Aerosols: Metabolism and Dosimetry. Kanapilly, G.M. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002662. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Although most inhalation toxicology studies of inhaled radionuclides have been with single radionuclides, different mixtures of radionuclides occur in different phases of the nuclear fuel cycle. Thus, it is important to determine the applicability of single radionuclide data to hazard evaluations for situations in which mixtures will be present. Our approach is to study a broad range of mixtures on a generic basis. In this manner, the data should be applicable to a number of different situations. Specifically, we are studying factors that affect the dissolution and absorption of radionuclides from the lung and their subsequent translocation to other organs. Emphasis is placed on evaluating the effects of a uranium matrix with different particle specific activities on dissolution processes. The approaches include physical and chemical characterization including x-ray diffraction, in vitro solubility tests and in vivo behavior studies in rodents. When appropriate for extrapolation of data to man, confirmatory studies are conducted in larger species.
Keywords: actinides; inhalation; aerosols; physical properties; chemical properties; solubility; radionuclide kinetics; lungs; rodents; in vitro; in vivo; behavior; translocation; uptake; biological radiation effects.

106697 Inhaled Thorium and Uranium: Aerosol Characterization and Behavior. Cuddihy, R.G. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002663. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will determine the physico-chemical properties and the biological behavior of aerosols of fuel materials in the thorium-uranium cycle. Aerosols of thorium oxides, uranium oxides, mixed thorium and uranium oxides, thorium carbides, uranium carbides, thorium nitrates and uranium nitrates will be studied. Aerodynamic size distribution of aerosols will be determined and correlated to deposition in the respiratory tract. Aerosol particle shape factors and surface area characteristics will be studied. Due to their differing chemical properties, thorium, uranium and their associated daughter products should dissolve from small particles at different rates. In vitro solubility studies will determine how the various compounds behave in different solvents. These solubilities will be related to absorption rates from the lung and to deposition of the material in other internal organs, especially the bone. Deposition and retention patterns observed in rats and beagle dogs will be used to construct biomathematical models of the metabolism of uranium, thorium and daughter products. Other fuel forms, such as molten salts or thorium metal, will be studied if these are incorporated in new reactor designs.
Keywords: thorium compounds; uranium compounds; aerosols; particle size; uptake; radionuclide kinetics; physical properties; chemical properties; respiratory system; shape; deposition; rats; dogs; metabolism; mathematical models.

106698 Dose-Response Relationships for Inhaled Plutonium Radionuclides. Muggenburg, B.A. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002665. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$800,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies are being conducted in beagle dogs and rodents to define relative importance of homogeneity vs non-homogeneity of alpha radiation dose to lung, importance of local dose around a particle, effect of particle size, and influence of age at exposure to inhaled plutonium aerosols. Dogs were exposed to monodisperse aerosols of either 239PuO2 (aerodynamic diameters (AD) of 0.75, 1.5 or 3.0 micrometers) or 238PuO2 (ADS of 1.5 or 3.0 micrometers) to achieve graded initial lung burdens. For a given ILB, average radiation dose to the lung will be constant but local dose rate around inhaled particles varies by a factor of about 3000 from the 0.75 micrometers AD 239PuO2 particle to the 3.0 micrometers AD 238PuO2. At early times after exposure, a few dogs died with radiation pneumonitis. Lung tumors and bone tumors are now occurring in some dogs exposed to 238PuO2. Rodents are being utilized to supplement studies in dogs. Hamsters were exposed to polydisperse aerosols of 239PuO2, 239Pu(NO 3)4, and 238PuO2. Pulmonary neoplasia was not observed in these animals but was observed in hamsters exposed by instillation of 210Po on hematite particles. Because of these unexpected results, additional studies are being initiated in Fischer-344 rats.
Keywords: dogs; rodents; aerosols; inhalation; plutonium compounds; biological radiation effects; lungs; neoplasms; mortality; particle size; age dependence; radiation doses.

106699 Dose-Response for Inhaled Actinide Radionuclides. Muggenburg, B.A. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002666. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$350,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

In this project rodents are being exposed to actinide aerosols with varied physical and chemical properties. The radionuclides being studied inlude 241Am, 244Cm, 242Cm, 232U, and 233U. Similar studies with 238Pu are included in another related project. These radionuclides represent the actinide alpha emitting radionuclides likely to be important in projected nuclear fuel cycles. In these studies, emphasis is placed on determining what characteristics of the particular radionuclide may relate to the biological effects observed. In addition, animals are being exposed at different ages to determine the influence of age at exposure on the biological effects. Emphasis in future studies will be placed on determining if the actions of other environmental pollutants (i.e., SOx, NOx and polycyclic aromatic hydrocarbons) are synergistic with the effects of alpha irradiation on lung.
Keywords: actinides; aerosols; inhalation; biological radiation effects; dose-response relationships; age dependence; physical properties; chemical properties; fuel cycle; radiation hazards; pollution; synergism; lungs; americium 241; curium 244; curium 242; uranium 232; uranium 233; plutonium 238; plutonium 239.

106700 Cytogenetic Effect of Radionuclides. Brooks, A.L. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002668. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Chromosome aberrations are one of the most sensitive indications of interaction of radiation with cells. The rate of chromosome aberration production and elimination as a function of radiation dose rate, quality and distribution will provide valuable information important to continuing dose-rate studies. Past studies have used chromosome damage in liver, bone marrow and testes. Future assays will be developed to evaluate chromosome damage in lung cells following inhalation of insoluble radioactive particulates. Because the rate of cell division in normal lung is low, the use of these cells in

cytogenetic assays is difficult. To overcome this problem we have initiated studies using exposure to NO2 to stimulate lung cell division. Alveolar cells, macrophages and airway epithelial cells will be used as sources of dividing cells. Lifespan studies will be initiated where animals are exposed to insoluble radioactive particulates by inhalation and at various intervals after exposure chromosome damage in lung cells will be determined using NO2 inhalation to stimulate cell division. The recent development of methods at ITRI to study lung cytokinetics will also be used in our studies. Studies using cytokinetic techniques will be designed to determine lung cell damage around insoluble particles.
Keywords: ionizing radiations; radioisotopes; inhalation; biological radiation effects; chromosomal aberrations; lungs; radiation injuries; dose-response relationships; animal cells.

106701 Coal Technology Aerosols Biologically Relevant Properties. Yeh, H.C. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002669. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$185,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

To adequately assess potential human inhalation toxicity problems associated with utilization of coal, it is vital to understand the mechanisms of aerosol formation and behavior as well as the general properties of pertinent aerosols. Further, implementation of inhalation toxicology studies in experimental animals requires that the physical and chemical properties of the aerosols be well defined and that the mechanisms of aerosol formation be well understood. Several important areas are being addressed. The first relates to mechanism of aerosol formation. The condensation of metallic vapors or organic compounds to produce new particles or as surface coatings on existing particles is being studied particularly in relation to the formation of particles of mixed composition. Aerosol behavior at high temperature and/or high pressure process stream or effluent is also investigated. Solubility characteristics of particles and particle coatings are being determined. Physical and chemical properties of aerosols measurable in vitro are related to the in vivo behavior of the materials. Information obtained in this study provides the basis for design of aerosol generation and characterization systems for animal exposures.
Keywords: coal industry; health hazards; environmental impacts; aerosols; inhalation; toxicity; chemical properties; physical properties; animals.

106702 Low Btu Gasifier: Early Damage Indicators For Inhaled Effluents. Mitchell, C.E. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002677. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$105,000.
Related energy source: Coal(100) **R and D categories:** Health effects assessments.

Potential health risks associated with low Btu coal gasification have not been adequately evaluated. Extensive literature has demonstrated the carcinogenic properties of various substances associated with the processing and utilization of coal and, although the products of coking, petroleum refining, coal pyrolysis and coal combustion are not identical to those of coal conversion, similar compounds may also be present in coal conversion processes. To assess the risks that may be associated with this developing technology and to provide guidance for developing cleanup systems, a project has been initiated to evaluate the relative cytotoxicity, mutagenicity, and carcinogenicity of various effluents from low Btu gasifiers. A multi-tiered approach is being utilized whereby initial in vitro screening of effluents is done using bacterial and mammalial screening procedures. Selected materials found potentially hazardous from in vitro tests will be further evaluated in whole animal inhalation studies. Changes in lung cell biochemical function will be assessed and compared with histologic alterations occurring at similar times after inhalation exposure. Of primary interest will be the relative carcinogenicity of materials studied. It is anticipated that results from these studies will assist in the establishment of adequate health protection standards and identification of required control technologies.
Keywords: low btu gas; gas generators; coal gasification; health hazards; coal gas; carcinogenesis; mutagenesis; toxicity; screening; in vitro; in vivo; inhalation; lungs; hydrocarbons.

106703 Retention of Aerosols from Coal Technologies. Snipes, M.B. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002678. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$175,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

At several stages of the various energy cycles utilizing coal, the potential exists for release of respirable particles to the atmosphere where they can be inhaled by man. Particle size and composition influence where particles deposit in the respiratory system and how long they stay there. Soluble particles are usually rapidly dissolved and the particle constituents removed from lung; relatively insoluble particles are subjected to physical and biological phenomena which lead to their removal or relocation. Considerable information is available on long-term retention of deposited particles. In this project, well-defined monodisperse particles and selected field collected effluents are used to determine long-term retention patterns to provide predictive information on inhaled particles of all types. Particle diameters ranging from ultrafine to several microns to cover the range of respirable particle sizes encountered in the environment are studied. Future studies will emphasize the use of toxicants adsorbed onto particles and a determination of their retention in lung and metabolic fate when cleared from the lung. Correlations will be made between information from studies with laboratory-produced aerosols and field collected effluents and field observations.
Keywords: aerosols; coal industry; air pollution; man; health hazards; inhalation; metabolism; particles.

106704 Immune Impairment for Inhaled Radionuclides. Bice, D.E. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002685. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Chronic pulmonary irradiation from inhaled radionuclides has been shown to severely depress systemic immune responses. This project investigates the effects of irradiation on the function of lymphoid tissues associated with the lung. Inhaled insoluble radioactive particulates tend to accumulate in tracheobronchial lymph nodes and in bronchus-associated lymphoid aggregates. Our studies will determine if an accumulation of radioactive particles in these tissues will result in a loss of local immunologic function even when levels present are not sufficient to produce a systemic depression of immunity. These lymphoid tissues are the first site at which protective immune responses would be produced against antigens released from primary lung tumors. A loss of their function could allow early tumor growth in the lung without recognition by immunosurveillance mechanisms. Current studies will provide data concerning immunologic responsiveness of lymphocytes in lung-associated lymphoid tissues after inhalation exposure to insoluble 239PuO2 particles. At various intervals after exposure to radioactive particles, animals will be immunized by aerosols of particulate antigens and immunologic responses evaluated. Future studies will be designed to determine if animals with compromised lung immunologic mechanisms have a higher incidence of lung tumors following exposure to carcinogens.
Keywords: radioisotopes; inhalation; biological radiation effects; lungs; immunosuppression; lymphocytes; plutonium 239; ionizing radiations.

106705 Insulation: Carcinogenic and Fibrogenic Materials. Pickrell, J.A. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002667. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Conservation of energy is an important part of our national energy policy. Implementing this policy will require increased use of insulating materials including fibers of glass, rock wool and ceramic materials. Our current knowledge of the fibrogenic and carcinogenic properties of these materials and binders used in their commercial application is inadequate considering their increasingly widespread utilization. Potential insulation material toxicants are being inventoried and assigned priority for study in multi-tiered toxicological tests. High priority is assigned to studies of phenol formaldehyde resin binder and glass fibers. In vitro cytotoxicity tests will be performed with alveolar macrophages and type II epithelial cells. Inhalation studies with binder and fibers in varying size and concentrations will be conducted in rodents. These will be used to establish deposition and retention patterns as a prelude to evaluating health effects. Serial sacrifice studies are planned to define morphologic changes. Biochemical changes will define indicators of early damage and correlate them to in vitro studies. Biochemical indicators of connective tissue changes will be correlated to development of fibrosis and neoplasia. The studies will be used to define potential lifespan toxicity studies. If necessary for extrapolation of data to man, limited studies will be conducted in non-rodent species.
Keywords: thermal insulation; carcinogenesis; fiberglass; mineral wool; ceramics; energy conservation; toxicity; rats; health hazards; biological indicators; biological models.

106706 Cytotoxic, Mutagenic and Carcinogenic Effects of Energy Related Agents in Diploid Human Cells which Differ in DNA Repair Capacity. McCormick, J.J. (Michigan State University, Carcinogenesis Laboratory, Fee Hall, East Lansing, MI, 48824). **Project number:** 007702. **Contract:** ER-78-S-02-4659. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: Coal(40); oil and gas(20); oil shale(20); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

A quantitative system has been perfected to measure the cytotoxicity of chemicals and radiation in diploid human cells in culture and the frequency of induced mutations. The system has been adapted to diploid cells derived from persons with genetic predisposition to cancer and defective capacity for DNA repair. Studies to date indicate a direct relationship between the cells' capacity to repair damage to DNA and the cytotoxic and mutagenic response and demonstrate that, in contrast to the response of commonly employed aneuploid mammalian cell lines, no measurable increase in mutations is induced by several agents at doses which yield a shoulder on the survival curves of normally repairing cells. Using diploid human fibroblasts with different capacities for DNA repair, we will: (1) investigate the relationship between threshold doses for cytotoxicity and mutagenicity and the ability of cells to repair lesions in DNA caused by low doses of energy-related chemicals and radiation; (2) quantitate the number and kind of chemical adducts remaining bound to the DNA of cells at critical times following exposure to determine the correlation between these adducts and the cytotoxic and mutagenic effects of the chemicals; (3) measure the cytotoxic effect of selected industrial carcinogenic metals in human cells and determine whether they can induce mutations and/or transformation; and finally, (4) investigate the cytotoxic and mutagenic effect of these energy-related agents in diploid fibroblasts derived from a series of selected mammals in order to compare the results with those determined above.
Keywords: cytology; mutagenesis; carcinogenesis; chemical effluents; man; animal cells; dna; biological repair; biological effects.

106707 Molecular Mechanisms of Mutagenesis and Carcinogenesis. Ptashne, M.S. (Harvard University, Biological Laboratories, 16 Divinity Avenue, Cambridge, MA, 02138). **Project number:** 007467. **Contract:** EE-77-S-02-4366. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

A variety of experiments designed to elucidate the molecular mechanisms of SOS induction by carcinogens in bacteria will be pursued. Initially, the SOS-induced proteolytic cleavage of repressor in bacteriophage lambda will be studied. Some of the questions explored are: (1) at which amino acid is the repressor cleaved; (2) can the reaction be observed in vitro and what protease is involved; (3) what signal (presumably a DNA product) sensitizes repressor or activates protease; (4) is this signal produced in higher organisms in response to carcinogens; (5) is a protease similar to the coli protease activated in higher cells in response to carcinogens; (6) will antibodies directed against the proteolytic sensitive site on phage repressors react to other SOS repressors in bacteria, enabling us to identify and isolate those repressors; and (7) will those antibodies identify similar repressors in cells of higher organisms.
Keywords: mutagenesis; carcinogenesis; biological models; bacteria; biochemical reaction kinetics.

106708 Impact of Energy-Related Pollutants on Chromosome Structure. Rill, R.L. (Florida State University, Institute of Molecular Biophysics, Tallahassee, FL, 32306). **Project number:** 007791. **Contract:** EP-78-S-05-5888. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$22,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The general objective is to describe the effects of pollutants from fossil fuel production and utilization on the structure and function of chromatin, and to thereby aid in achieving a basic understanding of the mutagenic, carcinogenic, or otherwise harmful effects of these agents. The approach will involve determinations of (a) the rates of incorporation of real and model pollutants into nuclei, chromatin, and DNA; (b) the chemical nature and amounts of various DNA pollutant and protein-pollutant adducts formed; (c) the specificity of various pollutants for structurally distinctive regions of chromatin; and (d) the effects of the above modifications on chromatin structural parameters. Reagents chosen for study include bisulfite ion, several alkylating agents, activated aromatic amines, and aromatic heterocycles. Explanation of harmful effects of pollutants on gene expression must take into account the structural and functional diversity of the natural substrate, i.e., chromatin. Techniques have been developed in this laboratory for the large scale isolation of a variety of chromatin fragments characteristic of fundamental structural subunits of chromatin (nucleosomes), as well as fragments from functionally and structurally distinct chromatin regions. These techniques, and our experience in physical/biochemical methods for studying macromolecular structure, will permit determination of the principal target areas of pollutants within chromatin and specific impacts of the adducts formed on chromatin structure and function.
Keywords: chromatin; molecular structure; air pollution; carcinogenesis; metabolism; chemical effluents; dna; cell nuclei; alkylating agents; aromatics; amines; sulfites.

106709 Animal Tests for Mutagens. Kohn, H.I. (Harvard Medical School, 50 Binney Street, Boston, MA, 02115). **Project number:** 007996. **Contract:** EP-78-S-02-5074. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Using the H-test (histocompatibility loci, mouse), effluents from energy producing systems (especially, based on coal) will be screened for mutagens that act on the germ cells. Spermatogonia will be tested first. The first step is to calibrate the system with a known mutagen, triethylenemelamine (TEM), that will serve as a standard of comparison and that previously was shown to induce mutations. Previously, the H-test scored only 1/60th the x-ray induced mutation rate demonstrated by the 7-locus tests. The H-tests screen more than 35 loci. It is important to judge the mutational hazard in terms of a variety of loci, since the final estimation of risk must be a summary estimate for the entire genome.
Keywords: mutagenesis; biological models; chemical effluents; mice; spermatozoa; mutagen screening; combustion products.

106710 Sulfate Formation in Oil Fired Power Plant Plumes. Dietz, R.N.; Garber, R.; Newman, L. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 09168. **Contract:** RP1000-1. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). Environmental Assessment Dept. **Funding:** EPRI-$259,000.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This research program was undertaken to provide an understanding of the formation of sulfate in the emissions from oil-fired power plants and the conditions controlling this formation. This program is being carried out on two parts. One part is a detailed study of the emissions from an oil-fired power plant and how plant operating conditions affect the composition of these emissions. The emissions study requires sampling the power plant exhaust gases at several locations in the plant under a variety of plant operating conditions. The resultant samples are analyzed for sulfate, sulfuric acid, sulfur dioxide, particulate loading, oxygen, carbon monoxide, carbon, and the principal metals in the particulates. The results from this part of the program are expected to show the conditions which affect the in-situ formation of sulfate and sulfuric acid. The second part of the program is a study of the mechanisms governing the change of sulfur species in the plume of the same power plant as the plume travels downwind for up to 50 to 100 km. An aircraft equipped with a special filter-pack assembly and certain real-time monitors (SO2, temperature, humidity, etc.) traverses the plume in the crosswind direction at several distances from the stack--typically 1/2 to 10 miles. Samples are analyzed primarily for SO2 and total sulfate in order to document the mechanisms of chemical transformation and/or particulate fallout. The samples are collected under various meteorological conditions which may have an influence on the plume chemistry.
Keywords: fossil-fuel power plants; exhaust gases; sulfates; chemical reaction yield; air pollution; plumes; sulfur dioxide; chemical reaction kinetics; gaseous wastes; sulfuric acid; particles; oxygen; carbon; carbon monoxide; synthesis; chemical analysis.

106711 Hemopoietic Toxicology. Hays. (University of California at Los Angeles, Los Angeles, CA). **Project number:** 002556. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Cadmium, chromium, and copper ions are found, in low levels, as environmental contaminants. It is known that these metal ions in the environment can affect biological functions. The sometimes disastrous effects which excess amounts of these trace metals have on the structure and function of the liver, kidney, bone and enzyme systems have been studied. There is some evidence that these metals may play a role in modifying normal immune responses. However, comprehensive, systematic investigations of the effects of these ions on the immune response mechanisms are lacking. We propose to investigate alterations of immune response using a mouse system to further define the potential hazards of exposure to heavy metals in the environment. A number of in vitro immunological tests will be employed by which in vivo changes in the immune system of exposed mice will be measured. Alterations of cell mediated immunity will be examined by mixed lymphocyte cultures (MLC) and cell mediated cytotoxicity (CMC). Suppression of t-cell and b-cell func-

tion will be evaluated by mitogen stimulation of lymphocytes in microculture. Alterations in the ability to mount an antigen-antibody response will be measured by humoral cytotoxicity of immune mouse serum to histocompatibility antigens.
Keywords: toxicity; cadmium; chromium; copper; metabolism; liver; kidneys; skeleton; enzymes; mice; biological effects; immunology.

106712 Toxicological Coal Assessment. Wallace. (Dept. of Energy Morgantown Energy Technology Center, Morgantown, WV). **Project number:** 002652. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The Morgantown Energy Research Center and the West Virginia University School of Medicine have been collaborating over the past year to design and detail a program of biomedical and toxicology studies of potential products, effluents, and fugitive emissions of low Btu coal gasification processes, fluidized bed combustion processes, and other fossil energy extraction, conversion, and utilization processes under research or development. Twenty-three members of the WVU School of Medicine have participated in the initial design of a program to develop and apply some twenty-five bioassays to determine the potential pathogenic effects of selected products and effluents obtained from the MERC gasification and combustion programs. The full set of proposals, written in neuroscience, pathobiology, pulmonary studies, and endocrine carcinogenesis groupings has been submitted to ERDA-DBER and reviewed. A management plan delineating MERC and DBER management responsibilities has been prepared and approved by the Director of MERC and the ERDA Assistant Administrator for Environment and Safety.
Keywords: coal; fluidized-bed combustion; coal gasification; low btu gas; health hazards; research programs; toxicity; recommendations; emission.

106713 Detection Atoms and Molecules. Hadeishi. (Lawrence Berkeley Laboratory, Berkeley, CA). **Project number:** 002693. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The goal of this project is to develop an electro-optical analysis technique that measures with a high degree of specificity and sensitivity atoms and molecules encountered in energy conversion processes. Our main emphasis will be on measurement of physical and chemical properties of energy-related effluents which have potential adverse health or environmental effects; also methods will be developed for in-situ measurement of energy conversion processes to better understand the physical and chemical processes taking place.
Keywords: atoms; molecules; quantitative chemical analysis; electro-optical effects; synthetic fuels; chemical properties; physical properties; health hazards; chemical effluents; environmental impacts.

106714 Coal--Oil Mixtures Toxicology. Raabe, C. (Univ. of California at Davis, Davis, CA). **Project number:** 002793. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$185,000.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Biological effects of pollutants in experimental systems.

This research addresses the problems associated with potentially toxic emissions which are associated with various stages of coal conversion processing for the production of synthetic oil or gas with emphasis upon the potentially carcinogenic polynuclear aromatic hydrocarbons. Although there are no near full-scale demonstration plants now producing synthetic oil or gas, coal tar volatiles similar to those expected in coal conversion are present in coke ovens currently in use in various industries. These studies address the physical and chemical characterization and biological testing of emissions from a representative coke oven system at a steel mill in the western U.S. These results will contribute directly to planned coal conversion systems with respect to extending our understanding of the toxic species in potential fugitive emissions. Chemical characterization will be done on the basis of aerodynamic size distribution to identify the specific species associated with the respirable fraction of released and condensed hydrocarbons which in the past have been epidemiologically implicated to the high incidence of lung, bronchial and tracheal cancer as well as cancer of digestive organs and peritoneum in coke oven-workers. Following physical and chemical characterization, a system will be developed to generate surrogate aerosols for use in laboratory studies designed to identify and evaluate the relative importance of selected chemical species. Biological exposure studies will proceed in parallel to the characterization studies. This will be begun with field collected samples and isolated hydro carbon fractions. Biological testing will include inhalation, ingestion and dermal exposures of small rodents. Since exposure to combinations of inorganic particles and polynuclear aromatic hydrocarbons have been reported to be more toxic than these agents individually, we will also study particle-carcinogen synergisms.
Keywords: toxicity; coke ovens; emission; polycyclic aromatic hydrocarbons; physical properties; chemical properties; aerosols; rats; biological effects; inhalation; ingestion; synergism; exhaust gases.

106715 Physics and Chemistry of Pollutant Interactions in the Environment. Ross, A.B. (University of Notre Dame, Notre Dame, IN). **Project number:** 002816. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purposes of this project are to collect and evaluate quantitative data on photochemical reactions and to make this data available to scientists who have an interest in the generation and/or the use of such data. Approaches used will be similar to those currently being used by the Radiation Chemistry Data Center (RCDC). Collection of bibliographic files of documents containing additional photochemical information will be required. Current coverage will be extended to forms of information available from photochemical experiments. Compilation and evaluation of data will be carried out by the data center staff members with assistance, as needed, by the research staff of the radiation laboratory. The collaboration of other scientists both inside and outside the laboratory will be sought in identifying areas suitable for critical assessment. External scientists will be invited to participate in critical assessment of data. The laboratory's excellent computer facilities will provide the necessary means for rapidly handling a wide variety of bibliographic and experimental information and for producing both hard copy and magnetically readable files of selected information for distribution to other users.
Keywords: photochemistry; information systems; data compilation; bibliographies; evaluation; data processing; air pollution.

106716 Radiation Protection Studies. McLaug, J.E. (Dept. of Energy Environmental Measurements Lab., New York, NY). **Project number:** 002839. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$178,000.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

Computational and experimental findings from other Radiation Physics Division projects are applied to selected problems in occupational radiation protection. The product, a publication of a method or a prototype instrument, is provided to the organizations that have the design or operational problem.
Keywords: radiation protection; occupations; nuclear physics; operation; nuclear power plants; health hazards.

106717 Environmental Evaluation Methods. McLaug, J.E. (Dept. of Energy Environmental Measurements Lab., New York, NY). **Project number:** 002840. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$662,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

Development studies are made to facilitate our characterization of man's radiation environment by computation, measurement, and monitoring. Direct or in situ methods for diagnosing the different components receive the primary emphasis. Radiation detector responses are determined, instruments are developed, and supplementary experiments and calculations are performed. Cooperative studies on environmental radiation are made and, when feasible, the field methods are adapted to studies of chemical particulate pollution.
Keywords: radiation detectors; radiation monitoring; environment; measuring instruments; calculation methods; pollution.

106718 Red Cell Membrane Toxicology. Celle, L.A. (University of Rochester, Rochester, NY). **Project number:** 002859. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$157,000.
Related energy source: Coal(50); nuclear fission(25); solar(25) **R and D categories:** Biological effects of pollutants in experimental systems.

The specific aims of this research include: (1) characterization of the role of calcium ion on erythrocyte ion permeability and its correlation to cellular deformability and flow resistance in normal and pathologic erythrocytes; (2) investigation of the effects of plasma proteins, physiologic levels of hormones, presence of heavy metals, exposure to uv and x-irradiation on rheologic properties of erythrocytes; (3) examination of leukocyte and platelet contributions to capillary flow and to capillary stasis; (4) studies of O2 transport to muscle cells as a function of hemoglobin oxygenation, concentration of organic phosphates, and pH PoO2, as well as hematocrit and flow velocity and studies of Po2 affecting the rheologic properties of the spleen; and (5) characterization of the mechanical properties of in vitro artificial membranes reconstructed of erythrocyte membrane

components in the attempt to model the mechanical/rheologic behavior of normal and pathologic erythrocyte membranes.

Keywords: erythrocytes; toxicity; cell membranes; calcium; pathological changes; permeability; membrane transport; ultraviolet radiation; x radiation; biological effects; proteins; physiology; animal cells; metals; leukocytes; blood platelets; oxygen; biological models; rheology.

106719 Delayed Effects of Radiation. Casarett, G.W. (University of Rochester, Rochester, NY). **Project number:** 002899. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$279,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is a systematic, multidisciplinary investigation, in mammals in-vivo, of: (1) the nature and mechanisms of development of the early unreversed or residual radiation injuries in cells, tissues, and organs; (2) the direct and indirect mechanisms by which these injuries lead in time to permanent and delayed radiation damage; (3) the manner in which this damage is involved in the pathogenesis of radiation-induced or temporally-advanced degenerative and neoplastic diseases, premature aging, and life-span shortening; (4) the nature and extent of the influence of damage or response of organs and tissues on the damage and recovery processes in other organs and tissues and the body as a whole following irradiation in various modalities (with respect to body parts irradiated, dose, and dose rate); and (5) postirradiation treatments for prevention or reduction of the permanent and delayed radiation effects. The correlated, multidisciplinary methodology (subcelluar, cellular, histologic, histochemical, biochemical, physiological, angiographic, radiographic, pathological, immunological, actuarial) is applied periodically in coordinated fashion to sacrifice groups and longitudinal study groups of animals to elucidate mechanisms of radiation effects and of natural disease development and aging from sequential events and processes occurring in parenchymal cells, supporting connective tissue cells and matrices, and vasculature and circulation throughout the life span.
Keywords: delayed radiation effects; animals; radiation injuries; animal cells; tissues; neoplasms; radioinduction; life span; dose-response relationships; organs; ionizing radiations; biological radiation effects.

106720 Radionuclide Energy and Damage. Mallie. (University of Rochester, Rochester, NY). **Project number:** 002905. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$113,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This program has been dedicated to the development of a biological dosimetry system which is capable of determining the dose delivered to critical organ systems in individuals exposed to ionizing radiation. Most often, physical or chemical techniques are used in the determination of the dose delivered to exposed individuals. A measurement is made in a radiation field in air, and from this measurement the dose delivered throughout the exposed individual is estimated. In more sophisticated studies, dose measurements are made within tissue-equivalent phantoms under conditions identical to those to be used with humans as treated in radiation therapy or in experimental animals. The only biological technique which has seen some use in both humans and animals, and which has been applied to accidental human exposures, makes use of cultured, circulating lymphocytes. However, this method has the disadvantage that it gives only an average dose, i.e., it does not specify the areas of the body which have undergone irradiation.
Keywords: ionizing radiations; dosimetry; animals; human populations; phantoms; radioisotopes; biological radiation effects; cell cultures; lymphocytes; radiotherapy; tissue-equivalent materials.

106721 Toxic Pollutants and Membrane Ion Transport. Shamoo. (University of Rochester, Rochester, NY). **Project number:** 002911. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$71,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We are investigating the mechanism of damage caused by the various environmental and energy-derived pollutants such as Hg2+, Zn2+, La3+, and Cd2+ on heart and skeletal muscle function, ion transport, and neuromuscular transmission. Studies are designed to correlate the biochemical interaction between various membrane-bound proteins, and their corresponding transport functions, with the various environmental factors and energy-derived pollutants mentioned above. This study will lay the ground work for the understanding of the mechanisms of damage to membrane structure and function, the dose required for such damage, and may yield to the discovery of chemical agents or treatments that act as antagonists to such toxicological compounds.
Keywords: pollution; toxicity; heart; muscles; biochemical reaction kinetics; proteins; membranes; mercury ions; zinc ions; lanthanum ions; cadmium ions.

106722 Organic Fluoride Toxicology. Smith, F. (University of Rochester, Rochester, NY, 14627). **Project number:** 002912. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$58,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The chemical stability of the C-F bond has been recognized for many years and it has been tacitly assumed that biological systems would be incapable of rupturing this linkage. However, there is a steadily growing number of reports describing the defluorination of a variety of organic fluoro compounds. In some instances, e.g., methoxyflurane, fluoride may be released in amounts sufficient to constitute a biological hazard. Other fluoro compounds have real or potential value as heat transfer agents or as dielectrics, and therefore may be of interest in energy cycles. There is a dearth of knowledge of the biological properties and C-F stability of such materials. Consequently, investigations into these aspects of prototype compounds such as trifluorethanol could be helpful in assessing risks associated with their use.
Keywords: organic fluorine compounds; biological effects; toxicity; research programs.

106723 Coal Gas/Combustion Effluent Assays. Wallace, W. (Morgantown Energy Technology Center, Morgantown, WV). **Project number:** 002948. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$76,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This project is designed to acquire, characterize and quantify samples of the potentially toxic particulate and liquid materials which might be released by low Btu coal gasification or fluidized bed combustion (FBC) of coals or other fossil fuels. Stream particulate sampling techniques will be developed, and the so-collected particulates will be analyzed to determine phase distribution, composition and surface properties for both organic and mineral components. Sampling and analysis of process and effluent streams, raw and aged, will be made on MERC units, including the 15 ton-per-day 42 inches internal diameter stirred fixed bed gasifier and its water-srubbed stream, and the one ton-per-day 18 inch internal diameter atmospheric fluidized bed combustors with cyclones, bag filters, or other clean-up devices in use. Low Btu gasifier bottoms will be supplied to Ames Laboratory for leaching studies. Particulates in the streams will be size classified and the particle cuts then characterized. Representative samples will be supplied for in vivo bioassays at MERC and the WVU School of Medicine.
Keywords: coal gasification; fluidized-bed combustion; combustion products; coal gas; chemical effluents; sampling; particles; particle size; gas generators; toxicity; phase studies; bioassay; chemical composition; surface properties; physical properties.

106724 Environmental Research Park in the Powder River Basin. (Idaho Operations Office, Idaho Falls, ID). **Project number:** 003011. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$16,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.
Keywords: environmental impacts; energy parks; terrestrial ecosystems; site selection; energy source development.

106725 Solid Waste to Methane Study, Pompano Beach Project. Fassel, V.A. (Ames Laboratory, Ames, IA). **Project number:** 003109. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to evaluate the possible environmental problems associated with the anaerobic digestion and production of methane from urban waste. In particular the effluent streams from the digestor will be characterized so that proper disposition can be recommended. Emphasis will be placed on possible ground water contaminants. Exit streams sampled will include the methane product gas, the filter cake and the filtrate. Major, minor and trace element levels will be determined. Microbiological characterization will include both bacterial and viral identification. Major classes of organic compounds present will be identified with more detailed analysis performed where needed. Since the carcinogenic level of the effluents is of major concern, an overall evaluation will be made using the Ames mutagenicity test. The specific issue within the water quality subtechnology is the possible contaminant of the ground water from digestion of urban waste as the most important concern. Other specific issues include characterization of

aromatic and aliphatic hydrocarbons, major, minor and trace metals and pathogens.
Keywords: solid wastes; municipal wastes; anaerobic digestion; methane; biosynthesis; florida; environmental impacts; chemical effluents; water pollution; ground water; quantitative chemical analysis; pathogenesis; carcinogens; hydrocarbons; metals; bacteria; viruses.

106726 Analysis of Products From the Combustion of Synfuels. Sharkey, A.G. (Pittsburgh Energy Technology Center, Pittsburgh, PA). **Project number:** 003213. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The principal objective of the program is to evaluate environmental factors associated with the combustion of synthetic fuels derived from coal. The approach consists of small scale combustion products of synthetic coal derived fuels. The combustion unit will process synthetic fuels at a rate of 5 to 30 gal/h. A coal derived boiler fuel will be combusted. Effluents from the combustion of the synthetic fuels will be characterized and monitored. The emissions from synthetic fuel combustion will be compared to the emissions produced from the normal combustion of No. 6 boiler fuel.
Keywords: coal fines; coal liquids; solvent-refined coal; fuel oils; slurries; combustion products; environmental impacts; emission; monitoring; gaseous wastes; chemical properties; physical properties; biological effects.

106727 Non-Nuclear Health Protection. White, O. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 003248. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$10,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This project involves the organization of an industrial hygiene working group for the purpose of reviewing research needs in this area for coal conversion technology and the development of a series of recommendations for research support. As part of this effort, a symposium on coal conversion industrial hygiene research requirements will be conducted at BNL, November 1978. The final report with recommendations is expected by January 1, 1979.
Keywords: coal gasification; coal liquefaction; health hazards; industrial medicine; information needs; preventive medicine.

106728 Exhaust Products from Alternate Fuels and Advanced Technology Engines. Horn, R. (Bartlesville Energy Technology Center, Bartlesville, OK). **Project number:** 003252. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The program would involve experiment with fuels and automotive engines as they are currently evolving in transition to more efficient fuels usage and utilization of alternative fuels. The objective is to generate, via experiment, information on the character and quantity of both regulated and non-regulated emissions from engines, fuels, and associated subsystems as technology and fuels usage evolve in response to energy-related objectives. The information would provide technical basis for judging and responding to the implications that fuels and engine technology development holds for automotive emissions; in parallel, the implications of emissions constraints for the course of energy technology development.
Keywords: internal combustion engines; automotive fuels; exhaust gases; chemical composition; quantitative chemical analysis; combustion products.

106729 Fractionation of Organic Samples from Hygas Pilot Plant. Cunningham, P. (Argonne National Laboratory, Argonne, IL). **Project number:** 003261. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

High Btu gasification of coal represents a rapidly developing technology whereby U.S. coal reserves may be converted into energy in an environmentally acceptable manner. Several pilot plants, using somewhat different processes for coal gasification, have operated for the last several years. Demonstration scale plants are currently in various stages of design. A need exists to show that these emerging coal gasification technologies present acceptable risks to the environment and human health. This program will chemically characterize process streams from coal gasification pilot plants with the objective of identifying and quantitating the amounts of any toxic components. The program will interact in parallel with ANL activity 62200, RPIS No. 108, dealing with cell tester measurements of toxicity and mutagenicity of coal gasification process streams. ANL 62200 will also measure cell tester system responses to chemical class fractions of the process streams produced by the characterization program described herein. These cooperative efforts are designed to provide a timely measure of toxicities of coal gasification process streams, and to lead to an identification of individual chemical compounds responsible for toxic effects.
Keywords: hygas process; process solutions; chemical effluents; chemical composition; toxicity; pilot plants.

106730 Develop On-Line Aerosol Sizing Mass Monitoring Instrument. Guthals, P. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** 004069. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective of the second year's work will be to repackage and harden the instrument for field use on mobile platforms. A probe for isokinetic air sampling from aircraft platforms to match aircraft velocities and instrument sampling velocities will be built. A data readout and recording system will be added to the instrument. Additional work on model verification will also be undertaken. The instrument will be used to measure the size distribution of aerosols in the respirable range in urban and power plant environments. The data will be used to aid in understanding the atmospheric chemical and physical processes which produce aerosols. The basic instrument has been constructed, tested in the laboratory, and successfully operated on a few trial runs aboard manned balloons, aircraft, and automobile platforms. The instrument performance has been modeled so that the observed data can be interpreted more correctly when ambient operating pressures, temperatures, and sampling rates are different from those used for laboratory bench calibration. Mass distributions are measured for ten aerosol ballistic equivalent size ranges from 25 micrometer diameter.
Keywords: aerosols; on-line measurement systems; design; performance; particle size; fossil-fuel power plants; urban areas; aerial surveying; measuring instruments.

106731 Heterogeneous Chemistry of Importance in Decisions Concerning Environmental Impact of Energy Product. Castleman. (University of Colorado, Boulder, CO). **Project number:** 007251. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$94,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Decisions concerning the siting of both coal and oil fired power plants require models which can be used in predicting the effects of pollutants on the environment, their impact on the health of individuals in surrounding communities, and their possible role in regional inadvertent pollutant interaction with other atmospheric constituents as well as by the factors influencing their airborne lifetime. Since these aspects are governed by the interconversion of the various chemical and physical states of the pollutants, the development of comprehensive realistic models requires a detailed understanding of the homogeneous and heterogeneous reactions responsible for their nature and behavior. One of the least well understood aspects of tropospheric chemistry concerns mechanisms and rates of aerosol formation, and the role of particles in heterogeneous phenomena; this proposal is directed to providing requisite data on these processes. Specifically, the work proposed herein constitutes a three-year effort addressed to: (1) association reactions of importance to tropospheric chemistry; (2) heteromolecular clustering of neutral species, their growth and photochemical stability, and aerosol formation; and (3) investigation of the role of aerosol surfaces on the chemistry of pollutants emanating from coal and oil fired power plants.
Keywords: fossil-fuel power plants; coal; fuel oils; aerosols; chemistry; troposphere; chemical reactions; photochemistry; agglomeration; surface properties; growth; air pollution.

106732 Standardization of Environmental Analysis Associated with Increased Energy Production. Lafleur. (National Bureau of Standards, Gaithersburg, MD). **Project number:** 007254. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$109,000.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to provide standard materials for use in quality assurance by DOE laboratories, BER contractors and others in order to increase the reliability and accuracy of analyses of environmental samples. To do this, the National Bureau of Standards prepares synthetic or surrogate standards, analyzes them and distributes them to approximately 12 laboratories for round robin testing. Results are compiled and discussed at twice-yearly meetings. To date, five surrogate materials have been issued plus a shale oil shale to be analyzed for five components. The FY 1979 program will continue work on shale oil and initiate work in the coal conversion area.
Keywords: environmental materials; quantitative chemical analysis; standards; comparative evaluations; shale oil; coordinated research programs.

106733 Proposal for Partial Support of the Subcommittee on the Geochemical Environment in Relation to Health and Disease. Petrie, W. (National Academy of Sciences, Washington, DC). **Project number:** 007411. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$17,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The Subcommittee on the Geochemical Environment in Relation to Health and Disease itself held no meetings during this period, but it sponsored a meeting on January 16, 1979, to discuss the status and national needs related to the health effects of asbestos and other fibrous materials. At that meeting, invited representatives from government agencies and industry-related associations met with subcommittee and staff members to discuss and determine consensus that a panel study is needed to define these hazardous materials and to identify and differentiate those aspects, such as size of fibers, that will help set up standards of risk. A brief prospectus was distributed to those present and others interested. Proposals were prepared and sent to USBM, USGS, DOE, NSF, and the Navy Department. Proposals to EPA and the health agencies are contemplated. The panel report, Geochemistry of Water in Relation to Cardiovascular Disease (POWC), the first of four from existing panels, was sent to the Office of Publications on January 26 and publication is expected in mid 1979. The PECH report, Trace Element Geochemistry of Coal Resource Development Related to Health, is undergoing intensive review and the resolution of minor problems. The report is now scheduled for publication late this summer. There was little progress on the POGU reports of the Panel on Aging and the Geochemical Environment and the Panel on Geochemical Environment and Urolithiasis.
Keywords: meetings; health hazards; asbestos; particles; aerosols; particle size; cardiovascular diseases; epidemiology; coal industry; age groups.

106734 Oil Shale Data Planning Committee. Heistand, R. (Development Engineering, Inc., Rifle, CO). **Project number:** 007738. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

Development Engineering, Inc. (DEI) has leased the facilities and is conducting mining and retorting activities at the U.S. government's Anvil Points oil shale research facilities near Rifle, Colorado. Contractors for several U.S. government agencies have conducted various environmental, health, and safety programs at the Anvil Points site. DEI will compile the data from these programs and submit it to an oil shale planning committee organized by the DOE Division of Biomedical and Environmental Research. DEI will also provide assistance to the committee in reviewing this data and developing research activities at the Anvil Points site. DEI will prepare a final report containing a compilation and evaluation of the data base subject to the provisions of the Anvil Points lease agreement dated April 24, 1972.
Keywords: oil shales; information systems; environmental impacts; health hazards; safety; information needs; anvil points research facility.

106735 *Distribution of Marine Birds on the Mid-Atlantic* U.S. Outer Continental Shelf. Powers, K.D. (Manomet Bird Observatory, Manomet, MA). **Project number:** 007740. **Contract:** 79-EV04706. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$67,000.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to provide a quantitative statement of the distribution in time and space of seabirds in the northwest Atlantic, particularly in the Georges Bank area. Trained observers of opportunity and ships of opportunity are being employed to achieve an extensive, low cost data set on these distributions, which, when complete, will permit a direct assessment of large scale impacts due to oil exploration, extraction, and transport. Twenty data sets were obtained in 1977 and more than ten, as well as two quarterly progress reports, are available for 1978.
Keywords: birds; aquatic organisms; continental shelf; atlantic ocean; population dynamics; petroleum.

106736 Trace Metal Characterization and Speciation in Geothermal Effluent. Kowalski, B.R. (University of Washington, Seattle, WA). **Project number:** 007952. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$45,000.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

This is a proposal to evaluate the potential impact of geothermal power plants on ground water quality by studying the chemical forms and species of trace metals in geothermal brines. Speciation is an important factor in biological availability. New sample pretreatments, separating, and electrochemical techniques will be employed. Arrangements have been made for field studies in conjunction with the specific geothermal site studies.
Keywords: geothermal fluids; environmental impacts; geothermal power plants; waste disposal; brines; chemical composition; trace amounts; metals; voltametry; absorption spectroscopy; water quality; chemical analysis; water pollution.

106737 *Myocardial Perfusion Scintigraphy Using a New Technique, the Mesh Chamber.* Osborne, L.S. (Massachusetts Institute of Technology, Cambridge, MA, 02139). **Project number:** 007953. **Contract:** 79-EV04969. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$121,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

Myocardial perfusion scintigraphy using a new technique, the Mesh Chamber, is a nuclear medicine proposal to study myocardial perfusion scintigraphy for detection of coronary heart disease. Osborne has designed an improved positron emitting tracer with better sensitivity and spatial resolution than present detectors. This should allow better detection of localized tissue anemia and diagnosis of coronary artery disease at a lower radioactive dose to the patient.
Keywords: myocardium; scintiscanning; perfused organs; nuclear medicine; cardiovascular diseases; tracer techniques; spatial resolution; detection; anemias; diagnostic techniques; radiation doses.

106738 Development of Laser-Excited Molecular Luminescence Spectrometric Methods for Polynuclear Aromatic Hydrocarbons. Winefordner, J.D. (University of Florida, Gainesville, FL, 32601). **Project number:** 007954. **Contract:** 79-EV06022. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$69,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This project proposes to develop analytical methods for polynuclear aromatic hydrocarbons by laser-excited molecular fluorescence and phosphorescence spectroscopy. Several methods, including new fluorescence detectors for GC and LC and room temperature phosphorimetry will be studied, evaluated and tested on real environmental samples. Special instrumental techniques will be used to improve sensitivity and selectivity.
Keywords: polycyclic aromatic hydrocarbons; spectroscopy; environmental materials; chemical analysis; luminescence.

106739 Characteristics and Environmental Investigations of DOE's Anaerobic Digestion Facility. Sengupta, S. (University of Miami, Miami, FL). **Project number:** 007991. **Contract:** 79-EV10133. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$7,000.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

Environmental and process analyses of DOE's anaerobic digestion facility at Pompano Beach will be conducted. Particular emphasis will be placed on the digestion process itself. Characterization and measurement of all inputs and outputs will be made in relation to process parameters. The primary areas of interest will be: input municipal waste and sludge, filtrate, filter cake, leachates and output gases. The thrust of the investigation will be directed toward evaluating the environmental and process characteristics of the anaerobic facility itself and not the front end processes and facilities such as trucks, shredders, classifiers, etc., the objective being evaluation of the process in terms of environmental viability. Since the emphasis of the study will be in relating effects of inputs and process parameters on output liquids, solids and gases, co-operation in experimental protocol development and information exchange with Waste Management, Inc. engineers is imperative. The first phase of the project will include efforts in establishing channels of information exchange and co-operation. The efforts will be divided into five integrated parts, viz. solids and liquids, gas analysis and air quality, trace analysis and groundwater quality. Trace and ultratrace analysis for heavy metals and organics will be conductedby Ames Laboratory, US DOE. All other components will be executed by the University of Miami team. The data from chemical analysis inputs and outputs will be used to obtain insights into the process chemistry and its sensitivity to input and operating variables. A feedback of information will allow optimization of the process. A three year study is proposed beginning September 1, 1977. Part of the first year will be used in obtaining baseline data, debugging of instrumentation and experimental protocol. Immediately after the plant starts operation, the emphasis will shift to obtaining information directly relating to the process, in order to identify environmental problems (if any), possible methods of solution, and optimization of the process characteristics.
Keywords: solid wastes; municipal wastes; anaerobic digestion; environmental impacts; florida; methane; biosynthesis; chemical effluents; air quality; gas analysis; water quality; ground water; quantitative chemical analysis; trace amounts.

106740 Nature of Nitrogenous Pollutants of In Situ Oil Shale Processes. Yen, T.F. (University of Southern California, Los Angeles, CA). **Project number:** 007993. **Contract:** 79-EV10017.000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$17,000.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

This proposal addresses the toxic and carcinogenic nitrogen compounds formed in in-situ oil shale retorting. In laboratory studies, nitrogen compounds will be separated, characterized and identified, interactions and transport will be studied, and the implications of long term storage in burned retorts will be evaluated.
Keywords: oil shales; in-situ retorting; nitrogen compounds; toxicity; carcinogens; environmental transport; chemical composition; shale oil; waste storage; chemical reaction yield; shale oil.

106741 Report on Research Program Under Manhattan District. Friedell. (Case Western Reserve University, Cleveland, OH). **Project number:** 007994. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The study consists of a one-year project to compile a technical history of biological and medical research activities conducted in the 1941 to 1950 era under the Manhattan District up to the establishment of the Atomic Energy Commission, Division of Biology Medicine. Much of the research was conducted under Security Regulations, but most of the documentation has been declassified but never compiled as a useful report. The project includes compilation and publication of information after reviews by peer reviewers and DOE staff.
Keywords: biological radiation effects; reviews; nuclear medicine; data compilation; data analysis; research programs; ionizing radiations.

106742 Analytical Applications of Resonance Ionization Spectroscopy. Hurst, G.S. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 002391. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant measurements technology.

Resonance ionization spectroscopy is the name that has been given to a newly discovered and unique technique which we believe holds vast promise in the area of analytical spectroscopy. The technique is based upon the use of precisely tuned energy sources (primarily lasers) to excite gaseous atoms or molecules into ionic states wherein their detection is possible by charge-counting methods. The excitation is a multistep photoionization process providing extreme specificity in the measurement. The RIS technique itself is characterized by extreme sensitivity. We have demonstrated the detection of single Cs atoms by RIS. This technique was conceived and has been verified experimentally as part of our program in activity No. RT 04 02, which is directed at the fundamental interaction of charged particles with matter. We anticipate that the work will continue. The project suggested herein will focus on the utility of RIS for chemical analysis, seeking to develop and expand upon the fundamental and experimental work that has already been done and to provide the experimental basis for designing and constructing RIS instrumentation. Resonance ionization spectroscopy will be studied and developed as a means for detecting a variety of atoms at the few or single atom level. The technique will then be developed and applied to measurement problems for which existing technology is inferior or does not presently exist. The applicability of the RIS technique to the detection and determination of sodium or lithium in inert gas will be evaluated. These applications are ideal for initial investigations and the analytical methods when developed can be applied to LMFBR and CTR environmental monitoring. Since RIS, as presently conceived, is best applied to atoms in the vapor state, we also plan to investigate the chemical dissociation of vapors followed by an RIS determination of the atomic species that are formed from dissociation. We fully expect that numerous other unique applications of RIS will emerge as the proposed research progresses.
Keywords: laser spectroscopy; chemical analysis; sodium; lithium.

106743 Transport of Toxic Elements. Coleman. (University of Rochester, Rochester, NY). **Project number:** 002900. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The toxic metals released by coal usage are expected to reach humans in food as well as in airborne forms. We have been engaged in research on the absorption of an essential heavy metal, calcium, by the intestine and have developed methods and techniques which permit us to analyze the operations of the individual intestinal cells involved in the absorptive process. Our major goal is to elucidate the pathways followed by this essential divalent metallic ion, during the normal absorption process, and to elucidate the mechanisms which control the absorption process. We propose to extend this work to examine the effects of toxic metals released by coal usage on the normal structures and function of intestine. We intend to elucidate the pathways by which these toxic elements pass the epithelial barrier of the intestine and to determine whether the intestine plays a role in the excretion of these materials.
Keywords: coal; combustion; health hazards; fossil-fuel power plants; metals; intestinal absorption; calcium; cations; metabolism; excretion; environmental transport.

106744 Evaluation of the Tumorigenic Enhancing Potential in Liver of Polycyclic Aromatic Hydrocarbons. Peraino, C. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 004011. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$84,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Studies in this laboratory have shown that dietary phenobarbital enhancers hepatic tumorigenesis in rats previously fed 2-acetylaminofluorene (AAF). This sequential treatment procedure has proven useful for examining the ability of a variety of agents to act as tumorigenic enhances in liver. The present study is designed to examine the possibility that this procedure might be useful as a means of screening energy-related pollutants (namely, polycyclic hydrocarbons) for such enhancing activity. The hydrocarbon chosen for the initial study is benz(a)anthracene, a compound with little or no intrinsic tumorigenic activity. Preliminary experiments showed that benz(a)anthracene resembles phenobarbital in its stimulatory effect on liver DNA synthesis and liver growth. When benz(a)anthracene was fed at a dietary concentration of 0.02%, following AAF feeding, no tumorigenic enhancement was observed. Subsequent experiments will involve the feeding of higher levels of benz(a)anthracene so that the enhancing ability of the hydrocarbon can be unequivocably evaluated.
Keywords: liver; metabolism; polycyclic aromatic hydrocarbons; toxicity; phenobarbital; carcinogenesis; benzanthracene; synergism; rats.

106745 Microdosimetry. Hayes, T.L. (University of California, Lawrence Berkeley Lab., 108 Donner Lab., Berkeley, CA, 94720). **Project number:** 004030. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Analysis of individual single pollutant particles found in association with biological surfaces (lung tissue and leaf surfaces) is carried out by rapid characteristic x-ray analysis in the scanning electron microscope. The individual particle data is essential if single cell exposure to foreign elements is to be estimated. Exposure of single cells, in turn, is of concern with respect to long term effects such as carcinogenesis where the initiating event may involve only a single cell. Automated procedures for the rapid mapping and semiquantitative analysis of single particles have been designed and the application of this system to the study of the interaction between fly ash particles (coal effluents) and the lung macrophage cell is being investigated. Measurement of matrix element and minor element concentrations in single particles, both on collection substrates and within the cell, has been demonstrated. The very large variation among individual particles with respect to the concentration of certain chemical elements means that the use of average concentrations as determined by multi-particle techniques does not yield an accurate estimate of the possible individual cell exposure. A very rapid mapping and analysis system is essential if a statistically significant number of single particles and single cell interactions is to be studied.
Keywords: microdosimetry; carcinogenesis; fly ash; aerosols; particles; coal; lungs; macrophages; biological effects; lungs; leaves; metals.

106746 Cellular, Mutagenesis and Carcinogenesis. Bartholomew, J.C.. (Lawrence Berkeley Lab., Laboratory of Chemical Biodynamics, Berkeley, CA, 94720). **Project number:** 004034. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$410,000.
Related energy source: Coal(100) **R and D categories:** Biological effects of pollutants in experimental systems.

We propose to learn how chemicals cause mutation and what role this process has in the neoplastic transformation of mammalian cells. Our approach is primarily to understand how chemical mutagens interact with DNA and chromatin. These studies include a determination of the structure of the complex between the mutagen and DNA. In particular, what effect does a mutagen have on the structure of DNA. How does a cell respond to the mutagen, and what role does the cell's metabolic system play in the interaction of the chemical with DNA. These studies will be carried out in model

systems, bacteria, and highly differentiated mammalian cells growing in culture. This project will characterize the present known mutagens. It should lead to predictions of the types of chemical structures which are the most dangerous mutagens. Our work has already suggested a number of assays for the detection of chemical carcinogens and it may allow development of compounds which can prevent mutations and inhibit chemical carcinogenesis.
Keywords: mutagenesis; carcinogenesis; animal cells; biological models; dna; chromatin; bacteria; mutagen screening; optimization.

106747 Optimize Filters and Stack Probe for Source Sampling. Tillery, M.I. (Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 004068. **Contract:** 78-BCG-3. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$70,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The objective is to design, fabricate and demonstrate a prototype particulate stack sampler which eliminates problem areas noted in EPA Method 5 (Manual Stack Sampling Method for Particulates). Features of the new design include higher sampling flow, lower weight in major components, built-in computing capability, automatic control of probe and filter heaters, single-point particle size separation in the nozzle, and stainless steel surfaces in contact with the sampling stream. Single-point particle size separation by variable-slit, virtual impactor within the nozzle is being characterized by aerosol studies under simulated stack conditions. Continuously-reading flow, pressure, temperature and moisture transducers permit periodic calculation and display of isokinetic factor and other important variables by a microcomputer/microprocessor system. Accuracy and ease of use will be demonstrated by laboratory and field demonstrations.
Keywords: aerosols; sampling; flue gas; air samplers; performance testing; power plants.

106748 Rapid Assays for Carcinogenic By-Products. Tennant, R.W. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 004086. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is directed at the development and evaluation of a mammalian cell system for the identification of potential carcinogens, and as a model system for study of the mechanism of chemical and radiation-induced tumorigenesis. A reproducible, quantitative focus assay for transformation of freshly isolated diploid Syrian hamster embryo cells by chemical carcinogens is the current objective. This method offers a direct estimate of carcinogenic potential in mammalian cells, and results can be verified by conventional tumor transplantation techniques. Various parameters of this assay method have been defined but the sensitivity of the method must be subject to stringent and exhaustive tests. This method will also be applied to an analysis of factors which influence the progression from the induced (premalignant) to the transformed state.
Keywords: carcinogens; hamsters; embryos; cell cultures; bioassay; response modifying factors; biological models; identification systems.

106749 Use of Selected Teratogenic Test Systems to Identify Hazardous Agents Associated with Nonnuclear Energy Technology. Russell, L.B. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 004090. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: Coal(80); nuclear fission(20) **R and D categories:** Biological effects of pollutants in experimental systems.

This project is designed to develop and use sensitive methods for detecting the effects of environmental teratogens in vivo in the mouse. Among chemicals to be tested, emphasis will be given to those related to coal-conversion and utilization technologies. By drawing on our earlier experience in radiation teratogenesis with regard to critical periods, and by utilizing a genetic strain of mice that is developmentally labile during certain of these periods, we are perfecting methodology for detecting small teratogenic effects induced during organogenesis. In addition, we are checking for teratogenic effects during the early period of totipotency, using survival as an indicator. Besides working on systems development, we have to date obtained results with one type compound of importance to coal-related technology, benzo(a)pyrene. We expect to identify other coal-related compounds that are teratogenic and to explore dose-effect relationships.
Keywords: coal; pollution; mice; teratogenesis; ontogenesis; dose-response relationships; benzopyrene; in vivo.

106750 Alveolar Clearance of Inhaled Metal Oxides. Sanders, C.L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 004110. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: Coal(70); oil and gas(30) **R and D categories:** Biological effects of pollutants in experimental systems.

Combustion of fossil fuels leads to atmospheric emission of a number of toxic trace metals, predominately in their oxide form. The purpose of this study is to examine both the acute and chronic toxicity of inhaled metal oxides in rodents. These studies will provide baseline data on metal oxide toxicity which will aid in the assessment of potential biomedical impact of the trace metal constituents of fossil fuel effluents such as fly ash.
Keywords: fossil-fuel power plants; chemical effluents; aerosols; lead oxides; mercury oxides; cadmium oxides; metals; inhalation; rodents; biological effects; toxicity; nickel oxides; carcinogenesis; fly ash; risk assessment; synergism; lungs; pathological changes; metabolism; acute exposure; lung clearance.

106751 Terrestrial Effects of Oil Shale Development. Wildung, R.E. (Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 001264. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$357,000.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

An interdisciplinary research approach taking unique advantage of PNL capabilities in petroleum chemistry, soil science, microbiology, and plant ecology is presently being applied to the study of the behavior and bioavailability of pollutants resulting from ground disposal of oil shale wastes. The principal objectives of this program are to: (1) develop a basic knowledge of important processes influencing the form, mobility, chemical and microbiological solubility and plant availability and toxicity of trace metals and organic residuals in retort waters and spent shales; (2) model the chemical reactions and transport of these materials through spent shale and soils; and (3) develop a rational basis for selection and subsequent laboratory and field testing of proper soil conditioners, irrigation waters, and native or agricultural plant species to result in permanent, safe, restoration of shale lands.
Keywords: spent shales; ground release; waste disposal; mobility; solubility; biochemistry; soils; chemical reactions; diffusion; land pollution; trace amounts; metals; waste water; land reclamation; organic compounds.

106752 Application of Holography to Aerosol Investigations. Hildebrand, B.P. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 004121. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This research project is aimed at investigating the usefulness of holographic methods to determine size, shape, distribution, composition and velocity of aerosols and particles contributing to pollution. These studies include a search for specific applications, design and fabrication of lightweight holocameras, and methods for automatic analysis of the hologram image. The goal for the proposed research is scientific instrumentation capable of quantifying the physical properties of particulates emitted by various sources. This would aid in the design of filter, scavenging systems and precipitators. The same instrumentation could provide other information such as deposition and re-entrainment rates of particles onto various surface (natural or artificial) ground cover, for example. Additional uses for such instrumentation might be for calibration of aerosol generators used for performing biological experiments determining the toxicity, of various pollutants. In many cases only indirect knowledge of the aerosol is available; size, shape and three-dimensional distribution is not well characterized. Since these physical properties have a bearing on toxicity, it is important to have a more precise determination of them.
Keywords: aerosols; holography; particles; air pollution; performance testing; toxicity.

106753 Laser Pumped Luminescence and Microwave Resonance (LPLMR) Spectroscopy and Absolute Mass Calibrations. Small, G.J. (Ames Laboratory, Ames, IA). **Project number:** 004137. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The broad objectives of this study are to develop the basic science, the investigative methods and the hardware so that the demanding analytical requirements associated with the characterization of organic and inorganic pollutants in effluents from energy generating sources can be met in a viable practical manner. Particular emphasis is devoted to the development of multipollutant analytical concepts and on the determination of ultratrace pollutants. Special attention is being placed on those inorganic and organic

pollutants which are or may be emitted from fossil-fueled energy sources and from coal liquefaction and gasification plants. Many of these pollutants are certainly health hazards, and some already identified are proven carcinogens. Two projects are supported: (1) laser pumped luminescence spectroscopy; and (2) absolute mass calibration of air particulate filters.
Keywords: laser spectroscopy; luminescence; microwave spectra; quantitative chemical analysis; air pollution; mass spectra; aerosols; particles; coal gasification plants; coal liquefaction plants; trace amounts; calibration; chemical effluents; multi-element analysis; mass spectroscopy.

106754 EPA, Beta Gauge and X-Ray Fluorescence Analysis. Jaklevic, J.M.; Goulding, F.S. (Lawrence Berkeley Laboratory, No. 1 Cyclotron Road, Building 70A, Room 2205, Berkeley, CA, 94720). **Project number:** 004036. **Contract:** 78 BCG. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$140,000.
Related energy source: Coal(60); nuclear fission(20); conservation(20) **R and D categories:** Pollutant measurements technology.

The program involves the design and construction of advanced x-ray instrumentation for air particulate analysis. Included are both energy dispersive and wavelength dispersive spectrometers and associated air sampling equipment. A beta-gauge mass monitor has also been developed and is undergoing continuing improvement. Our objective is to improve the existing design of the pulsed x-ray spectrometer. Included are higher counting rates, better energy resolution and improved mechanical design. Further developmental work on optimum excitation methods will be performed and implemented in the improved spectrometer design.
Keywords: x-ray fluorescence analysis; aerosols; particles; air samplers; x-ray spectrometers; design; air pollution monitors.

108000 Inventory of Federal Energy-Related Environment and Safety Research. Shriner, C.R. (Science Applications, Inc., 800 Oak Ridge Turnpike, Oak Ridge, TN, 37830). **Project number:** 003434. **Supported by:** Department of Energy, Washington, DC (USA). Office of Program Coordinator. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The Oak Ridge, Tennessee, office of Science Applications, Inc. (SAI) will provide work coordination and ensurance of overall performance for the Department of Energy's Inventory of Federal Energy-Related Environment and Safety Research project. This effort will include as a minimum: (1) collection of data through questionnaire dissemination to federal agencies and follow-up telephone contact to ensure response within a predetermined time schedule; (2) quality control and validation of all questionnaire data; (3) coordination of the data entry and keywording to be performed by DOE's Technical Information Center (TIC), Oak Ridge, Tennessee; (4) coordination of machine readable data collection from federal agencies, and provision of either hard copy or magnetic tapes of the data to TIC for merging with data keyed from questionnaires; (5) loading of the final Federal Inventory Data Base onto the SAI System 1022 Data Base Management System for on-line searching by DOE and approved DOE users (deliverable 45 days after receipt of final magnetic tape of the data from TIC); (6) provision to DOE of one camera-ready copy of Executive Summary, Interactive User's Guide, and Funding Summary Tables (deliverable 45 days after receipt of final magnetic tape of the data from TIC); (7) coordination with TIC in providing the format for the project listings and project indices; and (8) provision of response service (searches and reports) from the data base on request from DOE, and coordination of two workshops for users of the inventory.
Keywords: data compilation; management; environment; research programs; information systems.

***108001* Modular Exhibits.** Content, R. (Oak Ridge Associated Universities, Inc., Oak Ridge, TN, 37830). **Project number:** 004154. **Supported by:** Department of Energy, Washington, DC (USA). Office of Program Coordination. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant measurements technology.

This task provides for the operation and maintenance of four units of The Energy and The Environment Modular Exhibit. The Energy and The Environment is a 3' x 3', freestanding unstaffed exhibit. It provides information on some studies being done on the types, amounts, and hazard potentials of the possible pollutants from energy sources, such as nuclear and fossil fuels. Methods being developed to remove or neutralize any possible harmful effects of these pollutants are also outlined through color graphics and copy. The objective of the exhibit is to inform the American public of measures being undertaken to keep energy sources safe and environmentally acceptable. In operating the units, ORAU will schedule, promote, transport, show, maintain and report on twenty showings for each exhibit. The exhibit is suitable for a variety of sites, including shopping malls, fairs, conventions, expositions, and other locations where large numbers of people gather.
Keywords: exhibits; public relations; energy; environment; information; health hazards; environmental impacts; pollution; pollution control.

108002 Film on Land Reclamation. (Argonne National Lab., Argonne, IL). **Project number:** 003477. **Supported by:** Department of Energy, Washington, DC (USA). Office of Program Coordination. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This 15-minute film tells the story of the Macoupin County research project. The movie describes how this research activity is attacking environmental problems related to coal development. Funding is being provided to cover the cost of developing an announcement of this film's availability and to produce additional copies of the film. This will allow distribution of the film to universities, high schools, and citizens groups.
Keywords: land reclamation; coal mining; photographic films; environmental effects.

***108003* Americans for Indian Opportunity.** (Dept. of Health, Education, and Welfare, Washington, DC). **Project number:** 008230. **Supported by:** Department of Energy, Washington, DC (USA). Office of Program Coordination. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The work to be accomplished will focus on increasing the awareness mental health impact of development activities and of the need for planning for environmental and health protection. The project will assess the environmental and safety issues associated with the development of Indian lands. It will also assess the roles and responsibilities of different government agencies concerned with various aspects of environmental protection and individual safety. Finally, it will develop alternative models/strategies for environmental protection for use by various land-based Indian communities.
Keywords: american indians; indian reservations; energy source development; environmental effects; health hazards; social impact; safety; national organizations; land use.

110000 Cupola Furnace Modification. Alan. (Pennsylvania State Univ., 207 Hammond Bldg., University Park, PA, 16802). **Project number:** 11. **Contract:** AS02-76CS40028. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The purpose of this project is to use a pilot-scale cupola to develop an air injection system located above the tuyere line (hot air inlets) and below the top of the stock to: ignite off-gases to combust CO (carbon monoxide) to CO2 (carbon dioxide); absorb the heat of combustion in the stock; and to apply the system to three commercial size cupolas ranging from 42 inches to 96 inches in diameter. Results to date indicate that air injection will control CO evolution to 0.6% or less. This system will essentially eliminate the need for natural gas burners to combust CO external to the cupola. The projected decrease in coke consumption has not yet been determined. This project will help cupola foundries to meet EPA regulations on CO evolution (must be less than 4%) and to conserve foundry grade coke.
Keywords: foundries; carbon monoxide; carbon dioxide; air pollution abatement; energy conservation; metal industry; pollution control equipment.

110001 Coal Fired Aluminum Remelt. West, C.E. (Aluminum Co. of America, Alcoa Center, PA, 15069). **Project number:** 42. **Contract:** EM-78-C-01-4203. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The objective of this program is to utilize coal to replace oil and natural gas as a fuel for direct firing in aluminum melting furnaces. The crucial step is the development of a slagging combustor with a desulfurizing additive as an environmental control technique. Aluminum ingots, plant scrap, and old scrap are remelted and alloyed in the preparation of products, and over 15 million barrels of oil and natural gas equivalent are used in this process. Experimental evidence indicates that normal oxide formation atop the melt will render coal ash harmless to the product leaving desulfurization and slagging as the major technical hindrances. This project was initiated in FY 78 by ALCOA and development and test of the slagging combustor is expected to be completed in the third quarter of FY 80. A retrofit operational setup will then be initiated with completion scheduled for mid-FY 81. This unit will then be operated on a semi-commercial basis until the first quarter of FY 83.
Keywords: aluminium; melting; metal industry; fuel substitution; coal; combustors; recycling; desulfurization; performance testing.

110002 Accelerated Implementation of Fuel Efficient Forge Furnaces. Bjerklie, J. (Hague International, Inc., 3 Adams St., South Portland, ME, 04106). **Project number:** 50. **Contract:** PR01-80CS40335. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

DOE has funded Hague International, Inc., to develop and demonstrate an improved steel forge furnace, including a novel recuperator and burners, slot closure doors, etc. The present contract is for acceleration of the implementation of this technology by documenting performance and savings in a number of industrial applications. Environmental questions have been dealt with by studies conducted both by DOE Ames Laboratory and by an industrial laboratory chosen by ORNL in consultation with EPA. Typical fuel savings for this system are in the range of 50%. Savings are usually in distillate oils.
Keywords: furnaces; design; performance; efficiency; energy conservation; implementation; fuel oils; coal; mixtures; fuel slurries.

110003 Direct Reduction of Aluminum. Bruno, M. (Aluminum Co. of America, New Kensington, PA). **Project number:** 81. **Contract:** EC-77-C-01-5089. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The objective of this program is to demonstrate the technical feasibility of a pilot scale direct reduction process for producing aluminum and aluminum-silicon alloys. The process includes three major tasks: reduction to produce impure alloys, alloy purification, and purification to commercial grade aluminum. The process is designed to replace electrolytic reduction which currently consumes approximately 5% of the nation's electric power. Based upon coke for reactor heating and reduction, the process is also being designed to reduce energy requirements per pound of metal by approximately 50% and to use domestic ores in large proportion. The intention is to enable aluminum production in a manner similar to blast furnace production of iron. This project was initiated in FY 77 by ALCOA and efforts to date have been restricted to laboratory activities. A go/no-go decision is scheduled to be made in the first quarter of FY 80 with regard to experimentation in a pilot scale facility.
Keywords: aluminium; aluminium alloys; reduction; production; coke; energy conservation; metal industry.

110004 Evaluation and Demonstration of a Diesel Cogeneration System in the Chemical Industry. Nydick, S. (Thermo Electron Corp., 101 1st Ave., Waltham, MA, 02154). **Project number:** 272. **Contract:** FC01-79CS40279. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The contractor, along with the subcontractors, have the readily available technology to provide an industrial demonstration of a slow-speed, two stroke diesel cogeneration system, in a size range and in an application that will clearly establish the capabilities of such a system in the United States. A demonstration plant will be constructed and operated to this end.
Keywords: diesel engines; demonstration programs; electric generators; co-generation; feasibility studies; thermal power plants.

110005 Cogeneration at Riegel Textile Corporation at Ware Shoals, SC. Meyer, T. (Riegel Textile Corp., Southern Executive Office, Ware Shoals, SC, 29692). **Project number:** 271. **Contract:** FC01-79CS40278. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The objective of this project is to demonstrate commercially a coal-fired steam topping cycle cogeneration system in the textile industry. A pulverized coal-fired, high-pressure boiler coupled to a non-condensing turbine generator will be installed at Riegel Textile's weaving, dyeing, and finishing plant. The system will produce 3.5 MW(e) and 250,000 lb/h steam. There is no utility interface. This is a new project. Potential national energy savings resulting from successful demonstration have been estimated at about 0.15 Q per year.
Keywords: co-generation; textile industry; topping cycles; commercialization; fossil-fuel power plants; feasibility studies.

110006 Evaluation of the use of Granulated Blast Furnace Slag and Fly Ash in Blended Cement. Clifton, J.R. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 19. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The objective of this program is to facilitate the use of granulated blast furnace slag and coal fly ash as partial replacements for Portland cement. In other countries extensive use of slag and fly ash saves significant amounts of energy. This project involves laboratory testing to bolster efforts of the American Society for Testing Materials and other standards and specifying organizations to facilitate greater use of slag and fly ash. Full use of slag and fly ash in blended cement could save 0.3 Q per year by the year 2000.
Keywords: blast furnaces; slags; fly ash; cements; materials testing; uses; waste disposal.

110007 Demonstration of Arc-Coal Reactor System for Conversion of Coal to Acetylene. Wragg, J.G. (Avco Corp., 201 Lowell St., Wilmington, MA, 01887). **Project number:** 82. **Contract:** EM-78-C-02-4507. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The object of this project is to demonstrate, on a commercial scale, a process for converting coal to acetylene as a basic chemical. A 200 kW arc-coal reactor pilot facility is being operated under test conditions to determine the feasibility of larger units. The new process could save petroleum and gas now used in acetylene production. If the process were commercially implemented, a 1.0 to 1.5 Q per year reduction of natural gas/crude oil use would result.
Keywords: coal gasification; acetylene; pilot plants; production; synthesis; arc coal process.

110008 Demonstration of Polypropylene Waste to Fuel Oil Conversion Technology. Amato, A. (Novamont Corp., 1114 Avenue of the Americas, New York, NY, 10036). **Project number:** 258. **Contract:** AC02-79. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to demonstrate commercially a process for the conversion of atactic polypropylene, a waste product in the manufacture of polypropylene, to fuel oil. A commercial scale pilot plant constructed by Procedyne Corporation will be used in long term tests at the Novamont polypropylene plant. Conversion of atactic polypropylene to fuel oil could save about 0.6 million barrels of fuel oil (net) per year.
Keywords: polypropylene; manufacturing; waste product utilization; demonstration programs; fuel oils.

110009 Demonstration of RDF Co-Firing in a Cement Kiln. Jones, J.R. (Environmental Equipment Corp., 600 Fammin Bldg., Houston, TX, 77025). **Project number:** 148. **Contract:** EV-76-C-05-5150. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this project is to demonstrate the full commercial potential of using RDF (refuse-derived fuel) for co-firing in energy-intensive cement kilns. Cement clinker produced in a full-scale plant using RDF has been tested with positive results by a leading cement laboratory. Extension from this short-term, batch operation to continuous-running plant testing will establish the operating characteristics needed for final commercialization in the industry. It is estimated that implementation of RDF co-firing in cement kilns could save the energy equivalent of 8 million barrels of oil annually.
Keywords: refuse derived fuels; combustion; cements; manufacturing; kilns; fuel substitution; waste product utilization; demonstration programs; commercialization.

110010 Waste Oil Recycling. Thompson, C.J. (Bartlesville Energy Technology Center, Bartlesville, OK). **Project number:** 180. **Contract:** 19-79CS40246. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

This project is directed toward the commercial demonstration and implementation of a new process for the recovery of used automotive lubricating oil. The conventional acid/clay re-refining process has become environmentally unacceptable, sharply curtailing the amount of used oil which can be re-refined. Laboratory tests have indicated the technical feasibility of the new two-stage distillation, solvent precipitation process. In this process, all distillate and precipitate fractions of the waste oil are potentially recovered as useful products. Each year, about 650 million gallons of used automotive lube oil are disposed. If the planned commercial-scale demonstration succeeds in fully implementing the used oil recovery process, approximately 14 million barrels of oil equivalent per year

could be saved. This project was initiated in FY 78 and is being conducted by the Bartlesville Energy Research Center. Major milestones in FY 80 are design completion and selection of a re-refining plant site. Facility construction is expected to begin in the late summer of FY 81 with plant startup approximately one year later. Commercial operation is scheduled to commence in the second quarter of FY 83.
Keywords: waste oils; recycling; refining; demonstration programs; bartlesville energy technology center; waste product utilization; lubricating oils; recovery.

110011 New Fertilizer Process: Granulated Ammonia. Achorn, F. (TVA, National Fertilizer Development Center, Muscle Shoals, AL, 35660). **Project number:** 12. **Contract:** EX-76-A-31-1018. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The Tennessee Valley Authority, National Fertilizer Development Center, is investigating processes for conserving energy in the production of fertilizers in ammoniation-graulation plants under an Interagency Agreement initiated in FY 76. This four-year project will develop new formulations which reduce moisture added in the granulation process and utilize chemical then heat-of-reaction generated by combinations of ammonia and phosphoric acid as a substitute for natural gas in drying granular fertilizer. It is estimated that fuel consumption in these plants can be cut by as much as 65% by using the new formulation procedures, resulting in a cumulative energy savings of 5.8 million barrels equivalent by 1985, with first savings occurring in 1979. TVA is currently refining a pipe-cross reactor and other melt-type processes, and collecting data from ammoniation-granulation plants on energy requirements for producing fertilizers by conventional processes.
Keywords: reaction heat; fertilizers; production; energy conservation; ammonia; phosphoric acid; fertilizer industry.

110012 Environmental Development Plan. Cushnie, G.C. Jr. (Centec Corp., 11800 Sunrise Valley Dr., Reston, VA, 22091). **Project number:** 01-79CS40159 000. **Contract:** AC01-79CS40159. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The Environmental Development Plan (EDP) System is designed to provide a common basis for planning, managing, and reviewing the environmental aspects of the various energy technology programs under the Department of Energy's jurisdiction. For a specified technology development program, an EDP is expected to perform the following functions: (1) identify and evaluate the environmental concerns; (2) define general requirements for environmental, health, and safety research and impact assessments; (3) provide a coordinated timing schedule for required environmental research and development, technology program activities and decision points; and (4) indicate approximate time for documents required in the National Environmental Policy Act (NEPA) process, and Environmental Readiness Documents (ERDs), where appropriate.
Keywords: us doe; research programs; planning; management; reviews; environmental impacts; public health; safety; environment; information.

110013 Measurement of Circumsolar Radiation. Grether, D.F. (Lawrence Berkeley Laboratory, 90-3092, Berkeley, CA, 94720). **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE-$214,000.
Related energy source: solar(100) **R and D categories:** Pollutant measurements technology.

The primary objective of this project is to provide solar radiation measurements necessary for accurate prediction of the performance of solar energy conversion systems employing concentrating collectors. Such systems include central receiver and distributed collector systems for solar thermal conversion, parabolic mirrors for photovoltaic applications, and concentrating systems for heating and cooling of buildings. The measurements consist of determining the flux of energy from the sun and the circumsolar region (the small-angle region around the sun) as a function of angle, wavelength, and atmospheric conditions. The circumsolar radiation arises primarily from forward scattering of sunlight from atmospheric constituents with dimensions greater than the wavelength of light, such as aerosols, dust particles, ice crystals, or water droplets in thin clouds. Pyrheliometers, the standard instruments used to estimate the direct solar flux, typically have a field of view of 6 degrees (compared to the 1/2 degree angle subtended by the sun) and thus include a substantial portion of the circumsolar radiation within the measurement. Depending on the solar application, the pyrheliometer measurement either underestimates or overestimates the amount of solar radiation that would actually be collected.
Keywords: solar radiation; data acquisition; solar thermal power plants; performance; forecasting; central receivers; parabolic reflectors; mirrors; solar concentrators; solar flux; pyrheliometers.

110014 Alternative Fuels for Medium Speed Diesel Engines. Wood, C.D. (Southwest Research Inst., 6220 Culerra Road, P.O. Box 28510, San Antonio, TX, 78284). **Project number:** 4266. **Contract:** EM-78-C-01-4266. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE; AAR; DOT.
Related energy source: Coal(30); oil and gas(30); oil shale(30); conservation(10) **R and D categories:** Pollutant measurements technology.

The objectives of the proposed program are: (1) through engine experiments, define the degree to which the properties of diesel fuels can be allowed to vary away from specification values while still allowing acceptable fuel economy, combustion characteristics, and wear in a medium-speed diesel engine; (2) define the performance characteristics of medium-speed diesel engines under operation with alcohol, gasoline, and a simulated coal-derived liquid; and (3) prepare a comprehensive program plan for the future investigation of alternate fuels for medium-speed diesel engines which will make use of the results of the project, ongoing alternate fuel projects by other contractors, and user requirements.
Keywords: diesel engines; diesel fuels; efficiency; combustion properties; alcohols; gasoline; synthetic fuels; fuel substitution; performance.

110015 Alternative Fuels/Energy Sources for Non-Highway Transport. Lart, E.N. (Exxon Research and Engineering Co., P.O. Box 101, Florham Park, NJ, 07932). **Project number:** 5438. **Contract:** EC-77-G-05-5438. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(20); oil and gas(20); oil shale(20); nuclear fission(10); nuclear fusion(10); solar(10); conservation(10) **R and D categories:** Pollutant measurements technology.

The objectives are to prepare and present findings of Non-highway Alternative Energy Source Study to industry and government groups and organizations to be selected by DOE. Utilizing information provided under the basic alternative fuel study and the forecast of possible fuels and prime movers of the near (1985), mid (2000), and long-range (2000+) timeframes, the implications of contingency scenarios in which energy supplies are unexpectedly disturbed will be developed and evaluated. Consideration will be given to alternative fuel availabilities and lead-times, interchangeability of fuel use between modes and equipment multi-fuel capabilities. Alternative fuels examined will include, but not be limited to, alcohol fuels from biomass, shale, and coal derived fuels and hydrogen both as a fuel and a feedstock for synthetically derived fuels. The logistics of supplying coal to the international marine trade will be studied by: (1) investigating U.S. and Free World port capabilities for handling coal, (2) examining forecasts of future international coal movements, and (3) determining the current and future potential for coal in the international marine trade. The Free World availability for alternative aircraft fuel will be examined, the options available to foreign countries in the area of alternative fuels will be determined and the influence of these options on international aircraft fuel supplies will be projected.
Keywords: fuel substitution; air transport; maritime transport; rail transport; availability; coal; synthetic fuels; alcohols; shale oil; transportation systems.

110016 Pipeline Bottoming Cycle Study. Rossbagh, R.J. (General Electric Co., P.O. Box 15132, Cincinnati, OH, 95615). **Project number:** 1381. **Contract:** EM-77-C-03-1381. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The initial assessment and market analysis activity of this program have been concluded. A preliminary design has been developed. Current activity represents an extension of the baseline activity including applicability to northern sites and regulatory impacts.
Keywords: bottoming cycles; pipelines; marketing research; energy conservation.

110017 Bottoming Cycles for Marine Diesels. Russel, T.E. (General Electric Co., P.O. Box 15132, Cincinnati, OH, 05215). **Project number:** 4224. **Contract:** EM-78-R-01-4224. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant measurements technology.

The objectives of this program are to assess the energy savings and economic viability for marine diesel applications of the organic Rankine bottoming cycle. The approach is to select a ship and bottoming cycle (currently under development) as demonstration candidates and to: (1) prepare preliminary design; (2) assess economic, environment and safety characteristics, technological

feasibility, operational reliability and maintainability, and potential for industry utilization; and (3) develop a program plan leading to demonstration. Information on which to base a decision of whether or not to proceed to the next phase of a demonstration program will be developed.
Keywords: economics; energy conservation; diesel engines; bottoming cycles; rankine cycle power systems; ships; design; feasibility studies; demonstration programs; safety; maintenance.

110018 Characterization of Alcohol/Gasoline Blends. Adt, R.R. (Univ. of Miami, P.O. Box 248294, Coral Gables, FL, 33124). **Project number:** 5216. **Contract:** E(40-1)-5216. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(30); oil and gas(70) **R and D categories:** Pollutant measurements technology.

The objective of this project is basic investigation of SI engine operation with alcohol/gasoline blend fuels, including performance, exhaust emissions, and induction/combustion relationships. Fuels tested have included blends of up to 30% methanol or ethanol. Future testing will include fuel-grade methanol and special alcohol/gasoline formulations.
Keywords: ethanol; methanol; gasohol; internal combustion engines; performance; exhaust gases; combustion kinetics.

110019 Research on the External Fluid Mechanics of Ocean Thermal Power Plants. Adams, E. (Massachusetts Institute of Technology, Department of Civil Engineering, Cambridge, MA, 02139). **Project number:** 86107. **Contract:** ET-78-S-02-4683. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE-$98,000.
Related energy source: solar(100) **R and D categories:** Pollutant measurements technology.

The project objective is to investigate experimentally and analytically external flow problems unique to OTEC to minimize adverse environmental impacts and resource depletion. Required data on physical environmental effects of OTEC implementation will be made available for use in OTEC environmntal impact assessment/statement preparation.
Keywords: ocean thermal power plants; fluid mechanics; environmental impacts; fluid flow; jets.

110020 Toxicity and Impingement-Entrainment Studies (OTEC), Phase I. Gunter, G. (Gulf Coast Research Lab., Ocean Springs, MS, 39564). **Contract:** ET-78-R-02-0015. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE-$100,000.
Related energy source: solar(100) **R and D categories:** Pollutant characterization and analysis.

The project objective is to establish a data base on exposure of marine biota to OTEC (Ocean Thermal Energy Conversion) intakes and discharges for preparation of environment impact assessments and/or statements. The final scope of effort of this project is contingent upon results of a previously contracted effort for marine biota impact assessment involving laboratory and in situ experiment designs and literature surveys of existing knowledge. The suggested scope of effort is to develop a plan for subjecting site-specific species at all proposed OTEC candidate sites to chemical and physical environmental changes simulating those anticipated during passage through heat exchangers or in passing through the outflow of the plant.
Keywords: ocean thermal energy conversion; aquatic ecosystems; environmental impacts; heat exchangers; toxicity.

110021 Near Term Electric Vehicle Program: Safety. Rowland, E.A. (General Electric Co., P.O. Box 43, Schenectady, NY, 12301). **Project number:** 1294. **Contract:** EY-76-C-03-1294. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

Based on Phase I designs, trade-offs and preliminary designs, detailed designs for electric vehicles are being developed. Two complete integrated test vehicles will be delivered for test and evaluation. In addition to normal vehicle engineering parameters the detailed design will consider life-cycle costs, consumer acceptability and producibility analysis. Crash energy management, accident avoidance and non-operating safety are also considered.
Keywords: electric-powered vehicles; safety; design; life-cycle cost; performance testing; accidents; market.

110022 Near Term Electric Vehicle Program: Safety. Rowlett, B.H. (Garrett Corp., A Division of AiResearch Mfg. Co., 2525 W. 190th St., Torrance, CA, 90274). **Project number:** 1213. **Contract:** EY-76-C-03-1213. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

Based on Phase I designs, trade-offs and preliminary design, detailed designs for electric vehicles are being developed. Two completely integrated test vehicles will be delivered for test and evaluation. In addition to normal vehicle engineering parameters the detailed design will consider life-cycle costs, consumer acceptability and producibility analysis. Crash energy management, accident avoidance and non-operating safety are also considered.
Keywords: electric-powered vehicles; safety; design; life-cycle cost; performance testing; accidents; market.

110023 Electric Vehicle Handling. (DOT, National Highway Traffic Safety Adm., 2100 2nd St. SW, Washington, DC, 20590). **Project number:** 4242. **Contract:** EM-78-I-01-4242. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The development of a test procedure to measure handling, braking and stability of 3-wheel electric and/or hybrid vehicles and Department of Energy's near-term 4-wheel electric vehicles is discussed. The development of a test procedure and measurement of handling and braking characteristics of conventional passenger cars with 4 wheels and similar wheel bases and weights will be studied. The baseline data will be collected and a computer simulation program will be used as a reference for judgment when 3-wheel vehicle data are collected. The computer simulation will be used to project changes which may prove helpful and to do preliminary evaluation of new designs. It is hoped that a standardized approach to testing and simulation might be developed which will allow vehicle performance characteristics to be measured on a common basis.
Keywords: electric-powered vehicles; brakes; operation; performance testing; computerized simulation; data acquisition.

110024 Environmental Development Plan and Assessments. Bernard, M.J. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 49991. **Contract:** 49991. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

This project includes the preparation of an Environmental Development Plan for the Transportation Energy Conservation Division. This plan identifies the environmental, health, and safety issues associated with RD and D conducted by the Division and sets forth strategies for resolving these issues. This project also includes the preparation of Environmental Assessments for the Electric and Hybrid Vehicle Program, Alcohol Fuels, Turbocompound Diesel Engine, and Controlled Speed Accessory Drive System.
Keywords: transportation systems; energy conservation; health hazards; safety; environmental impacts; diesel engines; electric-powered vehicles; alcohol fuels; velocity; control equipment.

110025 Investigation of Alcohol/Gasoline Blends. Hurn, R. (Bartlesville Energy Technology Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 2245. **Contract:** 2245. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: oil and gas(90); solar(10) **R and D categories:** Pollutant characterization and analysis.

The objectives of this project are to: (1) characterize the physical and chemical properties of alcohol/gasoline blends, and (2) conduct engine/vehicle performance testing using these and certain other blend fuels in spark ignition IC engine vehicles.
Keywords: gasohol; physical properties; chemical properties; internal combustion engines; performance; field tests; fuel substitution.

110026 Alternative Fuels Data Bank. Hurn, R. (Bartlesville Energy Technology Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 96034. **Contract:** CS-01-01-03-1. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant characterization and analysis.

The Alternative Fuels Data Bank program is designed to provide a source of current technical information concerning the utilization of alternative fuels in highway vehicle applications. Primary input to this system is published research and progress reports from ongoing R and D activities.
Keywords: fuel substitution; automobiles; automotive fuels; data acquisition.

110027 Methanol Fuel Modification for Highway Vehicle Use. Keller, J.L. (Union Oil Co. of California, 376 S. Valencia, Brea, CA, 92621). **Project number:** 3683. **Contract:** EY-76-C-04-3683. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(80); oil and gas(10); solar(10) **R and D categories:** Pollutant characterization and analysis.

The aim of this project was to assess the effectiveness of fuel modifications (methanol and ethanol) in solving the most important problems brought about by the use of alcohol fuels in current IC engines. Extensive physical testing of modified fuels in both bench apparatus and vehicles was the approach used. A final report was published in July 1978.
Keywords: methanol fuels; ethanol fuels; automotive fuels; fuel substitution; internal combustion engines; gasohol; modifications; performance testing.

110028 Design Data for Hydrogen Engine. Adt, R.R. (Univ. of Miami, P.O. Box 248294, Coral Gables, FL, 33124). **Project number:** 1212. **Contract:** EC-77-C-03-1212. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

This project is designed to provide preliminary but comprehensive hydrogen-fueled automotive engine characterization data for future reference. Results of testing of carbureted and fuel injected four-cylinder engine configurations will establish basic engine parameters to permit the design of a first-generation hydrogen engine (as distinct from a modified gasoline engine).
Keywords: hydrogen fuels; automotive fuels; spark ignition engines; design; automobiles.

110029 Automotive Microcarburetor. Csonka, A.B.; Csonka, J.J. (FERRO Technical Co., 109 Larchmont Rd., Buffalo, NY, 14214). **Project number:** 4352. **Contract:** EC-C-02-4352. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

The objectives are to procure and test a prototype Microcarburetor (trade name) for engine and vehicle evaluation. Superior charge preparation and hence, the potential for lean limit extension are claimed for the Microcarburetor by the inventor. The potential for fuel savings and emissions reductions is also claimed. The principal investigator will construct a prototype unit with DOE funding for testing at JPL. No results are available at this time.
Keywords: automobiles; carburetors; performance testing; exhaust gases; procurement.

110030 Stirling Engine. Nightingale, N. (Mechanical Technology, Inc., Latham, NY, 12110). **Contract:** NASA DEN 3-32. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

DOE awarded a contract to Mechanical Technology Incorporated (MTI) in March 1978 to develop Stirling engines. The MTI team includes United Stirling of Sweden and AM General, a subsidiary of the American Motors Corporation. The goal of the automotive Stirling engine program is to advance the technologies as demonstrated in a series of engine prototypes so that the potential for high fuel efficiency, low noise and air pollution, and low costs can be proven. The program then will: transfer technology to the United States; encourage active private sector interest and involvement; stimulate earliest possible commercialization of Stirling engine-powered highway vehicles; provide positive transportation energy conservation without sacrificing personal mobility; and provide true transportation fleet multifuel capability as nonpetroleum fuels become available. Program activities are currently concentrated on design and fabrication of a new, more advanced automotive Stirling engine and development of improved components and materials. Detailed design of this new Stirling engine, called ASE MOD I, will be completed in June. This engine is scheduled to be tested on an engine dynometer in February 1981. The component and materials development is directed at an improved engine called SE MOD II. This engine is intended to meet or exceed the final program objectives and will be tested in a vehicle by EPA in 1984.
Keywords: stirling engines; design; technology transfer; fabrication; cost; technology assessment; automobiles; commercialization; energy conservation; automotive fuels.

110031 Electric Vehicle Impact Assessment Study. Hamilton, W.F. (General Research Corp., Santa Barbara, CA, 93111). **Project number:** 1180. **Contract:** EY-76-C-03-1180. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(30); oil and gas(30); nuclear fission(10); hydroelectric(10); conservation(20) **R and D categories:** Pollutant characterization and analysis.

The objectives of this project are to investigate electric cars and partially-electric vehicles, state-of-art reviews, future batteries, future vehicles, driving patterns/requirements, applicability/costs/marketability, fuel/energy use/impacts, air quality, noise, and supplies/resources of key materials.
Keywords: electric-powered vehicles; reviews; electric batteries; market; fuel economy; energy consumption; air quality; noise; technology assessment.

110032 Technology Assessment of Alternative Transportation Fuels. Dickson, E.M. (SRI International, 333 Ravenswood Ave., Menlo Park, CA, 94025). **Project number:** 0115. **Contract:** EY-76-C-03-0115. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(60); oil shale(40) **R and D categories:** Pollutant characterization and analysis.

An examination of socio-technical feasibility of alternative transportation fuels (from coal and oil shale to liquid fuels and electricity). Topics being investigated are: feasibility/impact assessments, institutional/policy questions, tradeoff analyses, social impacts, coal depletion models, diesel cars, electric cars and railroad electrification, and futures scenarios.
Keywords: technology assessment; fuel substitution; feasibility studies; social impact; diesel engines; electric-powered vehicles; government policies; electric railways.

110033 Characterization and Research Investigation of Methanol and Methyl Fuel. Pefley, R.K. (Univ. of Santa Clara, School of Engineering, Santa Clara, CA, 95053). **Project number:** 1737. **Contract:** EC-78-C-03-1737. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: Coal(80); solar(20) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to test and evaluate the most practical solutions to the problems engendered by the use of ethanol and methanol in current spark ignition-engine vehicles. Both reagent and utility grades of both fuels will be used. Engine dynamometer and vehicle tests of hardware, engine modifications, and recalibrations are the basis of the approach being used.
Keywords: methanol fuels; ethanol fuels; spark ignition engines; fuel substitution; retrofitting; performance testing.

110034 Study of Pipeline Applications of Fuel Cells. Wakefield, R. (Mathematica, Inc., Mathtech, 475 Lenfant Place W/SW, Washington, DC, 20024). **Project number:** 4327. **Contract:** EM-78-C-01-4327. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: oil and gas(50); conservation(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to (1) assess the potential application of fuel cells powering dc or possibly ac motors in pipeline transportation; (2) define the conceptual designs of preferred component configurations utilizing fuel cells for petroleum products, crude oil, and natural gas pipelines in two successive planning horizons (present to 1985 and 1985--2000); (3) evaluate the conceptual designs in terms of economic feasibility, net energy savings, environmental and safety implications, operational maintainability and reliability, and potential market acceptance; and (4) identify required research and development before demonstration and commercialization can occur.
Keywords: pipelines; fuel cells; power systems; design; feasibility studies; safety; maintenance; reliability; market; research programs; electric motors; economic analysis.

110035 Voluntary Truck and Bus Fuel Economy Improvement Program. (Department of Energy, Washington, DC). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Voluntary Truck and Bus Fuel Economy Program is a joint program by the DOT and DOE to collect, review and publish information concerning methods to improve fuel economy in trucks and buses. Major current efforts are in the area of determining the best methods for transferring this information to independent truckers, who form a substantial portion of the truck fleet. Publications are designed to demonstrate the economic advantage of fuel economy-improvement methods.
Keywords: trucks; buses; fuel economy; education; economic impact; motor vehicle operators.

110036 Driver Awareness Training. (Department of Energy, Washington, DC). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Driver Awareness Training Program is divided into two principle functions: DECAT (Driver Energy Conservation Awareness Training), a training program offered to government fleet administrators to teach their drivers how to drive more efficiently;

and Driver Awareness Outreach, a public information program to educate the driving public (through media publicity, films, and pamphlets) on the benefits and techniques of fuel-efficient driving. By these two methods, it is hoped that a substantial reduction in fuel demand can be accomplished. To date, approximately 5000 drivers and instructors have received DECAT training. The Outreach Film (Running on Empty) has been seen by about 10 million people and the printed matter has seen wide distribution.
Keywords: vehicles; education; operation; fuel economy; motor vehicle operators; public opinion.

110037 Mileage Guide. (Department of Energy, Washington, DC). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Mileage Guide is a booklet containing the EPA-derived fuel economy estimates for all EPA-certified vehicles marketed in the U.S., plus other useful fuel economy-related information. Approximately 14 million copies will be prepared and sent to auto dealerships, libraries, state energy offices, etc. this year. The Mileage Guide is designed to be a useful tool for prospective vehicle buyers so that they can maximize fuel economy within their desired vehicle class.
Keywords: fuel economy; vehicles; market; education; public opinion; manuals; fuel consumption.

111000 Waste Oil Disposal. Napier, J.M. (Oak Ridge Y-12 Plant, P.O. Box Y, Oak Ridge, TN, 37830). **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Laboratory studies have shown waste oil containing approximately 3000 ppM PCB can be vacuum distilled to remove the PCB. An overhead product contained the PCB concentrate and a bottom product contained less than 50 ppM PCB. The studies showed that about 65% of the oil could be reduced to less than 50 ppM PCB using this method. A preliminary cost estimate for a system designed to purify approximately 40,000 gallons per year is being obtained.
Keywords: waste oils; waste disposal; organic chlorine compounds; aromatics; purification; waste processing; removal.

111001 Waste Liquid Disposal. Napier, J.M. (Oak Ridge Y-12 Plant, P.O. Box Y, Oak Ridge, TN, 37830). **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Pilot plant studies were conducted to obtain design data for a chemical treatment facility to treat inorganic liquid wastes generated in electroplating shops and other plant work areas. The developed system used classical treatment processes, i.e., neutralization with lime, reactor-clarifier, filtration, etc. These studies were completed in FY 1979, and the data were used in the preparation of the conceptual design report and in employyment of an architectural design firm.
Keywords: liquid wastes; waste disposal; pilot plants; chemical reactors; design; waste processing.

111002 Oil--Machine Coolant Disposal. Napier, J.M. (Oak Ridge Y-12 Plant, P.O. Box Y, Oak Ridge, TN, 37830). **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

An activated sludge process for disposing of waste machine coolants was developed in FY 1978. In FY 1979, the operation of the pilot plant and technology was transferred to production operation. The facility transfer was completed with minimum effort. A contracted study to define the bacteria present in the reactor has shown the bacteria to be non-pathogenic.
Keywords: machine tools; coolants; bacteria; waste disposal; oils; sludges.

111003 Ecological Studies of Small Mammals in a Nuclear Site on Nevada Test Site. Bradley, W.G. (Univ. of Nevada, 4505 S. Maryland Parkway, Las Vegas, NV, 89109). **Contract:** AS08-76DP00562. **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Both census and field note observations were used to develop an inventory of the vertebrates found in the study areas. Sufficient data have been generated from Little Feller II to estimate density of rodents. These data and comparative data from Area 5 (Mohave Desert), Area 11 (Transition), and Area 13 (Great Basin) are presented. It was readily apparent that rodents in general were more numerous in Little Feller II. In addition, Dipodomys ordii, a Great Basin species, was an important new addition to the rodent fauna. It is believed that with the increased numbers of rodents found in this study area, a good sample of rodents from each activity strata can be obtained.
Keywords: mammals; ecosystems; nuclear power; nevada test site; inventories; rats; species diversity; biological radiation effects; low dose irradiation; chronic irradiation.

111004 Radionuclide Migration Study. (Geological Survey, Las Vegas, NV). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

By logging and sampling these wells (Nash, Bilby, Cambric, Bourbon, Almendro, Cheshire, and Faultless) routinely, studies will determine the rate at which groundwater refills cavity/chimney zones, the radionuclides present, their distribution and concentrations, and the effects of temperature, water chemistry, and rock pore spaces on radionuclide migration or retardation in groundwater. Each of these parameters must be determined or interpolated for each rock type present on the Nevada Test Site in order to predict the migration of radionuclides in groundwater.
Keywords: radionuclide migration; ground water; mathematical models; rocks; nevada test site.

111005 Geologic Program at Nevada Test Site. (Nevada Univ., Desert Research Inst., Reno, NV). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

This program continually updates the geological structure and stratigraphic interpretation of the Nevada Test Site, and supports the Containment Evaluation Panel (CEP) and the scientific laboratories. The CORE Library is also maintained under this program.
Keywords: nevada test site; geology; radionuclide migration; land reclamation; mathematical models.

111006 Unsaturated Zone Hydrology. (Nevada Univ., Desert Research Inst., Reno, NV). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

By collecting soil and rock samples from selected locations at various elevations on Nevada Test Site and determining grain size ratios, effective porosity, soil moisture content, and the concentration of radionuclides present at various depths, together with amount of rainfall, evaporation, temperature, humidity, and amount of ponding in natural depressions and in event surface craters, it can be determined if and to what extent precipitation on the valley sides and floors reaches the water table. The possiblity of radionuclide movement in this water will be evaluated.
Keywords: hydrology; soil chemistry; rocks; nevada test site; grain size; moisture; radioactivity; radionuclide migration; mathematical models.

111007 Hydrologic Flow Systems at Nevada Test Site. (Geological Survey, Las Vegas, NV). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

This program involves the chemical characterization of groundwater on Nevada Test Site, incorporates the continually refined stratigraphic and hydrologic data from all drilling and testing programs and will result in a 3-dimensional computer model of the hydrologic regime of NTS and vicinity. It will greatly assist in predicting the rate and direction of groundwater flow and the migration of radionuclides in groundwater.
Keywords: nevada test site; ground water; hydrology; mathematical models; radionuclide migration; forecasting.

111008 Tatum Dome Study. (Nevada Univ., Desert Research Inst., Reno, NV). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives are to drill, complete, develop, pump test and sample all aquifers overlying Tatum Dome; to demonstrate radioactive contamination or the lack of it in aquifers overlying Tatum Dome; and to obtain as much hydrologic data for these aquifers as possible.
Keywords: aquifers; contamination; radioactivity; hydrology; radiation monitoring.

111009 Plutonium--Soil Association: a Summary. Tsuneo, T. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** W-7405-ENG-26. **Contract:** D-ON-9-14. **Supported by:** De-

partment of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

This report summarizes the research from 1974 to 1978 on plutonium--soil association in the Safety-Shot areas of the Nevada Test Site (NTS). In addition, a recommendation is made to initiate cleanup trial operations in the NTS complex for the purpose of providing information on equipment development, testing and evaluation of soil sealing, logistics of operation, and cost-effectiveness of the operations. Any site selected for the trial operations must be characterized physically and biologically prior to, during, and after the operations. In this way, environmental problems of larger-scale operations of cleanup may be anticipated and prevented.
Keywords: plutonium; radionuclide kinetics; soils; nevada test site; soil chemistry; decontamination; economics; environmental impacts.

111010 Nevada Applied Ecology Information Center: a Prototype. Pfuderer, H. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Nevada Applied Ecology Group (NAEG) was exceptionally farsighted in establishing the Nevada Applied Ecology Information Center in January 1972, not long after the Nevada Test Site research programs began. Since its inception, the Data Base on the Environmental Aspects of the Transuranics has proven to be a useful tool to a wide range of researchers and planners, both nationally and internationally, in addition to those associated with the NAEG. Because of its versatility and ease of access, the Data Base on the Environmental Aspects of the Transuranics has played a major role in the development of new projects by the Ecological Sciences Information Center.
Keywords: nevada test site; information centers; data compilation; data base management; information systems; ecosystems; ecology; transuranium elements; radionuclide migration.

111011 Soil Radioactivity Distribution Studies for the Nevada Applied Ecology Group. (Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM, 87545). **Supported by:** Department of Energy, Albuquerque, NM (USA). Albuquerque Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Since the inception of the Nevada Applied Ecology Group in 1970, personnel from the Los Alamos Scientific Laboratory (LASL) have contributed to the determination and evaluation of radionuclide inventory and distribution in soils at selected study sites at the Nevada Test Site complex (NTS) and surrounding areas. A brief historical survey of those activities is presented. During the period March 1977 to March 1978, LASL participated in workshops and information meetings, in preparation of nuclear site study protocols for estimation of inventory and distribution of various radionuclides, in evaluation of instrumental data that was collected in order to aid in defining specific nuclear site studies, and in referee activities for analysis of samples for radionuclide content. In that same period, several data sets were evaluated and are presented in this report. They include data relative to the vertical movement of plutonium and americium in desert soil profiles, and data relative to distribution of various isotopes of uranium in the blow-sand mounds at two study sites, one located on NTS and the other at the Tonopah Test Range.
Keywords: soils; radioactivity; nevada test site; plutonium isotopes; americium isotopes; radionuclide migration; uranium isotopes.

111012 Development of an Approach for Monitoring the Plant Availability of Transuranics in the Nevada Test Site Soils. Baker, D.E. (Pennsylvania State Univ., University Park, PA, 16802). **Contract:** AS02-77CH04515. **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Existing experimental results obtained for the accumulation of plutonium and other transuranics by vegetation from Nevada Test Site (NTS) soils are being studied to develop an approach which would be useful for predicting the availability of plutonium to plants. Site variability with respect to soil-plant relationships affects the plant production potentials for soil in any environment. Ultimately each site must be considered in relation to depth and distribution of roots, the effect of root exudates on soil particles and associated ionic species. Air--water relations, Eh, pH, and chelation effects at the soil--plant root interface are site specific characteristics which must be measured to predict the plant availability of any ion species. Existing principles and approaches for monitoring the plant availability of chemical elements in soils are only partially applicable to plutonium and other transuranic ion species in NTS soils because of the very small amounts present, the nonuniform distribution, the nonuniform chemical form, and the effects of radioactivity on chemical and physical state. These factors complicate the extension of experimental observations from analogous results for stable nuclides. As an initial step toward understanding the chemistry of plutonium in natural environments, several Eh--pH diagrams have been calculated. At equilibrium, Pu/sup 3+/ and PuO2CO3OH/sup -/ are the important dissolved forms of Pu. Metastability of oxidation states and radiolytic effects may cause deviations from the equilibrium behavior. It is recommended that the effects of factors affecting the plant uptake of plutonium be measured for NTS soil samples in the development of an approach to soil monitoring which utilizes a black box model which integrates the parameters important to ionic diffusion from soil to plant roots.
Keywords: plants; radionuclide kinetics; radioactivity; uptake; plutonium; soil chemistry; radionuclide migration; nevada test site; radiation monitoring.

111013 Seismic Effects. (Adaptronics, Inc., McLean, VA). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose is to investigate the seismic effects produced by underground nuclear explosions. The program has four basic elements: (1) to document the duration and intensity of ground shaking and to measure the response of engineered structures to that motion; (2) to predict the period, amplitude and duration of response motion in buildings to assess the possible effects of that motion on the structural integrity of the building; (3) to complete analyses of ground motion data from the accelerated high-yield test program and to produce current ground motion prediction equations for Pahute Mesa; and (4) to periodically examine all active mines to determine the condition of working places.
Keywords: nuclear explosions; seismic effects; mining; environmental impacts.

111014 Simulation of Plutonium Ingestion by Grazing Cattle. Martin, W.E. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

A simple model of plutonium ingestion by cattle grazing a uniformly contaminated pasture is I/sub Pu/ = I/sub v/C/sub v/ + I/sub s/C/sub s/ where I/sub Pu/ is the plutonium ingestion rate (pCi/day), I/sub v/ and I/sub s/ are vegetation and soil ingestion rates (g/day), C/sub v/ and C/sub s/ are plutonium concentrations (pCi/g) in vegetation and soil. In a ground zero area such as the inner compound of Area 13 (NTS), where the spatial distribution of plutonium is nonuniform and highly variable, the simple ingestion model seems to require a stochastic interpretation. The conclusions to be drawn from these simulation studies are: (1) that the grazing, soil, and plant studies conducted in Area 13 were apparently well designed; (2) that a repetition of the study would probably yield results similar to those already obtained; (3) that given an adequate sampling design, reasonably accurate estimates of plutonium ingestion rates by grazing cattle can be obtained in spite of the extreme variability of the contributing factors; and (4) that given site-specific input parameters, the simulation model provides estimates of I/sub Pu/ which are as accurate as those obtained from long-term grazing studies relying on fistulated steers.
Keywords: cattle; forage; ingestion; biological pathways; plutonium; radionuclide migration; plants; soils; radionuclide kinetics.

111015 Effects of Variations in Source Term and Parameter Values on Estimates of Radition Dose to Man. Bloom, S.G. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

Models had been previously developed to characterize the general behavior of plutonium in a typical ecosystem at the Nevada Test Site (NTS) and to provide a basis for estimating the radiation dose from 239-Pu that might be received by a hypothetical man who resides in and obtains most of his food from this ecosystem. The source term and parameters in these models are subject to wide variations due to uncertainties in sampling, measuring, and interpreting plutonium levels in laboratory experiments and in the environment. Regardless of the extent of these variations, previous exercises with the models indicate that inhalation is far more significant than ingestion as a pathway for transporting 239-Pu to man and that the lung and bone are the critical organs for radiation dose estimates. These features are used to develop simpler forms of the models which are then used to examine the effects of variations in the source term and parameters.
Keywords: human populations; radiation doses; plutonium 239; nevada test site; radionuclide migration; inhalation; environmental exposure pathway; biological pathways.

111016 Status of Endangered and Threatened Plant Species on Nevada Test Site: A Survey. (EG and G of Santa Barbara, 130 Robin Hill Road, Goleta, CA, 93017). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Previous work was undertaken as NVO-DOE's compliance with the Endangered Species Act of 1973 (amended in 1978) which declared as a policy: All Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act. Describing the present status of those listed species, providing recommendations to NVO about their occurrence and conditions, and suggesting protective measures where these are believed needed are the primary objectives of this project. Plant specimens are collected, mounted and deposited in the NTS herbarium for a continuing record of plant conditions on NTS. Herbarium rebuilding and maintenance is thus a secondary objective of this task. This entails affirmation of identities by authorities on particular plant groups, sometimes needed because of the uniqueness and rarity of some NTS species among which are several found nowhere else. Hence, the maintenance and identification/verification of plant specimens has significance beyond NTS and is of interest to botanists nationwide.
Keywords: nevada test site; plants; inventories; botany; classification; endangered species.

111017 Status of Endangered and Threatened Plant Species on Tonopah Test Range: A Survey. (EG and G of Santa Barbara, 130 Robin Hill Road, Goleta, CA, 93017). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Previous work was undertaken as NVO-DOE's compliance with the Endangered Species Act of 1973 (amended in 1978) which declared as a policy: All Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act. Describing the present status of those listed species, providing recommendations to NVO about their occurrence and conditions, and suggesting protective measures where these are believed needed are the primary objectives of this project. Plant specimens are collected, mounted, and deposited in the NTS herbarium for a continuing record of plant conditions on NTS. Herbarium rebuilding and maintenance is thus a secondary objective of this task. This entails affirmation of identities by authorities on particular plant groups, sometimes needed because of the uniqueness and rarity of some NTS species among which are several found nowhere else. Hence, the maintenance and identification/verification of plant specimens has significance beyond NTS and is of interest to botanists nationwide.
Keywords: endangered species; plants; inventories; nevada test site; botany.

111018 Effects of Transuranics on Desert Ecosystem Processes: An Exploratory Study. Ausmus, B.S. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

An exploratory study investigating the effects of stress on desert ecosystem processes was conducted. Uncontaminated soil profiles were excised intact from seven sites in Area 18 and established as microcosms in an environmental chamber at field ambient conditions. Based on studies in mesic ecosystems, CO2 efflux was chosen as a parameter to monitor through time. Microcosms were monitored 5 months to establish parameter behavior and any differences among sites. To determine the effect of stress on CO2 efflux, seven treatment doses of CdCl2 were applied to soils randomly across sites. Data following treatment show CO2 efflux increases due to doses of 3.89, 7.78, and 77.8 mg/sq-cm. Extractable Ca and extractable NO3-N were significantly reduced at one or more treatment doses at harvest. Extractable PO4-P was not affected. This exploratory study confirms the utility of microcosm techniques for measuring the effects of stress upon a desert ecosystem. Further refinement of these techniques will allow: (1) the effects of transuranics on ecosystem processes to be quantified, and (2) the feasibility of decontamination or stabilization alternatives to be tested in the laboratory prior to field trials.
Keywords: deserts; terrestrial ecosystems; carbon dioxide; environmental transport; biological stress; calcium; nitrates; phosphates; biological models; transuranium elements; decontamination; soils.

111019 Inventory and Distribution of Radionuclides at the Nevada Test Site and Environs. (Nevada Univ., Desert Research Inst., Reno, NV). **Contract:** AC08-76DP01253. **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to locate, identify and guantitate any and all radioactive contamination of surface soil in and around the Nevada Test Site.
Keywords: nevada test site; radionuclide migration; environmental impacts; radioactivity; radiation monitoring.

111020 REECo Support to the Nevada Applied Ecology Group (NAEG). (Reynolds Electrical and Engineering Co., Las Vegas, NV). **Contract:** AC08-76NV00410. **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to provide support to NAEG in the area of radioecological studies and to prepare and generate data reports.
Keywords: nevada test site; radioecology; radioisotopes; radioecological concentration; soils; radionuclide migration; ground water; plants; animals; radionuclide kinetics.

111021 Nevada Applied Ecology Group (NAEG) Vegetation Studies. Romney, E.M. (Univ. of California, Los Angeles, CA). **Project number:** AM03-76-SF-00012. **Contract:** AM03-76-SF-00012. **Supported by:** Department of Energy, Las Vegas, NV (USA). Nevada Operations Office. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The five years of study by the Nevada Applied Ecology Group of Pu and other radionuclides at the old safety-shot sites in Nevada have provided much environmental information, especially as relates to the nature, distribution, persistence, and amount of the contaminants present. There is, however, much important information on resuspension and on biologic, edaphic, and hydrologic reaction mechanisms which yet needs to be obtained in order to help resolve the many questions concerning dissemination of transuranic elements into the natural environment. Several cases in point are discussed as examples. At least another five years of coordinative studies at the old safety-shot sites are highly recommended.
Keywords: nevada test site; plutonium; radionuclide migration; spatial distribution; environmental transport; transuranium elements; radioecology.

111022 Animal Investigation Program. Smith, D.D. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627C-036. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE-$106,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will assess the potential hazard to man through food-chain animals feeding on plutonium-contaminated land and investigate claims of radiation damage to domestic animals living off the Department of Energy's (DOE) Nevada Test Site (NTS). Six beef animals from a grazing herd on the NTS are sacrificed semiannually. These along with periodically collected NTS wildlife are prepared for pathological and radionuclide analyses of selected tissues. The migration patterns and distances of NTS mule deer herds are determined using radio telemetry techniques. Alleged radiation damage to livestock is investigated; bioenvironmental sampling programs at other DOE operational sites are developed; and ad hoc sampling programs in response to any release of radionuclides from NTS are initiated. An annual report of progress-to-date is published in November of each year. An ad hoc investigation report is prepared and published within six months after each investigation. Reports are requested and used by the Nevada Operations Office of DOE and are used by state and Federal wildlife officials for game management. Gamma-emitting radionuclides were detected infrequently and strontium-90 concentrations in bones continued in a downward trend. Statistical analyses of plutonium-239 levels in cattle tissues 1971--1977 revealed levels in lungs, liver, and bone are related to the age of the cattle. Activities did not change significantly in the ingesta and lungs, but tended to increase for bone and liver. Hypothetical dose estimates to man from ingesta of tissues were estimated to be less than 9 millirems. No gross or microscopic lesions were found that could be directly attributable to the effect of ionizing radiation. Deer migrated up to 60 kilometers during the winter months. Statistical estimates were made of the Nevada Test Site deer population.
Keywords: plutonium 239; cattle; radionuclide kinetics; food chains; deer; nevada test site; population dynamics; wild animals; management; strontium 90; radioactive effluents.

111023 Influence of Microbial Activity on the Solubility and Availability of Plutonium. Au, F.H. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627A-81. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the influence of microbial activity on the solubility and biological availability of plutonium and americium. Agricultural crops have been planted in undisturbed plutonium-contaminated soil at the Nevada Test Site using portable greenhouses. The solubility of plutonium as effected by sterile/nonsterile soil and various soil extractants will be determined. The influence of microbial activity as exemplified by successive microbial generations on plutonium solubility will be determined. A research report on the role of microorganisms on increasing the biological availability of plutonium will be published. It was found that plutonium incorporated in tissue was biologically available to succeeding microbial growth. This plutonium was available as other plutonium compounds for uptake by organisms. In the extraction of plutonium in sterile and nonsterile contaminated soil, it was found that plutonium is solubilized by microbial action and that a microbial-plutonium complex occurs to bind it tightly on the soil particles.
Keywords: plutonium; americium; biological accumulation; microorganisms; uptake; plants; soils.

111024 Grazing Studies on the Actinide Contaminated Ranges of the Nevada Test Site (NTS). Smith, D.D. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627A-83. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs. **Funding:** DOE-$60,000.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to provide an assessment of the impact of radionuclide releases on an ecosystem from data collected from tissue and ingesta of animals grazing on a contaminated range. Rumen-fistulated steers serve as biological samplers at six nuclear sites to determine preference for vegetation as a function of availability and season for correlation with tissue radioactivity data to provide inventory information. Grazing ruminants (cattle) will live and graze on one area of known radionuclide contamination for an extended period of time. Periodically animals will be sacrificed and samples collected for analysis for radioactivity. Periodic reports are presented at the Nevada Applied Ecology Group (NAEG) information meetings and published in the proceedings of these meetings. Data will be used by the Department of Energy, NAEG, and other researchers to evaluate models and to delineate transport mechanisms and requirements for clean up of contaminated sites. Food habit analyses of cattle ingesta revealed that shrub species made up the major portion of their diet. Grasses were preferred during the spring months. An apparent relationship between actinide concentrations in the ingesta and Eurotia lanata content was noted. Concentrations of plutonium-239 in the lung, liver, muscle, and femur tissues of the Area 13 cattle were significantly higher than in those tissues collected from cattle grazing other NTS areas, or from Rocky Flats, CO, or Searchlights, NV. The gonadal concentrations of the actinides approached those of bone. These data indicate that consideration should be given to the plutonium-239 dose to gonads as well as that to bone, liver, and lungs for man.
Keywords: nevada test site; contamination; actinides; transplutonium elements; transuranium elements; cattle; radionuclide kinetics; environmental exposure pathway; plutonium 239.

113000 Effects of Aqueous Effluents from In Situ Fossil Fuel Processing Technologies on Aquatic Systems. Bergman, H.L. (University of Wyoming, Rocky Mountain Institute of Energy and Environment, Dept. of Zoology and Physiology, Laramie, WY, 82071). **Project number:** RMIEE TA No. 001. **Contract:** ET-78-C-03-1761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$111,000; EPA-$111,000.
Related energy source: Coal(30); oil and gas(10); oil shale(60) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to evaluate the response of aquatic systems to wastewaters derived from in situ fossil fuel processing for input to the development of control technology measures. The approach is to: (1) determine toxicity to aquatic biota by short term and long term tests with appropriate measures of survival growth, reproduction, behavior, physiology, pathology, and biochemistry; (2) evaluate wastewater degradation and residue kinetics in model laboratory microcosms; (3) evaluate bioaccumulation and metabolism in aquatic biota. The main results of this work will be recommendations on maximum exposure concentrations to protect aquatic biota. These recommendations can then be used as the basis for designing cost effective control technologies and monitoring requirements.
Keywords: toxicity; waste water; in-situ processing; biological effects; aquatic ecosystems; growth; reproduction; behavior; physiology; pathology; biochemistry; decomposition; biological accumulation; maximum acceptable contamination; metabolism; fresh water; biological stress; environmental impacts.

113001 Phytotoxicity and Plant Response to Aqueous Effluents Derived from In Situ Fossil Fuel Processing. Skinner, Q.D. (University of Wyoming, Rocky Mountain Institute of Energy and Environment, Plant Science Division, College of Agriculture, Laramie, WY, 82071). **Project number:** RMIEE TA No. 012. **Contract:** AS20-79LC01761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$100,000.
Related energy source: oil and gas(20); oil shale(80) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to: (1) develop quantitative, short-term, diagnostic screening procedures for plant systems; (2) using such procedures, quantitate the response of arid zone plants to process waters derived from in situ fossil fuel processing and other related waters (e.g., leachates, runoff); and (3) select tolerant or mitigatory plant species for revegetation and rehabilitation of disturbed areas. The initial approach has resulted in the development of quantitative seed germination and hydroponic growth procedures. Selected species will be evaluated for their response to various process-derived waters. This work will result in a cost-effective approach to the selection of tolerant species for revegetation and rehabilitation and will provide input to the development of control measures for process related waters.
Keywords: coal gasification; in-situ gasification; environmental effects; ground water; aquifers; ashes; leaching; runoff; plants; toxicity; tolerance; seeds; germination; hydroponic culture; preferred species; arid lands; land reclamation; chemical effluents; population dynamics; revegetation; pollution control.

113002 Mineralogical and Geochemical Study of the Colorado Oil Shale. Slaughter, M. (Colorado School of Mines, Department of Chemistry and Geochemistry, Golden, CO, 80401). **Contract:** ET-78-S-03-1768. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$62,000.
Related energy source: oil shale(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to quantitatively determine the elemental and mineralogical analyses of oil shale on a microstratigraphic scale. Analysis was performed using electron microprobe, scanning electron microscopy, x-ray diffraction, and x-ray fluorescences. Most of the analysis has been completed and the results are being programmed for computer analysis. The computer analysis will correlate and integrate the data and the results will be integrated for the final report.
Keywords: mineralogy; geochemistry; oil shale deposits; stratigraphy; electron microprobe analysis; x-ray diffraction; fluorescence; data analysis; colorado.

113003 Effluent Inventory and Control Technology Review. Horst, B.I. (Science Applications, Inc., 1200 Prospect Street, La Jolla, CA, 92037). **Project number:** 1-026-06-095-00. **Contract:** 31-109-38-3764. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$30,000.
Related energy source: Coal(20); oil shale(80) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this work was to collect and analyze the available emissions data for these experimental oil shale, underground coal gasification, and tar sands facilities operated and/or managed by LETC personnel. The work was approached by interviewing LETC personnel responsible for each individual project and gathering the needed raw information and data. The results contain a description of each project and tables of data collected from the project. The collection and analysis of this data is significant because it is needed to design pollution coated devices to meet EPA and state environmental regulations. The final product was a report that collects and analyzes all the emission data and puts it into a useful format for use in air and water pollution control research.
Keywords: oil shale processing plants; liquid wastes; gaseous wastes; sampling; pollution control; in-situ gasification; coal; oil sand processing plants; data compilation; wastes.

113004 Off-Gas Utilization/Control for In Situ Oil Shale Retort. Carlin, T.J. (Science Applications, Inc., 1200 Prospect Street, La Jolla, CA, 92037). **Project number:** 1-092-00-298-00. **Contract:** ET-78-C-01-3181. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$90,000.
Related energy source: oil shale(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the work is to investigate the feasibility of utilizing the off-gas from the in situ oil shale retorts. The problem was approached first by compiling data on the composition and other characteristics of the off-gases; second, by determining the applicable air pollution regulations that the effluent from the utilized gases must meet; and last, by researching various off-gas processes that can use the off-gas and meet applicable air pollution standards. The results indicate that combustion processes either proceeded by or followed by sulfur controls are the best ways to utilize the off-gases in an economical and environmetally sound manner. The research is significant in that it tells the type of research that must be done on combustion processes to develop them for use on oil shale off-gases.

Keywords: feasibility studies; in-situ retorting; gaseous wastes; waste product utilization; pollution control; chemical composition; sulfur dioxide.

113005 Environmental Monitoring of Pricetown, West Virginia, In Situ Coal Gasification Field Test. Eli, R.N. (University of West Virginia, Civil Engineering Department, Morgantown, WV, 26505). **Project number:** EY-77-C-21-8087. **Contract:** EY-77-C-21-8087. **Supported by:** Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center. **Funding:** DOE-$75,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to develop hydrology models for predicting coal seam pollutant plume movement and pollutant removal during and after in situ gasification.
Keywords: coal gasification; in-situ gasification; water pollution; hydrology; ground water; hydrocarbons; mathematical models.

113006 Occupational Safety and Toxicological Evaluation of Effluents Derived from In Situ Fossil Fuel Processing. Hepler, D.I. (Elars Bioresearch Laboratories, Inc., P.O. Box 2211, Fort Collins, CO, 80522). **Project number:** AC20-79LC10125. **Contract:** AC20-79LC10125. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$46,000.
Related energy source: Coal(20); oil shale(80) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to perform a complete baseline toxicological evaluation of an in situ oil shale processing retort water. This data will be interpreted in terms of the occupational health risks upon exposure to such waters as encountered by field and laboratory personnel. The data has been used to develop appropriate evaluations of oil shale and coal gasification waters. The data will also be used as input to determine criteria for control of wastewaters. Standard toxicological evaluations including the following have been accomplished: acute primary eye irritation, skin sensitization, acute oral and dermal LD-50 in two species, acute intraperitonial LD-50 in three species, teratology and 90-day feeding triacsin two species, modified dominant lethal assay, and Segment I reproduction study. Results have shown the absence of an acute health hazard under anticipated exposure risk conditions.
Keywords: oil shale processing plants; waste water; toxicity; health hazards; water pollution control; skin; ingestion; teratogenesis.

113007 Laboratory Determination of Leaching Rates from Oil Shale Retorted Under Simulated In Situ Retorting Conditions. Bethea, R.M. (Texas Tech University, Lubbock, TX, 79409). **Project number:** FG03-78ET13084. **Contract:** FG03-78ET13084. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the rate of leaching of inorganic salts from oil shale during and after in situ processing. Parameters being investigated include retorting conditions, water quality parameters, shale mineralogy, and groundwater composition.
Keywords: leaching; retorts; in-situ retorting; oil shales; bench-scale experiments; salts; water quality; mineralogy; ground water; waste water.

113008 Pollutant Control Through Staged Combustion of Pulverized Coal. Wendt, J.O.L. (University of Arizona, Tucson, AZ, 85721). **Contract:** EX-76-C-01-1817. **Supported by:** Department of Energy, Washington, DC (USA). Office of Coal Utilization. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

This project focuses on the development of new pulverized coal combustion technology with a view to minimize the amount of pollutants emitted. Emphasis is on nitrogen oxide emissions, a significant portion of which can be attributed to oxidation of chemically bound nitrogen in the fuel. Staged combustion, in which a portion of the combustion air is removed from the normal burner air and added at some distance downstream, appears to be an effective combustion modification, yet the maximum extent that Fuel NOx can be controlled by this method is unknown. The two specific objectives addressed in this contract are: (1) to determine quantitatively those factors that influence NOx emissions from pulverized coal combustion; and (2) to define the optimum staged combustion configuration for low NOx emissions. Success in this research will, therefore, provide technical guidelines that allow increased utilization of coal through combustion without excessive environmental damage.
Keywords: coal fines; combustion; combustion products; nitrogen oxides; combustors; design; chemical reaction yield; air pollution abatement.

113009 Environmental Aspects of Oil Shale Underground Coal Gasification and Tar Sand Processing. Poulson, R.E. (Laramie Energy Technology Center, Laramie, WY, 82071). **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: Coal(30); oil and gas(30); oil shale(40) **R and D categories:** Environmental transport and conversion of pollutants.

Work under this project will plan the assessment of in situ oil shale processing environmental concerns, will design and carry out subprojects to determine what oil shale fluid products or wastes might be produced and what effects they might have on the environment, and will study how these effects might be mitigated.
Keywords: oil shales; in-situ retorting; environmental impacts; liquid wastes; water quality; meteorology; air quality; ground subsidence; infrared thermography; green river formation; risk assessment.

113010 Water Quality Data Storage and Analysis. Pelton, V. (University of Wyoming, Water Resources Research Institute, Laramie, WY, 82071). **Contract:** PL90337. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$6,000.
Related energy source: Coal(25); oil shale(75) **R and D categories:** Environmental transport and conversion of pollutants.

This project will computerize water quality data from oil shale (underground coal gasifiction and tar sand) related wells. The data will be used for correlations on baseline, operational, and post-operational parameters.
Keywords: oil shale industry; water quality; information systems; baseline ecology; water pollution.

113011 Study of Aerobic Oxidation and Allied Treatments for Upgrading In Site Retort Waters. Probstein, R.F. (Water Purification Associates, 238 Main Street, Cambridge, MA, 02142). **Contract:** AC20-79LC10097. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$74,000.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine by design and experiment the most cost effective aerobic oxidation scheme for upgrading in site process water. This includes a determination of the system economics, its sensitivity to changes in water quality and quantity and to changes in physical and kinetic parameters. Pretreatment ncessary for biological oxidation such as ammonia removal, pH control, and toxicity control will be investigated. To date, the major wastewater streams produced in oil shale processing have been identified and the quality and quantity of these waters expected at commercial scale retorting operations have been estimated. A bio-reactor system has been designed, built, and tested.
Keywords: aerobic conditions; oxidation; waste water; water treatment; cost; efficiency; oil shales; retorts; in-situ retorting.

113012 Formation of NOx and Other Products from Chemically Bound Nitrogen. Blair, D.W. (Exxon Research and Engineering Company, Linden, NJ, 07036). **Contract:** EF-77-C-01-2650. **Supported by:** Department of Energy, Washington, DC (USA). Office of Coal Utilization. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

Research is reported that is designed to separate the process of coal particle combustion into a series of sequential stages (pyrolysis, gas phase combustion, and char burnout), and to carry out both theoretical and experimental studies on the formation of NOx and other products from chemically bound nitrogen that occurs in these stages. The results of this program will provide insight into the fundamental processes of coal combustion, and they will be used to construct useful diagnostic models of the formation of NOx from chemically bound nitrogen is coal combustion. The ultimate aim of the models is the optimization of coal burner design and operation for NOx abatement. This program is in the startup phase. Diagnostic equipment used in studying the pyrolysis stage of coal particle combustion is being put into operation. Theoretical work on both pyrolysis and char burnout is being initiated. This program is a continuation of work that was funded under NSF RANN Grant No. AER 75-03964. In that work, the techniques used in the pyrolysis studies were developed as was an early pyrolysis model. Initial results were obtained on the devolatilization of nitrogen from four coals and one oil shale. Quantities of major gaseous species devolatilized were also measured under simulated combustion pyrolysis conditions.
Keywords: coal; combustion kinetics; nitrogen oxides; synthesis; chemical bonds; pyrolysis; devolatilization; pollution abatement; chars; nitrogen; removal; combustion products; denitrification.

113013 Direct Sampling and Characterization of Gaseous Species. Greene, F.T. (Midwest Research Institute, P.O. Box 27-303, Kansas City, MO, 64180). **Contract:** EF-76-C-01-2288. **Supported by:** Department of Energy, Washington, DC (USA). Office of Coal Utilization. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

A research program is reported that is devoted to identifying the gaseous alkali metal species that may play a role in fireside corrosion, and to developing direct mass spectrometric probes for sampling such species from both idealized laboratory flames and small-scale coal combustors. A knowledge of the gaseous alkali metal species and their behavior during pulverized coal combustion should help elucidate the mechanism of fireside corrosion. A better understanding of this mechanism should assist in finding ways to reduce fireside corrosion, thereby permitting improved Garnot efficiencies and greater boiler availability. A molecular-beam mass-spectrometric sampling system for the study of minor species in coal dust-air flames was designed, constructed, and tested. Interferences caused by ionization by particulates and metastable species were eliminated, and the system capability was demonstrated by sampling alkali metal and other species as parts per million levels from coal dust-air flames. Limited attempts were also made to improve laboratory cost-dust feeder and burner designs.
Keywords: combustion products; coal; combustion properties; alkali metals; corrosive effects; trace amounts; combustors; corrosion; bench-scale experiments; mass spectroscopy.

113014 Biodegradation of Compounds Used in the Recovery of Secondary Oil. Grula, M.M. (Oklahoma State Univ., Stillwater, OK, 74074). **Project number:** 89-00-1201. **Contract:** 80-BC10168.000. **Supported by:** Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to determine the biological degradability of the chemical compounds that are currently being used for enhanced oil recovery. We will examine the degradation products produced by various microorganisms occurring in soils. Polyacrylamides will be hydrolyzed by removal of the nitrogen and substitution of a hydroxyl group. Results have shown that sulfonate detergents are very difficult to degrade biologically; co-surfactants (alcohols and other solvents) are very rapidly degraded; and biopolymers are rapidly degraded by aerobic bacteria.
Keywords: petroleum; enhanced recovery; biodegradation; chemical effluents; microorganisms; synergism; nitrogen; hydroxyl radicals; aerobic conditions; solvent properties; surfactants; alcohols; bacteria; polyacrylates.

113015 Tritium Labelling of Dissolved Organics in Oil Shale Retort Water. Jones, J.R. (Univ. of Surrey, Guildford, Surrey, England GU2 5XH). **Contract:** PL92446. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this research are to develop methods for efficient isolation of dissolved organic solutes from oil shale retort water and to develop methods for uniform incorporation of tritium into the organic isolate. Successful methods have been developed and provide for the first time a high specific activity, uniformly and randomly tritium labelled sample of organics present in oil shale process waters. The radioactive material will find broad applicability in tracing the fate and transport of dissolved organics in the environment and their removal by treatment procedures.
Keywords: waste water; oil shales; organic compounds; tritium compounds; labelling; retorts; environmental transport; waste processing.

113016 Environmental Integration. Kendall, R.F. (Bartlesville Energy Technology Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 89-00-1201. **Contract:** 80-BC10171.DIR. **Supported by:** Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to: (1) consolidate and disseminate environmental, safety, and health (ES and H) requirements information to BETC, other governmental agencies, industry, and the general public; (2) coordinate and integrate BETC's ES and H activities; (3) mitigate constraints on fossil energy technology development and ultimate commercialization; and (4) develop and transfer new technology information. The approach to Environmental Integration is to: (1) determine ES and H requirements for BETC's liquid fossil fuel program; (2) coordinate and schedule environmental and safety requirements for ongoing and proposed field projects to assure regulatory compliance; (3) determine ES and H impacts on fossil energy technology development; (4) establish mitigation research requirements; and (5) project environmental impacts on the commercialization of liquid fossil fuel technologies.
Keywords: fossil fuels; environmental impacts; health hazards; safety; information needs; technology transfer.

113017 Chemical Degradation of EOR Compounds. Donaldson, E.C. (Bartlesville Energy Technology Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 89-00-1201. **Contract:** 80BC10167.DIR. **Supported by:** Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to determine the rates and products of degradation of EOR chemicals in a subsurface environment of 6000 feet depth. Chemical compounds placed in an autoclave with rock and brine are subjected to temperature and pressures of a subsurface depth of 6000 feet. The pilot run on the easily hydrolyzed ethyl acetate to check equipment occurred as predicted yielding acetic acid and ethyl alcohol. Co-surfactant alcohols show no degradation after one month. Sulfonate surfactants show incipient degradation after one month. Polymers will be changed in February.
Keywords: decomposition; chemical reaction kinetics; enhanced recovery; simulation; pilot plants; acetates; acetic acid; ethanol; surfactants; sulfonates; polymers; alcohols.

113018 Biodegradation of Compounds Used in the Recovery of Secondary Oil. Grula, M.M. (Oklahoma State Univ., Stillwater, OK, 74074). **Project number:** 89-00-1201. **Contract:** 80-BC10168.000. **Supported by:** Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

We will determine the biological degradability of the chemical compounds that are currently being used for enhanced oil recovery by examination of the degradation products of microorganisms occurring in soils. Results show that polyacrylamides are hydrolyzed by removal of the nitrogen and substitution of a hydroxyl group; sulfonate detergents are very difficult to degrade biologically; co-surfactants (alcohols and other solvents) are very rapidly degraded; and biopolymers are rapidly degraded by aerobic bacteria.
Keywords: enhanced recovery; petroleum; environmental impacts; biodegradation; chemical effluents; microorganisms; synergism; nitrogen; hydroxyl radicals; aerobic conditions; solvent properties; alcohols; bacteria; polyacrylates.

113019 Chromatographic Properties of EOR Compounds. Donaldson, E.C. (Bartlesville Energy Technology Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 89-00-1201. **Contract:** 80BC10166.DIR. **Supported by:** Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to determine the long-term (100 years +) migration properties of chemical compounds in a subsurface environment equivalent to a petroleum reservoir. Determination is made of the chromatographic coefficients of adsorption and chromatography by following the transport properties of the EOR chemicals in rocks subjected to subsurface conditions. One sulfonate run was completed and prepared for evaluation with a finite difference computer program simulating a reservoir. Dispersion of miscible fluids was completed for determination of the coefficient of dispersion.
Keywords: enhanced recovery; chromatography; environmental transport; rocks; sulfonates; simulation; dispersions; computer codes.

113020 Utilization of Nahcolite in a Dry SO2--NOx Absorber System. Howatson, J. (University of Wyoming, Chemistry Department, Laramie, WY, 82071). **Project number:** RMIEE TA No. 033. **Contract:** ET-77-S-03-1761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE-$25,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Nahcolite, the mineral form of sodium bicarbonate associated with the oil shales of the Green River Formation of Northwestern Colorado, is being actively considered by the power plant industry as the chemical component of a dry SO2--NOx absorber system for the next generation of coal-fired power plants. This project was initiated to obtain detailed information about the chemical aspects of such an absorber system. The reactions of nahcolite and its thermal decomposition product sodium carbonate with sulfur dioxide and nitrogen oxides are being investigated over the temperature range projected for power plant operation. Products formed are being characterized by x-ray diffraction, scanning electron microscopy and chemical analysis. Reaction rates are being measured by weight change and chemical analysis. A bench scale apparatus has been designed and constructed for study of the absorption reactions over a broad range of conditions. The initial work has concentrated on sulfur dioxide absorption. At flue gas temperatures the primary solid reactant is the very porous sodium carbonate produced by the thermal decomposition of nahcolite. Evidence has been obtained that sodium pyrosulfite and sodium sulfite can be produced under some conditions as precursors to the ultimate product sodium sulfate. Continuation of the work in progress will lead to detailed information about the rates and mechanisms of the absorption reactions. The rate information will be useful in optimizing system design and operation and the mechanism information will be useful in evaluating

the possibility of obtaining solid products more valuable than sodium sulfate.
Keywords: nahcolite; sodium carbonates; sulfur dioxide; nitrogen oxides; chemical reactions; fossil-fuel power plants; reaction kinetics; adsorption; sorptive properties; off-gas systems; air pollution control; bench-scale experiments; flue gas.

113021 Electrochemical Disposal of H2S. Brosilow, C.B.; Angus, J.C. (Case Western Reserve University, Cleveland, OH). **Contract:** EF-77-G-01-2728. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Pollutant characterization and analysis.

The purpose of this research is to obtain experimental data on the direct electrolysis of liquid H2S to elemental S and H/sub 2/. The information on anodic and cathodic products, overvoltages, and current densities will be used to make a preliminary estimate of whether an electrochemical process for H2S disposal, which will also deliver net electrical work, is technically and economically viable. Electrolysis of liquid H2S at both cryogenic and room temperatures has been accomplished. Pyridine was used as an electrolyte. Gaseous hydrogen was evolved at the cathode and elemental crystalline alpha-sulfur was the anodic product. The sulfur dissolves in the liquid H2S which prevents the formation of an insulating layer of sulfur on the anode. Cathodic current efficiencies were 99.8 +- 0.7 percent and anodic efficiencies were 86.3 +- 3.6 percent. The cause of the low anodic efficiencies has not yet been identified. Parallel reactions or systematic errors in the analytical procedures are each possible. The major source of voltage loss is solution resistance.
Keywords: hydrogen sulfides; electrolysis; bench-scale experiments; hydrogen production; sulfur; production; efficiency; current density; overvoltage.

113022 Test and Evaluate MHD Components. Murphree, D. (Mississippi State Univ., P.O. Drawer A/AP, Mississippi State, MS, 29762). **Contract:** EX-76-C-01-2246. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This work will evaluate materials and components for heat recovery and seed recovery components in dynamic conditions simulating the MHD environment. Data will be obtained on gas chemistry and materials which will provide the designer of HRSR equipment with the information needed to operate the system in accordance with performance and environmental specifications.
Keywords: coal-fired mhd generators; heat recovery; materials; seed recovery; simulation; environment; specifications; gas analysis; evaluation.

113023 MHD Coal Fired Flow Facility and MHD R and D. Dicks, J.B. (Univ. of Tennessee Space Inst., Tullahoma, TN). **Contract:** ET-78-C-01-3191. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The scope of this project is to obtain experimental information on the effect of slag carryover. A facility will be designed and constructed to permit testing to determine process characterization. These will include effects of slag carryover on NOx and SOx control and the characterization of effluents and emissions leaving the MHD plant.
Keywords: coal-fired mhd generators; gaseous wastes; liquid wastes; nitrogen dioxide; sulfates; slags; pollution control; chemical analysis; process control; design; construction; research programs.

113024 Study of Seed Reprocessing Systems for Open Cycle Coal-Fired MHD. Potterton, S.T. (Babcock and Wilcox, 4282 Strausser St. NW, North Canton, OH, 44720). **Contract:** AC02-79ET15613. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The project will review and assess processes capable of desulfurizing K2SO4 in an environmentally acceptable manner. These processes will be evaluated on the basis of cost, energy usage, and environmental impact. Conceptual designs will be proposed which consider recovery of waste heat and useful by-products and, in particular, solid waste disposal.
Keywords: coal-fired mhd generators; open-cycle mhd generators; seed recovery; spent seed; processing; potassium sulfates; desulfurization; cost; environmental impacts; solid wastes; waste disposal; waste heat; heat recovery.

113025 Study of Seed Reprocessing Systems for Open Cycle Coal-Fired MHD. Herrigel, H. (Resources Conservation Co., P.O. Box 3766, Seattle, WA, 98124). **Contract:** AC02-79ET15534. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The project will review and assess processes capable of desulfurization of K2SO4 in an environmentally acceptable manner. These processes will be calculated on the basis of cost, energy usage, and environmental impact. Conceptual designs will be prepared which consider recovery of waste heat and useful by-products and, in particular, solid waste disposal.
Keywords: coal-fired mhd generators; open-cycle mhd generators; seed recovery; spent seed; processing; potassium sulfates; desulfurization; cost; environmental impacts; solid wastes; waste disposal; waste heat; heat recovery.

113026 Development of Heat Recovery/Seed Recovery System for Open Cycle MHD. Probert, P. (Babcock and Wilcox, Barberton, OH, 44203). **Contract:** AC02-79ET15511. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

This work will obtain a data base for the design of heat recovery and recovery subsystems and components. Included is the study of NOx reduction, SOx reduction, and the control of particulates from MHD power plants.
Keywords: open-cycle mhd generators; coal-fired mhd generators; heat recovery; seed recovery; waste heat; equipment; design; nitrogen oxides; sulfur oxides; particles.

113027 MHD Environmental Project. Dolene, D. (Montana Energy and MHD Research and Development Inst., Box 3809, Butte, MT, 59701). **Contract:** AC07-79ID12036. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The scope of this activity is to provide identification and characterization of environmental issues of concern to MHD facilities. Included in this work is analysis of environmental requirements for MHD, development of an environmental data base, characterization of system interfaces, validation of quench systems, impact of effluent species, and environmental site monitoring.
Keywords: mhd generators; environmental impacts; monitoring; air pollution.

113028 Effect of Synfuels Process Waters on Indicator Bacteria. Adams, J.C. (Univ. of Wyoming, Dept. of Microbiology and Veterinary Medicine, Laramie, WY, 82071). **Project number:** Purchase Order No. PL-91487. **Contract:** PL-91487. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this research is to determine the effect of various synfuel process waters upon representatives of the following groups of bacterial indicators of health hazards: total coliforms, fecal coliforms, and fecal streptococci. This will help answer several questions that could be raised if process waters are allowed to mix with natural/receiving waters. Some of these questions are: (1) will the process waters kill or damage the selected bacterial indicators; (2) will the death or damage be dependent upon the concentration of the process waters in the receiving waters; and (3) finally, will the mixing of the process waters with the receiving waters cause errors in the interpretation of bacteriologic data.
Keywords: bacteria; biological indicators; waste water; synthetic fuels; chemical effluents; water pollution; health hazards; metabolism; toxicity; streptococcus; process solutions.

113029 Microbial Interactions with Aqueous Effluents Derived from In Situ Fossil Fuel Processing. Williams, S.E. (Univ. of Wyoming, Inst. of Energy and Environment, Plant Sciences Division, College of Agriculture, Laramie, WY, 82071). **Project number:** RMIEE TA No. 038. **Contract:** AS20-79LC01761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to: (1) determine the specific effects microorganisms have on altering constituents of fossil fuel derived aqueous effluents by evaluating changes in retort waters resulting from microbial growth, isolating bacteria, and other organisms, demonstrating growth in these waters, and estimating biochemical parameters of bacteria and other organisms demonstrating growth in these waters; (2) evaluate the influence of these effluents on soil microorganisms in an undisturbed environment by assaying samples from treated and untreated plots for total fungi and by completing and summarizing procaryote assays of treated and un-

treated soils; and (3) evaluate the influence of these effluents on parameters indicative of soil biological activity by determining the influence of aqueous effluent from Rock Springs Site 9 on alkaline phosphomonesterase activity.
Keywords: microorganisms; aqueous solutions; waste water; fungi; bioassay; soils; enzymes; oil shale industry; waste management; biological effects; pollution control; land pollution control.

113030 Reverse Osmosis for Treating In Situ Process Condensates and Excess Mine Drainage Water. Hicks, R.E. (Water Purification Associates, 238 Main Street, Cambridge, MA, 02142). **Project number:** AC20-79LC10089. **Contract:** AC20-79LC10089. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to determine the applicability of reverse osmosis to mine drainage water and process condensates from modified in situ oil shale processes; compare the cost and performance of reverse osmosis with ion exchange, resin adsorption, and biological oxidation treatments. The results of this work will be input in a complete waste water treatment scheme which is separately funded. Completed work indicates that reverse osmosis will adequately treat moderate to high quality waters with minimal pretreatment. Low quality retort waters foul and plug the membranes and do not appear to be amenable to reverse osmosis treatment.
Keywords: acid mine drainage; in-situ processing; oil shales; osmosis; cost; pollution control; ion exchange; resins; oxidation; retorts; waste water; water treatment.

113031 Land Restoration for In Situ Oil Shale, Coal, and Tar Sands Processing Technologies. Skinner, Q.D. (Univ. of Wyoming, Range Management Division, Laramie, WY, 82071). **Contract:** AS20-79LC01761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: Coal(35); oil shale(65) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to develop methods for initiation of reclamation and monitoring of reclamation success at the LETC experimental field sites for in situ oil shale and tar sands processing and underground coal gasification. Support services such as consultation on permit applications will be provided as needed and requested by LETC. Mapping of vegetation for the Rock Springs, Wyoming, site is in progress. Mapping for the Green River, Wyoming, and Hanna, Wyoming, sites is to begin soon. Reclamation plans for all three sites will be prepared after the sampling and mapping procedures have been completed.
Keywords: land reclamation; in-situ processing; oil shale mining; coal mines; oil sands; in-situ gasification; underground mining; wyoming; revegetation; planning; evaluation.

113032 Role of Spent Shale in Oil Shale Processing and the Management of Environmental Residues. Hines, A.L. (Colorado School of Mines, Chemical and Petroleum-Refining Engineering Dept., Golden, CO, 80401). **Contract:** AC20-79LC10020. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the project are: (1) to conduct leaching studies on spent shale to identify the leachates; (2) to develop methods to treat and clean up water produced during in situ retorting processes; and (3) to investigate the adsorptive and absorptive properties of hydrocarbon and combustion gases on spent shale produced by in situ processes. Stripping of ammonia and carbon dioxide from a model retort water has been carried out at a number of gas and liquid flow rates at 180 and 200 degrees F. A study and analysis of the adsorption data of hydrogen sulfide on spent shale retorted in an inert atmosphere has been completed.
Keywords: leaching; spent shales; waste water; chemical composition; water treatment; adsorption; absorption; hydrocarbons; gaseous wastes; in-situ processing; ammonia; carbon dioxide; hydrogen sulfides; retorts; packed bed; waste management.

113033 CDIF/MHD Test Integration. Feret, J. (Westinghouse Electric Corp., P.O. Box 10864, Pittsburgh, PA, 15236). **Contract:** EF-77-C-01-2617. **Supported by:** Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The contractor will perform failure mode and effects analysis in accordance with the DOE approved CDIF/MHD Safety Analysis Plan, prepare CDIF Safety Status Reports on test components and subsystems, perform malfunction analysis, and establish criteria for emergency operating procedures.
Keywords: mhd generator cdif; safety; systems analysis; emergency plans.

114000 Marine Environmental Test Program. Kawahara, F.K. (Navy Ocean Systems Center, San Diego, CA, 92152). **Project number:** 3058. **Contract:** EX-76-A-16-3058. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this project are to generate meaningful data on the in-situ marine effects on nuclear fuels for the space program which may be inadvertently deposited in the ocean due to a space mission abort; and to determine effects of heat and radiation on the marine life in proximity to these nuclear fuels. Long-term, in-situ ocean exposure of solid nuclear fuel samples, clad and unclad, is conducted by placing pellets in perforated cages at shallow depths. Natural occurring and implanted marine life in the cages is periodically extracted and examined and after long exposure is returned to laboratory for analysis of effects. Various types of fuels of interest to the space program are placed in the program as they become available. Bottom and water samples are taken in and around the test site and analyzed for dispersion effects.
Keywords: space flight; nuclear fuels; seas; aquatic ecosystems; environmental effects; radiation hazards; seawater; corrosive effects; aquatic organisms; biological effects; temperature effects; biological radiation effects; uranium; plutonium; risk assessment; safety engineering; corrosion; radionuclide migration; space power reactors; cladding.

114001 Environmental and Radiological Safety Studies. Bronisz, S.E. (Los Alamos Scientific Lab., CMB Division, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** D431. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$700,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the program is to generate meaningful data on the environmental effects of the radiation and heat from radioisotope heat sources and radioisotope fuels used for power sources in the space program. Environmental chambers and aquariums are utilized to permit selection of parameters to be tested and to ensure control over them. The effects of these parameters on the fuel material and simulation of different climates, soils, and water compositions are evaluated.
Keywords: safety; radioisotopes; radioisotope heat sources; nuclear fuels; space flight; energy sources; environmental effects; soils; water; data; hazards; air; contamination; radioactive aerosols; age dependence; weathering; climates; computer codes; plutonium; radionuclide migration.

114002 HTGR Seismic Studies. Charman, C. (General Atomic Company, P.O. Box 81608, San Diego, CA, 92138). **Project number:** 64-2204-05. **Contract:** AT03-76ET35300. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$500,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program are to demonstrate the safety of the seismic design of the HTGR core; to test a scale model of the core to determine dynamic characteristics under excitation in the principal horizontal and vertical directions; to compare results with GA private test program and design code predictions; and to improve design codes using test data.
Keywords: htgr type reactors; reactor cores; seismic effects; design; mockup; performance testing; computer codes; reactor safety.

114003 HTGR Accident Initiation and Progression Analysis. Joksimovic, V.W. (General Atomic Co., P.O. Box 81608, San Diego, CA, 92138). **Project number:** 64-2207-04. **Contract:** AT03-76ET35300. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$900,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program are to provide guidance for safety research and development programs for high temperature gas cooled reactors; to identify accident event trees, estimate frequency of event, consequences of events, and related risks; and to identify key accidents in HTGRs requiring additional R and D.
Keywords: htgr type reactors; reactor safety; research programs; reactor accidents; risk assessment.

114004 HTGR Safety Research. Joksimovic, V.W. (General Atomic Company, P.O. Box 81608, San Diego, CA, 92138). **Project number:** 64-2207-05. **Contract:** AT03-76ET35300. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program are to: (1) provide information to accurately predict release of fission products to the environment and the effect on public safety during HTGR accident conditions; (2) determine the need for test facilities to better measure the potential hazard to the public from accident and off-normal HTGR conditions; (3) develop analytical models and experimental data to better predict HTGR containment atmosphere response during HTGR blowdown accidents; and (4) develop methods to verify the seismic adequacy of critical HTGR components.
Keywords: htgr type reactors; reactor safety; reactor accidents; research programs; fission products; containment systems; radiation hazards; environmental effects; plumes; radionuclide migration; blowdown.

114005 GCFR Safety Aspects of Fuel and Core. Sevy, R.H. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 01353. **Contract:** 0038. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$610,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program include: the assessment of GCFR safety related fuel and core features under normal and accident conditions to pinpoint safety and design related concerns; the assessment of GCFR core and reactor structure response to core-disruptive type accidents; the evaluation of accident consequences (radiological) to the outside of a GCFR containment building; the formulation of a GCFR safety test program; and the design, procurement and assembly of GCFR test trains for in-pile safety tests.
Keywords: gcfr type reactors; reactor safety; reactor core disruption; risk assessment; test facilities; reactor cores; fuel pins; plutonium.

114006 Gas Reactor In-Pile Safety Test (GRIST). Arbtin, E. (Idaho National Engineering Lab., 550 Second Street, Idaho Falls, ID, 83401). **Project number:** 00520. **Contract:** 41-1570-1-186. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$600,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program are to: (1) develop the conceptual design for a gas reactor in-pile safety test loop including definition of system and handling requirements, definition of major design features, completion of safety and environmental impact reports; (2) design, procure and assemble all hardware for the test loop and its supporting systems; (3) develop all check-out and proof-test procedures, operating procedures, operator training, and the experimental test and examination procedures; and (4) operate the test facility with reduction and reporting of the test data.
Keywords: gcfr type reactors; reactor safety; loss of flow; loss of coolant; test facilities.

114007 GCFR Accident Initiation and Progression Analysis. Broido, J.H. (General Atomic Company, P.O. Box 81608, San Diego, CA, 92138). **Project number:** 00589. **Contract:** 0167. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$580,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program are to identify and evaluate various high risk accidents for the GCFBR; to apply this information to idenitify practical improvements in reactor system design or operating procedures to reduce these risks; to apply this information to provide guidelines and priorities for selecting safety-based R and D for GCFBR's; and to maintain close liaison and input to other organizations performing safety testing and/or analysis on GCFBR for DOE and NRC.
Keywords: gcfr reactor; reactor safety; reactor accidents; research programs; plutonium; risk assessment.

114008 Gas Cooled Fast Reactor (GCFR) Safety. Hanson, D.L. (Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 00354. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$540,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the program are to: (1) perform fuel cladding melting and relocation tests for the loss of flow accident without scram; (2) perform similar GCFR accident simulation tests on test assemblies representing the GCFR control element; and (3) demonstrate behavior at a full size simulated GCFR subassembly in the event of a loss-of-pressure accident with scram.
Keywords: gcfr type reactors; reactor safety; research programs; loss of flow; fuel elements; meltdown; test facilities; nuclear fuels; simulation.

114009 Environmental Assessment of Alternate Fast Breeder Reactor (FBR) Fuels. Tennery, V.J. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** OH107. **Contract:** 0022. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$360,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The environmental impact of the use of alternate fuels instead of mixed-oxide fuel for the LMFBR and its supporting fuel cycle is being assessed. Expected effluents and control technology requirements for substituting alternate fuels for mixed-oxide fuel in LMFBR fuel cycle are being analyzed. Resulting environmental impacts, using existing computer codes, are being estimated.
Keywords: nuclear fuels; lmfbr type reactors; fuel cycle; environmental impacts; chemical effluents; computer codes; radioisotopes; safety; radioactive wastes.

114010 Meteorological Studies. Van der Hoven, I. (National Oceanic and Atmospheric Administration, Air Resources Laboratory, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** HH009. **Contract:** EX-76-A-27-1289. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$250,000; NRC-$220,000.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives consist of research and meteorological dispersion to obtain dispersion parameters for a variety of types of sites, particularly LMFBR program and potential reactor sites; field measurements of downwind tracer gas concentrations and related meteorological parameters over a wide range of distances, terrain, weather conditions and source configurations; validated dispersion parameters and improved calculational models; and performance of building wake effects studies.
Keywords: lmfbr type reactors; site selection; meteorology; air; computer codes; radioactive effluents; measuring instruments; dispersions.

114011 Sodium Cooled Breeder Reactor Safety Program. Gavigan, F.X. (DOE, Division of Reactor Research and Technology, Washington, DC, 20545). **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$51,827,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the program is to provide a technology base of analytical tools and experimental data fully responsive to major accident safety considerations in the design, evaluation, licensing, public acceptance, and economic optimization of sodium cooled breeder reactors for commercial power generation. The approach is to organize safety technology work in terms of four lines of assurance, each of which represents a barrier to the initiation or progression of a major breeder reactor accident sequence, and to pursue individually manageable projects within each line of assurance. Products will be analytical tools and experimental data that can be used to demonstrate that sodium cooled breeder reactors can be designed such that postulated major reactor accidents would not pose significant risk to public health and safety.
Keywords: lmfbr type reactors; reactor safety; computer codes; plutonium.

114012 Commercial Nuclear Waste Management Terminal Storage R and D. Carter, N. (Battelle Memorial Institute, 505 King Avenue, Columbus, OH, 43201). **Project number:** AR-03-01. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$66,000,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project objectives are (1) to assure the timely availability of repositories in geological formations for terminal storage of radioactive wastes from commercial sources for which Federal custody is required; and (2) to conduct geoscience studies in promising crystalline, shale and salt formations in order to identify sites for terminal storage repositories. Pilot plant repositories will be constructed.
Keywords: radioactive wastes; radioactive waste disposal; underground disposal; geology; geological surveys.

114013 Defense Radioactive Waste Management R and D. Beckner, E.H. (Sandia Labs., Albuquerque, NM, 87115). **Project number:** JM-05-03. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$11,180,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to demonstrate the geological isolation of transuranium (TRU) contaminated waste. Necessary geoscience investigations will be performed to allow selection and characterization of a site in bedded salt for the terminal storage of existing and future DOE generated TRU contaminated wastes.

Keywords: radioactive waste management; radioactive waste storage; underground storage; geologic structures; site selection; storage facilities; salt deposits.

114014 Sodium Combustion Product Plume Transport Studies. Morewitz, H.A. (Atomics International Div., Rockwell International, 8900 De Sota Avenue, Canoga Park, CA, 91304). **Project number:** SA047, Subtask B. **Contract:** EY-76-C-03-0824. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(50); solar(50) **R and D categories:** Environmental transport and conversion of pollutants.

The test series consists of seven release tests using 23 to 68 kg of 540 degrees C sodium. The sodium was released directly to the atmosphere under controlled meteorological conditions (Pasquill A, D and F) at heights up to 36 meters. The purpose of the test series is to provide a source of airborne sodium oxide particles which simulate the release from either a solar energy receiver or an LMFBR heat transport system. These tests will (1) characterize the released airborne particles in terms of concentration, deposition, size and species; (2) determine the downwind dispersion of particles under various meteorological conditions; and (3) obtain experimental data to validate chemical and depletion models in the COMRADEX Code.
Keywords: lmfbr type reactors; sodium; aerosols; environmental impacts; environment; fires; reactor accidents; reactor safety.

114015 Dispersion Modeling. Coffey, R.S. (NUS Corporation, 4 Research Place, Rockville, MD, 20850). **Project number:** 2320. **Contract:** EN-77-C-02-4290. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$45,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop mathematical models to predict the dispersion characteristics of nuclear fuels uses in the space power program in the atmosphere, lithosphere and hydrosphere. Data generated in the laboratory which demonstrate the behavior of nuclear fuels in the environment are modeled mathematically. These models are used to statistically evaluate the risk of using space power systems.
Keywords: space power reactors; reactor safety; environmental impacts; risk assessment.

114016 Environmental Assessments of Nonproliferation Alternatives. Rohwer, P.S. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 01446. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to identify key environmental issues and constraints to licensing for alternative nuclear systems considered in the Nonproliferation Alternative Systems Assessment Program (NASAP). Work is done by examination of NASAP characterization contractor's reports and published analyses of nuclear fuel cycles. Product is input for quarterly NASAP Rolling Report which, at completion, will be the DOE's NASAP report.
Keywords: environmental impacts; fuel cycle; proliferation; licensing.

114017 Model Evaluation of Breeder Reactor Radioactivity Releases. Miller, C.W. (Oak Ridge National Laboraory, Building 7509, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** OH 155. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE-$255,000.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The purpose of this project is to recommend those models and parameters best suited for predicting individual and population exposures resulting from routine and accidental breeder reactor radioactive discharges and to verify models to the extent possible. Models with potential for near-term application to breeder reactor releases and models to be subjected to long-term evaluation have been identified through an extensive literature search. Data on key parameters in these models is being compiled. These data will be subjected to statistical analysis to determine optimal values to be used in assessment models and to determine the uncertainty associated with these parameter values. Data are also being compiled for comparison with model output. At the conclusion of the project uncertainties will be documented and recommendations will be made as to those models and parameters which are best suited for breeder reactor assessments.
Keywords: lmfbr type reactors; radioactive effluents; fission product release; mathematical models; calculation methods.

114018 Environmental Radiation Safety, Plutonium Source Team Evaluation. Moss, O.R. (Battelle Pacific Northwest Lab., Richland, WA, 99352). **Project number:** AG-40-20-04. **Contract:** AC06-76RL01830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the project is to evaluate the plutonium source term in the environment in the event of a space vehicle or nuclear source accident which might result in the damage of a 238-Pu refractory oxide power source. Experiments are conducted on aerosol interaction, soil-plutonium aging, plutonium dissolution, and aerosol characterization. Particle size distributions, coagulation rates, dissolution rates, and source term are measured, calculated, and evaluated from compiled data. From the aerosol interaction experiments, a general conclusion is that coagulation of different aerosols (soil, plutonium, etc.) observed in the experimental model results in an increased safety factor (on the order of a factor of 10) over the plutonium aerosol alone. Plans are to conduct additional experiments to measure soil scattering and resuspension from impact and better quantify coagulation ratios.
Keywords: radiation protection; plutonium; health hazards; radionuclide migration; soils.

114019 Advanced Cooling Concepts Test. Johnson, B.M. (Battelle Pacific Northwest Lab., Richland, WA, 99352). **Project number:** 01400. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE; EPA; EPRI.
Related energy source: Coal(30); oil and gas(10); nuclear fission(30); solar(10); geothermal(20) **R and D categories:** Environmental transport and conversion of pollutants.

A 10-MWt Advanced Heat Dissipation Test System is to be built at the PG and E Kern Station, Bakersfield, California. This concept uses ammonia to transfer the heat from the condenser to the cooling tower. In the cooling tower, two advanced cooling methods will be tested. These are deluged-wet/dry cooling and/or all-dry cooling. The unit also uses a steam-to-ammonia reboiler in place of the standard condenser. Altogether the improvements are expected to demonstrate a 30 to 50% reduction in dry and dry/wet cooling system for power plants. The project is currently in Title II design phase and is planned to be built in FY 1981. EPRI is supplying the majority of funds to the design and construction phases. The principal hardware components have been purchased.
Keywords: thermal power plants; cooling systems; cooling towers; ammonia; feasibility studies; design; condensers.

114020 Water Use Information System. Fletcher, J.F. (Westinghouse Hanford Co., Richland, WA, 99352). **Project number:** 01326. **Contract:** EY-76-C-14-2170. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: Coal(10); oil and gas(10); nuclear fission(50); nuclear fusion(10); geothermal(10); hydroelectric(10) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the project is to develop a computerized system whereby it is possible to predict where and when deficiencies in power plant cooling water availability may occur, thus dictating nonconventional cooling methods which are less water consumptive or changes in power plant siting. The objective is met through the establishment of: a data bank on water availability (ground, surface, estuarine) and its associated characteristics; power plant operating characteristics, with primary emphasis on water withdrawals and consumptive use; and a predictie model for central station power plant growth and associated water usage. To date, the basic data bank is operational and is being used by a number of groups, and the predictive model is under development (to be operational in early CY 1979). An initial hand analysis of the need for advanced power plant cooling methods was published in 1976. This will be updated in FY 1979-80. Supporting water requirements studies for geothermal and high temperature reactors were undertaken in 1979--1980.
Keywords: water; consumption rates; information systems; cooling systems; power plants; site selection; mathematical models; water requirements; thermal effluents.

114021 Meteorological Effects of Thermal Energy Release. Patrinos, A.A. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 01308. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The objective of the METER Program is to develop methods and a data base to assess the atmospheric effects of heat and moisture releases from large nuclear and fossil energy generating facilities. The atmospheric effects of interest include precipitation modification, fogging and icing, drift deposition and shadowing. Included in the program are effects from mechanical and natural draft cooling towers as well as cooling ponds. Primary emphasis is given to field studies with related analytical and physical modeling studies conducted as well. Oak Ridge National Laboratory has been carrying out a precipitation study over a several year period at the 3160 MWe

Bowen Power Plant in Georgia utilizing a dense raingage network around the plant to determine to what extent normal rainfall patterns are affected by thermal emissions from natural draft cooling towers. A report of six months of storm data was published in June 1979. Other efforts include: (1) an analysis of drift deposition and transport from mechanical draft cooling towers; (2) airborne measurements of velocity, temperature, and humidity in cooling tower plumes; (3) mathematical modeling to predict the occurrence of snowfall from natural draft cooling tower plumes; and (4) physical modeling of multiple plume interactions between adjacent cooling towers.
Keywords: meteorology; waste heat; thermal pollution; air pollution; nuclear power plants; fossil-fuel power plants; cooling towers; cooling ponds; environmental impacts; environmental effects; moisture; climates; modifications.

114022 Power Plant Reject Heat Utilization. Spiewak, I. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** AG-0409-02. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of this project is to assess the potential for using power plant waste heat.
Keywords: thermal power plants; waste heat; waste heat utilization; feasibility studies.

114023 Long-Term Defense Waste Management Technology. Daly, G.H. (DOE, Office of Nuclear Waste Management, Washington, DC, 20545). **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The technology program is directed toward the development and evaluation of alternatives for the long-term management of DOE radioactive wastes from producing materials in the defense program. It consists of developing alternative technologies for each waste type and assessing the associated hazards, costs, and environmental impact in order to selected and implement the optimum long-term disposition alternative. Technology to reduce volumes of waste, immobilize the residue and package the waste in a manner acceptable for interim and terminal isolation is being developed.
Keywords: radioactive waste management; radioactive waste disposal; radioactive waste processing; solidification; volume; national defense; evaluation; cost; environmental impacts; high-level radioactive wastes.

114024 Waste Treatment Technology. Daly, G.H. (DOE, Office of Nuclear Waste Management, Washington, DC, 20545). **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The program will develop technology for immobilizing waste from commercial nuclear fuel cycles and converting it to forms which provide safety and economy of management, satisfy regulatory requirements, and are acceptable for terminal isolation.
Keywords: radioactive waste processing; solidification; high-level radioactive wastes; vitrification; volume.

114025 Off-Gas Processing: Krypton Recovery. Groenier, W.S.; Stephenson, M.J. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** WAA-80-139. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the krypton recovery program is the development of engineering technology, based on fluorocarbon absorption, for the safe, reliable removal of Kr-85 during the reprocessing of spent power reactor fuel. Absorption and separation of krypton and xenon from air streams by contacting with fluorocarbons have been demonstrated on a pilot-plant scale at the Oak Ridge Gaseous Diffusion Plant (ORGDP). This process was conceived by Steinberg at Brookhaven National Laboratory in 1959. Because the system operates in the temperature range of -25 to +50 degrees F, it avoids the potential hazards associated with operating at liquid nitrogen temperatures. The system is also much less sensitive to contaminants in the feed gas such as trace organics, carbon dioxide, and nitrogen oxides. Small quantities of water can be handled effectively in the system. The removal of krypton and xenon from contaminated air can be accomplished by intimately contacting the bulk gas stream with a continuously flowing stream of fluorocarbon solvent in a packed absorber column at a relatively low temperature and moderate pressure. Because of differences in solubility, essentially all of the krypton and xenon, plus substantial amounts of oxygen, nitrogen, and argon, can be dissolved in the solvent. The off-gas leaving the absorber column is reduced in krypton by a factor of 100 to 1000 and can be vented safely.
Keywords: krypton 85; radioactive waste processing; fuel reprocessing plants; off-gas systems; adsorption; fluorinated aliphatic hydrocarbons.

114026 Transportation Technology Environmental Information Center. Davidson, C.A. (Sandia Laboratories, Albuquerque, NM, 87185). **Project number:** AS-05-05;AR-05-25;AP-05-15. **Contract:** ALO 51 (ALO 517B). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$60,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Under this program, a centralized source of environmental information is provided for use by organizations engaged in risk assessment, testing, and evaluation of standards for programs involving the transportation of energy materials. Information generated is analyzed, summarized, and disseminated to potential users. Emphasis is placed on obtaining the latest information, ensuring comprehensive coverage of transportation application and publicizing the existence of the information. Such information is provided on a cooperative basis to other government agencies, industries, and when appropriate, to foreign nations. Information collected under this program has been and is being used as the prime source for studies of normal and accident transportation environments, in truck, train, aircraft, and ship modes of transport. The index to this work is updated annually and information is added to the program as it becomes available.
Keywords: transportation systems; accidents; environmental effects; energy sources; transport; data acquisition; risk assessment; standards; transportation systems.

114027 Study of Physical Parameters of Transportation Accidents. Hartman, W.F. (Sandia Laboratories, P.O. Box 5800, Albuquerque, NM, 87185). **Project number:** 800037. **Contract:** AT(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$70,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Examination of the extreme severities of transportation accidents indicates that it is not necessarily desirable, or even possible, to protect cargo against all possible accidents. Accepting some small probability of an undesired consequence may be necessary. The referenced transportation accident analysis (as described in detail in SLA-74-0001) provided a probabilistic definition of the environments experienced by containers in transportation accidents. However, as this analysis indicated, these environments are not only a function of the accident statistics, but also depend on the composition of cargo load. Because of a companion study being conducted for DECT by Battelle Northwest Laboratories, PNL, the load analyzed in the study which resulted in SLA 74-0001, identified herein as the transportation accident criteria (TAC) study, consisted primarily of small cylindrical containers with individual weights less than 4000 pounds which are carried out in large numbers on one trailer or boxcar. The results of the TAC study could not be directly related to the environment experienced by large shipping casks carried on their individual railcars or flatbed trailers. A study was completed in FY 76 to extend the TAC study to describe the transportation accident environments to which these large fuel casks can be exposed. Those features of transportation systems operation and maintenance which potentially contribute to severe accidents will be identified. Benefits of possible modifications to these operations will be evaluated with the data base and analytical models derived in the previous tasks.
Keywords: transportation systems; accidents; casks; safety; operation; maintenance; modifications; cargo; railways; environmental impacts; impact tests.

114028 Assessment of ECT Implications of Malevolently Produced Releases from Radioactive Materials Shipping Containers. (Sandia Laboratories, Transportation Safety Technology Division 5433, Albuquerque, NM, 87185). **Project number:** 800036. **Contract:** AT(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$190,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

This program provides a comprehensive study of the failure modes of protective packages for radioactive materials subjected to malevolent attack and the resulting consequences from a release and dispersal of the contents of the container. The major efforts include: (1) categorization of packages, (2) evaluation of attack modes, (3) tests on obsolete full scale and model packages, (4) tests on model packages reflecting current and planned technologies for shipping high level waste and spent fuel, (5) tests on spent fuel to determine source term (release and aerosol fractions, particle size distribution, and energetics), and (6) possible design improvements and deterrent systems.

Keywords: casks; design; failures; testing; high-level radioactive wastes; spent fuels; security; physical protection; safety; transport; sabotage; safeguards.

114029 Transport of and Packaging of Radioactive Materials--Films. Colgan, R.C. (Sandia Laboratories, Division 3153, Albuquerque, NM, 87185). **Project number:** 800050. **Contract:** AT(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$40,000. **Related energy source:** nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of this program are to produce films on the packaging and shipping of radioactive materials; to provide motion picture coverage of Sandia tests and projects being conducted for the Transportation Staff/ECT/DOE; and to provide and/or coordinate motion picture coverage of other DOE laboratories or multilaboratory projects in this area. The work involves the preparation of a film specification sheet (purpose, content, etc.) on a specific topic defined by the Transportation Staff, followed by a treatment, script, filming, narration, interlock and optical track prints. Six films and a specification and treatment for a film on the package design for all types of radioactive materials shipments have been completed. Photography will begin on this film in FY1978 and the film will be completed in FY1979. Future projects include films to be defined by the Transportation Staff/ECT/DOE and report films on tests conducted for that Staff by Sandia. A stock footage library will continue to be maintained. A 14-1/2 minute, sound, color film, Accident Safe, on a variety of tests on containers used to carry radioactive materials including the five full-scale cask impact and burn tests has been completed. The film also discusses the use of computer modeling and scale-model testing as accurate prediction and analyses techniques. Four short, sound, color films on the full-scale impact and burn tests were made as each test was completed. The final film was a 3-minute, sound, color film on all five tests, and it has received extremely wide distribution. Also completed were six, short, silent, color films on various 1/8-scale and full-scale cask impact tests.
Keywords: radioactive materials; packaging; transport; casks; testing; photography; photographic films.

114030 Risk Assessment and Testing. Rhoads, R.E. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 800041. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$320,000.
Related energy source: Coal(10); oil and gas(10); nuclear fission(80) **R and D categories:** Environmental effects assessment.

The objective of the Transportation Safety Studies project is to assess the risks to man and the environment from the transport of energy materials. The study encompasses essentially all transportable energy materials and transportation modes with emphasis on nuclear fuel cycle materials. State-of-the-art risk assessment methods such as fault tree analysis are used in the study. The program output will be a series of reports on the risks in transporting particular energy materials by particular transport modes. The reports will provide: (1) a quantitative evaluation of the risk, (2) information to assist society in determining the acceptability of the risk, and (3) an indication of the principal contributors to the risk. This will provide direction on methods to change the transport system should the risk be judged unacceptable by society.
Keywords: risk assessment; safety; environmental impacts; transport; energy sources; fault tree analysis; transportation systems.

114031 Year 2000 Study. DeSteese, J.G. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800032. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$250,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives of this project are to: (1) characterize the present transportation systems for energy materials; (2) project system characteristics through the year 2000; (3) identify possible problems that could occur in energy material transportation; and (4) suggest actions that could be taken to prevent their occurrence. Such identification of potential problems well in advance of their occurrence will serve to reduce the number and severity of potential crises. The project will include literature searches, workshops, discussions with key personnel in energy and transportation, and analysis of the information obtained.
Keywords: radioactive materials; transport; forecasting; radioactive wastes; economics; transportation systems; waste transportation.

114032 Full Scale Vehicle Testing Program. Yoshimura, R.H. (Sandia Laboratories, Division 5433, Albuquerque, NM, 87185). **Project number:** 800043. **Contract:** E(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$550,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

For the first time, full scale hazardous material packaging systems will be exposed to a series of extreme full scale transportation accidents that will be carried out under laboratory controlled conditions. This test series will measure the response of actual hardware to real accident conditions. In the current test program, three basic tests were planned: (1) locomotive grade-crossing impact with a tractor-trailer system carrying a spent nuclear fuel shipping cask; (2) crash test of a truck transport system and spent nuclear fuel shipping cask into a solid concrete barrier; and (3) collision into a solid concrete barrier and fire test of a special railcar carrying a spent nuclear fuel shipping cask. The locomotive grade-crossing test and the crash test of the truck transport system were conducted during FY 77.
Keywords: transportation systems; accidents; packaging; impact tests; spent fuel casks; trucks; trains; safety; cargo; railways.

114033 Sub seabed disposal. Anderson, D.R. (Sandia Laboratories, Albuquerque, NM, 87185). **Project number:** AP-05-15-20. **Contract:** AT(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$2,830,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to determine the environmental and technical feasibility of emplanting high-level radioactive wastes into the deep ocean floor in geologically stable and biologically inactive sediments; and (2) to develop and maintain a capability of assessing the ocean radioactive waste disposal programs of other nations. The approach is to first assess and define an entire disposal system and to determine the feasibility of seabed disposal from firm scientific and technical information. The safety and environmental effects of such a system are then to be determined, and the requirements to carry out seabed disposal defined, based on the findings of the program as above and subject to considerations of both the feasibility and safety of the system. The final step is to prove system capability by a combination of tests and demonstrations.
Keywords: radioactive waste disposal; marine disposal; sea bed; high-level radioactive wastes; feasibility studies; sediments.

114034 Study of Decommissioning Accelerators and Fusion Devices. Marmer, D.G. (Argonne National Laboratory, 9700 S. Cass Avenue (EIS-10), Argonne, IL, 60439). **Project number:** 800313. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$85,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this study is to determine the cost, amount of waste produced and sensibility of components when an accelerator is permanently decommissioned. A thorough list of existing accelerators is being developed. Comments on guidelines for low level waste disposal as they pertain to accelerator comments are discussed.
Keywords: cost; accelerators; decommissioning; low-level radioactive wastes; radioactive waste disposal.

114035 DOE National D and D Plan. King, J.C. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 800308. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE-$60,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Several hundred radioactively contaminated facilities under the cognizance of the Department of Energy have been removed from active service and must be dismantled, decontaminated or prepared for safe storage of their radioactive inventory. Included are reactors, laboratories, fuel reprocessing plants, waste management and other facilities used in the development of nuclear energy. Responsibility for disposition of facilities declared surplus prior to October 1, 1976, is with the Division of Environmental Control Technology (ECT). To provide overall coordination of disposition planning, ECT has established a National Disposition Planning Program. Initial objectives of this program are to develop a nationwide inventory of surplus DOE contaminated facilities and to establish an initial prioritization of facilities for disposition. The ultimate output of the program will be a Disposition Program Plan which will be utilized in developing five-year plans for disposition of surplus facilities and for preparing annual budgets. Three contractors, including Battelle Pacific Northwest Laboratories (PNL), Atomics International (AI), and United Nuclear Industries (UNI) will contribute to the National Disposition Planning Program. PNL responsibilities are to assist in the development of a comprehensive, long-range National Disposition Program Plan and five-year operating plans, using the prioritization and planning methodologies developed for the Hanford Decommissioning Planning Project. PNL is also responsible for providing overall program review and evaluation as requested by the sponsor.
Keywords: decontamination; decommissioning; nuclear facilities; safety; planning.

114036 Engineering Feasibility of Uranium Tailings Stabilization Methods. Overmyer, R.F. (Ford, Bacon and Davis Utah, Inc., 375 Chipeta Way, Salt Lake City, UT, 84108). **Contract:** AC13-76GJ01658. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE. **Related energy source:** nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The work had the following objectives: (1) determine effectiveness of various tailings stabilization materials on radon flux attenuation, including coal, activated charcoal, oil and Calcilox under various environmental conditions, and (2) determine diffusivity of radon gas through various media, including air, sand, and clay. The work included large scale testing of Calcilox volumetric stabilizer in tailings, with and without soil covers; laboratory scale tests of effectiveness of coal, oil, and activated charcoal as covers over tailings; and gaseous diffusion experiments on radon through air, sand, clay, glass, and steel wool. The results of the work will provide input into the determination of the stabilization concept to be used at each site.

Keywords: mill tailings; feasibility studies; stabilization; feed materials plants; engineering; radioactive waste management; radon; coal; oils; activated carbon; attenuation.

114037 Asphalt Emulsion Sealing of Uranium Tailings. Hartley, J.N. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Contract:** 80379. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The overall objective of this project is to investigate the use of asphalt emulsion sealants to contain radon and radium in uranium tailings, including the development of engineering criteria for sealing uranium tailings. The approach is to carry out both laboratory and field studies on the use of asphalt emulsion as a long-term sealant for (1) uranium tailings characterization, (2) asphalt emulsion tailings seal formulation, (3) radon and radium diffusion and permeation measurements, and (4) asphalt emulsion tailings seal stability tests. Field studies include reviewing application technology and conducting field test at selected inactive tailings sites. The stability of the seal, as affected by mechanical abuse, root penetration and overburden requirements, is evaluated, and the effectiveness of the seal for radon reduction is determined.

Keywords: asphalts; mill tailings; sealing materials; emulsions; radon; radium; radionuclide migration; field tests; stability; radiation protection.

114038 Pollution of Ground Water Due to Inactive Mill Tailings. Chappelle, W. (Univ. of Coloradc, Center for Environmental Sciences, 1100 14th Street, Denver, CO, 80202). **Contract:** EY-76-S-02-4017. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of the work is to determine the geochemical processes involved in the transport of contaminants from inactive mill tailing sites and to survey the extent of water pollution at such sites. Other objectives are: (1) to establish the presence of ground water at or near existing sites; (2) to establish the extent of seepage and leaching by rainfall and snowmelt and the need for a lining of the ground in the case of tailings relocation; (3) to predict the amount and concentration of contaminants which could emanate from the piles; (4) to measure contaminant concentration in the ground surrounding pile and to validate the predictions; and (5) to evaluate the hydrology of alternate, final repositories.

Keywords: ground water; contamination; mill tailings; leaching; hydrology; radionuclide migration; radiation monitoring; radicactive waste disposal; radioactive waste facilities.

114039 Decommissioning of the New Brunswick Laboratory. Mann, S.A. (DOE, 9800 South Cass Avenue, Argonne, IL, 60439). **Contract:** DOE/CORO. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the project is to return to unrestricted use the site of the old New Brunswick Laboratory facilities in New Jersey. The laboratory consists of several building complexes on a 4.7 acre site. Radioactive contamination in the buildings will be reduced to acceptable levels by removal of equipment, materials, and portions of the structure as necessary. The underground piping system will be removed as well as a stockpile of pitchblende contaminated soil buried on the site. Following decontamination, all remaining structures will be demonlished and the site released for unrestricted use. Initial decontamination was accomplished by a commercial firm under contract to DOE during FY 1978. This work involved removal of all contaminated furniture, equipment, ventilation, and filter systems and the entire above grade piping systems. An architect-engineer firm is presently under contract to prepare a Phase II design package for further decontamination work at the site. This will consist of procedures for removal of the remainder of building contamination including the underground sewer system and demolition of all structures.

Keywords: decommissioning; nuclear facilities; new jersey; decontamination; radioactive wastes; transport; removal; abandoned sites.

114040 Weldon Spring Site-Supervision and Decommissioning. Cavendish, J.H. (National Lead Co. of Ohio, P.O. Box 39158, Cincinnati, OH, 45239). **Contract:** AC05-76OR01156. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to decommission the DOE-Weldon Spring site and return it to unrestricted use. The site consists of four pits that contain the radioactive wastes generated from the production of uranium metal at the Weldon Spring Production Center from 1957 to 1966. DOE also has possession of a quarry located four miles from the Weldon Spring Plant which was used for the disposal of contaminated rubble and thorium residues. The residues contained in the four pits are to be removed by private contractor. The National Lead Company of Ohio will monitor the removal of the sludges and pump any surface runoff as necessary back into the pits. After the sludges have been removed, the supernatant liquors will be treated and disposed of, and the site will be graded to an essentially natural contour. Pending geological and risk assessments, there may be an attempt made to seal a portion of the floor of the quarry with grouting. If this proves successful, then the quarry area will be filled, graded, and seeded. Biodenitrification studies of pit water have been initiated at ORNL. Background information on the quarry has been summarized; geological and risk assessments have been initiated through ORNL toward isolation of the quarry from the environment.

Keywords: decommissioning; radioactive waste storage; radioactive waste facilities; uranium; mill tailings; radioactive waste processing; transport; radiation monitoring; land reclamation; excavation; risk assessment; denitrification; decontamination.

114041 Decommissioning Engineering: Shippingport Atomic Power Station. Miller, R.L. (UNC Nuclear Industries, P.O. Box 490, Richland, WA, 99352). **Contract:** EY-76-C-06-1857. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the program is to decontaminate and decommission (D and D) the Shippingport Atomic Power Station following shutdown and defueling consistent with contractor obligations.

Keywords: shippingport reactor; reactor decommissioning; decontamination.

114042 Decommissioning of Sodium Reactor Experiment Facilities. Carroll, J.W. (Atomics International/Rockwell, 8900 DeSoto Avenue, Canoga Park, CA, 91304). **Contract:** AI03-76SF75008. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the task are to dismantle the Sodium Reactor Experiment (SRE) facility and to remove all significant reactor originated radioactivity from the site, thus releasing the facility from all requirements for radiological control, licensing, or monitoring and make the site available for other uses.

Keywords: sre reactor; reactor decommissioning; reactor dismantling.

114043 Decommissioning of DASMP Areas (Mound Facility). Elswick, T.C. (Monsanto Research Corp., P.O. Box 32, Miamisburg, OH, 45342). **Contract:** P79-02-216. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The D and D of inactive DASMP areas was initiated, wherein surplus plutonium-238 contaminated gloveboxes and other equipment were removed from the inactive DASMP areas. These areas are being restored to a reusable condition for further program utilization. The areas to be decommissioned and decontaminated are portions of the PP Building, portions of the R Building, and the Waste Transfer System. The project consists of removing contaminated gloveboxes, decontaminating areas to specified levels (wipe <3000 d/m/60 sq-cm and external radiation <1 mr/hr at surface) disposing of contaminated equipment and wastes. In PP Building partitions are being installed where gloveboxes have been removed in order to maintain the access corridor concept for proper ventilation control. This work package's program benefit will be to satisfy a directive to remove plutonium-238 processing from Mound Facility plus it will provide space for new DOE programs.

Keywords: decommissioning; plutonium 238; nuclear facilities; gloveboxes; decontamination; removal; transport; mound laboratory.

114044 Decommissioning of Center for Energy and Environmental Research (CEER), Mayaguez Facility. Barcelo, H. (Univ. of Puerto Rico, Mayaguez, PR). **Project number:** 800090. **Contract:** EY-76-C-05-1833. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE. **Related energy source:** nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The reactor facility will be decommissioned and decontaminated to levels suitable for release for unrestricted use. The approaches used consist of: (1) preparation of an engineering assessment; (2) preparation of the site for disposition operations; (3) removal of reactor core tower and support structures; (4) removal of radioactive or contaminated pool structures, such as beam ports and thermal column Pb window; (5) removal of radioactive pool concrete and embedments; (6) removal of contaminated components of the cooling system; (7) decontamination of hot cells, laboratories, and other work areas; (8) removal and decontamination of hot waste storage components of the cooling system; and (9) final radiation survey of CEER to be incorporated in the writing of a final report.
Keywords: decommissioning; reactor decommissioning; nuclear facilities; decontamination; engineering; transport; equipment; removal; laboratory equipment; radiation monitoring; reactors.

114045 Decommissioning Liquid Waste Evaporator System (PM-2A). Meservey, R. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Contract:** EY-76-C-07-1570. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE. **Related energy source:** nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to dismantle completely the Liquid Waste Evaporator System PM-2A. All contaminated systems will be decontaminated, disassembled, removed, and transported to the Radioactive Waste Management Complex. The project involves the decommissioning of two 189,270 liter underground carbon steel storage tanks, a condenser building with a 567.8 liter holding tank, the PM-2A evaporator tank with heater, and a stainless steel waste water line 339.8 m long. The waste water line runs between the inoperative liquid waste evaporator (located in Building TAN-616) and PM-2A Tanks 709 and 710. Three uncontaminated tanks are also located in the PM-2A area. Approximately 5400 cubic m of contaminated soil exists in this area.
Keywords: decommissioning; liquid wastes; evaporators; decontamination; tanks; radioactive waste storage; transport; soils; radioactive waste facilities.

114046 Recycle of Contaminated Scrap Metal. Cavendish, J.H. (National Lead Co. of Ohio, P.O. Box 39158, Cincinnati, OH, 45239). **Contract:** AC05-76OR01156. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to obtain amendments to the present Code of Federal Regulations, providing for the recycle of and unlicensed use of contaminated metals below specified de minimis levels, and to provide the technology and facilities for decontaminating DOE inventories of scrap metals meeting the amended criteria. The Cascade Improvement/Cascade Uprating Program (CIP/CUP) presently underway will generate large quantities of metallic scrap with a total value, at current market prices, in excess of $50 million. First, a large portion of the scrap was classified and, second, most of it was contaminated with slightly enriched uranium. Enriched uranium, being a special nuclear material, is covered by 10CFR70 of the Code of Federal Regulations which prohibits the possession of any quantity by anyone not holding a specific license for its possession. This regulation effectively barred the commercial use of CIP/CUP scrap since issuance of a specific license to all potential users of the scrap and consumer products made from it would not be possible. Therefore, it was decided by OR to propose the amendment of 10CFR70 to establish a de minimis limit below which metal would be exempted from the licensing requirements. In addition, a program to develop processes for decontamination of CIP/CUP scrap to meet the proposed de minimis limits was initiated. It was found that smelting eliminated the need for security classification and also decontaminated most metals.
Keywords: scrap metals; recycling; decontamination; smelting; regulations; radioactive wastes; us doe; prices; radioactive waste management.

114047 Decommissioning of Retired Hanford Facilities: Technology. Bair, W.J. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to conceive, develop, and test advanced technology applicable to the Hanford decommissioning effort. This project is divided into several tasks that encompass the extremely diverse technology applicable to the Hanford decommissioning effort. Technology assessments were made on: concrete decontamination and concrete properties; dry ice blasting; arc saw evaluation; burial ground stabilization; instrumentation development; electro polishing/vibratory finishing application; and fixatives (contamination).
Keywords: decommissioning; hanford reservation; nuclear facilities; technology assessment; concretes; underground disposal; stabilization; radioactive wastes; electropolishing; electronic equipment; decontamination; radioactive wastes.

114048 Contaminated Equipment Volume Reduction. Graves, A.W. (Rockwell Hanford Operations, P.O. Box 250, Richland, WA, 99352). **Contract:** RHO/800014. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Contaminated Equipment Volume Reduction project includes design, development, and demonstration of process equipment which will reduce the size and volume of contaminated metallic equipment to a form suitable for terminal storage or disposal. The project includes two major tasks. A size reduction task includes the design, fabrication, development, and demonstration of an arc saw which will accept an arbitratily shaped, full-sized stainless steel vessel or other radioactively contaminated metallic equipment, and remotely, rapidly, and safety reduce it to fragments which will be conveniently sized for subsequent handling. The volume reduction task includes the design, fabrication, development, and demonstration of a vacuum furnace system to melt down metallic pieces of contaminated equipment into ingots acceptable for disposal.
Keywords: packaging; radioactive wastes; equipment; compacting; materials handling; furnaces; design; vacuum melting; radioactive waste processing; volume.

114049 Supervision and Decontamination of Niagara Falls Storage Site. Cavendish, J.H. (National Lead Co. of Ohio, P.O. Box 39158, Cincinnati, OH, 45239). **Contract:** AC05-76OR01156. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is the decommissioning of the 191 acre DOE-Niagara Falls site and its return to unrestricted use. The DOE site is used as a radioactive waste storage area. No radioactive wastes were or are generated on the site. The wastes were shipped there from several production locations between 1944 and 1953. National Lead Company of Ohio currently provides supervision and caretaking activities on the site. The non-DOE owned residues are expected to be removed by a private contractor prior to FY 1983. After this is completed, the DOE-owned residues will be removed, buildings demolished, and the site decommissioned. The study of methods for reduction of radon exhalation from wastes was continued and asphaltic emulsion coating of some residues was completed. A detailed radiological survey of the site was subcontracted to Battelle-Columbus and the majority of the field work was completed.
Keywords: decontamination; decommissioning; radioactive waste storage; radioactive waste facilities; new york; radon; radiation monitoring.

114050 DOE Decommissioning Planning System. Stelle, A.M. (Atomics International/Rockwell, 8900 DeSoto Avenue, Canoga Park, CA, 91304). **Contract:** AI03-76SF75008. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the National Decommissioning Planning System is to develop and implement a system to generate priorities and a long range plan for the Department of Energy's (DOE) decommissioning program. The system output will be a 20-year plan, which identifies projects, priorities, alternate decommissioning strategies, schedules, costs, work force requirements, and waste quantities. The plan will assist DOE in preparing annual budget requests.
Keywords: reactor decommissioning; reactor dismantling; planning; cost; nuclear facilities; decommissioning.

114051 Building 350: Plutonium Glovebox Disposal. Kline, W.H. (Argonne National Lab., 9800 South Cass Avenue, Argonne, IL, 60439). **Project number:** 42810/800376. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.

Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives to the program are to decommission ANL's Surplus Plutonium Fabrication Facility (PFF) and make the area available for further nuclear work by New Brunswick Laboratory (NBL). The project includes dismantling gloveboxes, ventilation ductwork, utility systems, and associated internal and external equipment, including necessary size reduction to fit acceptable packaging for acceptance at a DOE Transuranium (TRU) retrievable storage site, and decontamination of the facility to acceptable levels. Prior to size reduction, equipment will be disassembled and bagged out and attempts made to decontaminate glovebox interiors to less than retrievable TRU levels using simple cleaning techniques followed by coating all inside surfaces with latex paint. Size reduction, conducted in a specially-constructed plastic enclosure maintained negative to general work area and utilizing workers dressed in protective clothing and air supplied respirators, will be accomplished by disassembly and mechanical cutting. Complete dismantlement and decontamination of remaining systems and structures will be performed.
Keywords: gloveboxes; plutonium; radioactive waste disposal; laboratory equipment; decommissioning; decontamination; nuclear facilities.

114052 Nuclear Rocket Development Station (Area 25): Survey and Cleanup. Bicker, A.E. (Reynolds Electric and Engineering Co., Inc., P.O. Box 14400, Las Vegas, NV, 89114). **Contract:** AL08-76N00410. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project was begun in FY 1978 by conducting a comprehensive survey of Area 25 to complete the delineation of radioactivity on and in equipment, facilities, and land areas. The scope of this project was made with the assumption that Area 25 will remain under DOE control, the E-MAD and ETL facilities are currently in use and not considered as part of the project, and that systems and very large fixtures to which access can be limited to negate any health hazard will be isolated and remain in place. Some of the tasks that need to be completed are: (1) remove two exhaust ducts from ETS-1 and dispose of RWM area; (2) decontaminate test cells A and C and remove irradiated fixtures, materials, and equipment to the RWM site; (3) remove soil from contaminated areas, including piles, and transport to the RWM site; and (4) decontaminate facilities within the R-MAD compound and remove contaminated equipment to the RWM site.
Keywords: nuclear facilities; rockets; decommissioning; decontamination; soils; equipment.

114053 100-F Production Reactor: Planning for Decommissioning. Ruff, W.G. (UNC Nuclear Industries, P.O. Box 490, Richland, WA, 99352). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this project are to establish engineering, planning, tool/process development and field operation for decommissioning the contaminated portion of the retired plutonium production reactors at Hanford.
Keywords: hanford production reactors; reactor decommissioning.

114054 233-S Plutonium Facility Decommissioning. Graves, A.W. (Rockwell Hanford Operations, P.O. Box 250, Richland, WA, 99352). **Contract:** RHO/800010-U3. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Decommissioning of 233-S Plutonium Facility task, Surplus Facilities Management Program (SFMP) Work Breakdown Structure (WBS) 5.4.6.3, includes all 200 area surplus facility decontamination and decommissioning (D and D) operations up through FY 1981. Beginning in FY 1982, each 200 area structural facility project will be under a separate WBS. During FY 1981, this WBS will also contain the long-range Rockwell Hanford Operations (Rockwell) Disposition Planning (WBS 5.3.6.2) and the Strontium Semiworks D and D (WBS 5.4.6.4) efforts of initial planning and facility characterization. Each facility decommissioning task is subdivided into three major activities: (1) engineering and planning; (2) tooling and equipment development; and (3) D and D operations. The detailed description of each activity is contained in the Rockwell D and D Program Plan, RHO-CD-241(Rev.1).
Keywords: nuclear facilities; decontamination; decommissioning; plutonium; engineering; planning; equipment.

114055 Formerly Utilized Sites Remedial Action Program. Keller, E.L. (Oak Ridge Operations Office, P.O. Box E, Oak Ridge, TN, 37830). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Formerly Utilized Sites Remedial Action Program (FUSRAP) has objectives to identify sites formerly utilized by the Manhattan Engineer District (MED) and Atomic Energy Commission (AEC), characterize their radiological condition, decontaminate sites as necessary and authorized by Congress, develop acceptable disposal sites, and certify the decontaminated site for future use. Sites are being identified by searching MED/AEC records and soliciting assistance from the public. The site radiological condition is assessed from review of the records and by performing radiological surveys where necessary. A series of engineering studies and environmental reports, including those prescribed by the National Environmental Protection Act, are prepared for each site to evaluate remedial action alternatives in relation to standards for particular uses of the site. Appropriate remedial actions are selected and implemented for each site based on these studies and comments of the state and the public. A certification of the radiological condition of the site is made after completing the remedial action. If the remedial action involves removal of the contaminated material from the site, a disposal site must be provided. New disposal sites will be developed as required, after necessary engineering and environmental studies are completed. Results to date include the radiological assessment of about 126 sites and the identification of about 30 sites that probably need some kind of remedial action. Work on some sites will begin in FY 1980.
Keywords: abandoned sites; nuclear facilities; decontamination; radiation monitoring; evaluation; radioactive wastes; radioactive waste disposal.

114056 Environmental Development of Savannah River Plant. Crawford, T.V. (Savannah River Lab., Aiken, SC, 29801). **Project number:** GE-03-47-04-0. **Contract:** DE-AC-09-76SR00001. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy. **Funding:** NMPP.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The purpose of this task is to improve the understanding of the impact of the Savannah River Plant (SRP) industrial complex on the environment of the SRP site and the surrounding southeastern United States. This is necessary in order to: (1) meet regulatory requirements and to be consistent with the NRC approach to the commercial nuclear industry; (2) ensure that reports and presentations discussing the environmental impact of operating SRP facilities are technically sound; (3) minimize potential delays in construction of new facilities onsite by regulatory and public questions on environmental impact by having done our environmental evaluations early; (4) ensure that the best available calculational methods are usable by SRP shift personnel during and by assessment personnel after an accidental release of a pollutant to the environment; and (5) ensure that operations onsite have a minimum adverse environmental impact in accordance with Executive Order 11514. This is done by developing improved methods of measuring emissions from SRP facilities and extremely low levels of radionuclides in the environment. Measurements of nuclides not detectable by routine environmental monitoring methods are made. Numerical computer models have been developed for transport and dispersion in streams rivers, and the atmosphere. Atmospheric models are linked to dose-to-man assessment codes which include agricultural, population, and dosimetry data. Models are tested with environmental data. Studies of the ecological effects of operating SRP are made.
Keywords: savannah river plant; environment; radiation monitoring; low dose irradiation; radioactivity; computer codes; environmental transport; atmospheric chemistry; water chemistry; human populations; nuclear industry; environmental impacts; terrestrial ecosystems; radionuclide migration.

115000 Comparison of Alternative Approaches for Estimation of Particulate Concentrations Resulting from Coal Strip Mining Activities in Northeastern Wyoming. (ERT, Concord, MA). **Project number:** PE. **Contract:** P3545-106. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

Four alternative methods of quantifying particulate emissions from strip mining were evaluated and applied to expected levels of mining activity in the Anderson-Wyodak coal field in 1975. Based on the results of modeling analyses, relative costs, production constraints, and uncertainties associated with each emission alternative were determined.
Keywords: surface mining; air pollution; coal mining; particles; wyoming.

115001 Refinery Office of Policy Environmental Impacts. Snyder, T. (DOE, Office of Policy and Evaluation, 1000 Independence Avenue, Washington, DC). **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation. **Funding:** DOE.

Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

This two part study consists of: (1) an analysis of the impacts on domestic refineries of various policy initiatives (e.g., tariffs on imported refined products) which could affect domestic refining operations; and (2) an analysis of the environmental impacts and constraints faced in siting refineries on the Gulf/East Coasts.
Keywords: petroleum refineries; energy policy; environmental impacts; site selection; coastal regions.

115002 Electric Utility Supply Planning and Coal Policy Analysis. Zussman, M. (DOE, Office of Policy and Evaluation, Washington, DC). **Project number:** PE. **Contract:** EJ-78-C-01-6392. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: (1) develop alternative strategies for implementing visibility regulations; (2) evaluate methods of visibility control, develop baseline visibility conditions, and develop a source inventory; and (3) assess impacts and feasibility of alternative strategies.
Keywords: fossil-fuel power plants; visibility; electric utilities; pollution regulations.

115003 Electric Utility Issues in the Area of Fossil and Alternative Technologies. Zussman, M. (DOE, Office of Policy and Evaluation, Washington, DC). **Project number:** PE. **Contract:** EJ-78-C-01-6394. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to: (1) determine the impact of major coal characteristics on the direct cost of electrostatic precipitators; (2) evaluate proposed EPA NSPS for utility boilers; (3) evaluate EPA's proposed visibility regulations; and (4) study the impact of RCRA on the electric utility industry.
Keywords: electrostatic precipitators; electric utilities; fossil-fuel power plants; air pollution; pollution regulations; coal; cost; fuel substitution; visibility.

116000 Strategic Petroleum Reserve Oceanographic Support Program. Contract: EL-78-I-01-7146. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The Strategic Petroleum Reserve (SPR) oceanographic studies include the optimization of diffuser design and location, prediction of brine plume characteristics, determination of the sensitivity of marine biota to salinity variations, baseline characterization of the existing biological community, and measurement of physical parameters (e.g., currents) affecting brine dispersal. These studies provide essential input to such key elements of SPR development as the selection of the proper disposal sites, diffuser design, EIS's and permit acquisition. Provision has been made to perform comprehensive monitoring during disposal operations to verify whether the actual impacts are consistent with those predicted by the studies. A large and unique data set has been acquired on the near shore coastal ocean off Louisiana and Texas. The data set includes monthly and quarterly sampling of biota, water and sediment quality, and selected physical variables and extensive time series of continuously recorded observations of currents, temperatures, salinity and meteorology. Interpretative reports include descriptions of coastal circulation dynamics and biological and geochemical response. In September 1979, DOE initiated an effort through NOAA to synthesize the data acquired by this program and develop an applied ecological model which may be used as a decisionmaking instrument. A model for this prototype brine discharge site, Bryan Mound, will be available by May 1981.
Keywords: oceanography; strategic petroleum reserve; waste management; baseline ecology; site selection; brines; environmental impacts; coastal regions; louisiana; texas; decision making.

116001 Sound Absorbing Panel Developments. Williams, G. (American Air Filters, 1930 Bishop Lane, Louisville, KY, 40277). **Project number:** 846-926. **Contract:** AC79-79BP14104. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

This project is to develop, fabricate, and deliver sound-absorbing panels tuned for maximum 120-Hz attenuation. BPA will modify the 500-kV, 1008-MVA transformer bank as necessary, and install the panels. Project goal is to reduce present 120-Hz sound level by 15 dB. If successful, this would ameliorate similar sound problems at other high voltage substations.
Keywords: fabrication; transformers; power substations; noise pollution control; sound waves; attenuation; environmental effects.

116002 Gasohol Utilization and Test Program. Hurless, H.D. (Bonneville Power Administration, P.O. Box 491, Vancouver, WA, 98666). **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to conserve petroleum-based resources by using transportation fuels derived in part from domestic non-petroleum sources, to demonstrate in a visible way Bonneville's concern for conserving non-renewable resources, and to advance the state-of-the-art for gasohol utilization. Five late model sedans are using 10% to 20% methyl alcohol and 80% to 90% unleaded gasoline. Records are maintained on fuel economy, engine performance including exhaust emissions, and maintenance. The vehicles are performing well, and gasoline consumption has been reduced. Some highly accurate tests of miles per gallon will be conducted soon. Plans call for a large dispensing facility to be installed, and the program to be expanded to a substantial portion of the fleet of vehicles.
Keywords: gasohol; performance testing; automotive fuels; automobiles; exhaust gases; fuel economy.

116003 Electric and Hybrid Vehicle Demonstration Agreement. Esposito, V.J. (Department of Energy, Washington, DC). **Project number:** IPMIS 01-79CS50082. **Contract:** AA79-79BP10576. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project includes purchasing electric vehicles which are certified by the DOE and evaluating the performance of these vehicles. Special instrumentation is installed on each vehicle to monitor the electrical energy. Data are kept on the type of driving, average speed, distance traveled, energy used in recharging, and all costs incurred in maintenance and repair of the electric vehicles. The data are collected and furnished to the DOE in the form of quarterly reports.
Keywords: electric-powered vehicles; hybrid electric-powered vehicles; performance testing; maintenance; repair; cost; energy demand; data acquisition.

116004 Investigating Effects of Power Peaking on Fall Chinook Egg Incubation and Hatching Study. White, R.C. (Univ. of Idaho, College of Forestry, Moscow, ID, 83843). **Contract:** RP79-79BP10848. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: hydroelectric(100) **R and D categories:** Environmental effects assessment.

Hydroelectric power projects operate on a demand basis. This hydro peaking program results in large amounts of water being released in a relatively short period of time, causing rapid downstream increases and decreases in flow during and after the peaking demand. During the fall and winter in the Pacific Northwest, rapid river fluctuations can effect the spawning of adult salmon and steelhead and the incubation of their eggs. This study is designed to examine the influence of hydro peaking on egg incubation and fry quality. The information obtained from this study can help formulate power peaking operations which are more compatible for both salmonid egg incubation and power generation needs. Objectives of the study are as follows: (1) to assess flow associated impacts of power peaking on egg incubation and hatching success of fall Chinook salmon; (2) to experimentally compare effects of dewatering and flow fluctuation on survival of green and eyed Chinook eggs and on quality of fry; and (3) to experimentally determine tolerance of different developmental stages of eggs to varying periods of complete dewatering and associated effects on fry quality. Contracting difficulties prevented this study from being initiated until the fall of 1979. Consequently, results from this one-year study will not be available until the fall of 1980.
Keywords: salmon; population dynamics; fishing industry; management; hydroelectric power plants; environmental impacts; fishes; peaking power plants; hydroelectric power plants; tolerance.

116005 Survey and Evaluation of Fish Protective Facilities at Water Withdrawals in the Columbia Basin. Swan, G.A. (National Marine Fisheries Service, CZES Big Pasco Industrial Park, Building 900, Pasco, WA, 99301). **Contract:** A179-79BP10684. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: hydroelectric(100) **R and D categories:** Environmental effects assessment.

The purpose of this study is to survey all water withdrawals on the mainstem Columbia River from Wells Dam to Bonneville Dam, and on the Snake River from Lewiston, Idaho, to the Columbia River to determine if juvenile anadromous fish are being afforded adequate protection. During FY 1979, an inventory of water withdrawals including information on ownership, site location, volume of withdrawals, water rights, mode of operation, type of fish protective facilities, and maintenance schedules was made. After the inventory is completed an inspection of each water withdrawal will be made to

determine the condition of fish protective facilities currently in use, and obtain information on flow characteristics such as flow patterns and water velocities in the vicinity of the withdrawal. From information gathered during FY 1979, the contractor has selected typical withdrawal sites for further study. A report will be prepared summarizing the findings of these additional studies along with recommendations that may be developed for improving fish screening criteria that are currently being used by fishery agencies to protect fish at water withdrawals. Final results of the study will not be available until completion of the work effort in the fall of 1980.
Keywords: columbia river basin; fishing industry; fishes; water requirements; inventories; salmon; management; population dynamics; water rights; energy source development; behavior; physiology.

116006 Imprinting of Hatchery-Reared Salmon and Steelhead Trout for Homing of Transported Fish. Ebel, W.J. (National Marine Fisheries Service, 1700 Westlake Avenue N, Seattle, WA, 98109). **Contract:** A179-79BP10682. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: *general science*(100) **R and D categories:** Environmental effects assessment.

The greatest obstacle to the maximum production of salmon and steelhead trout in the Columbia River Basin is the loss of juvenile migrants in the mainstem Columbia and Snake Rivers. Passage at dams and delays in the reservoirs behind dams have been signaled out as the most important causes of these high mortalities. A system that would safely bypass the river areas in which these high losses occur would be of benefit to the resource. The most efficient way to protect downstream migrants would be to transport them directly from hatcheries or a central collection area, without ever releasing them into the river. Present experience is that most fish transported directly from the hatcheries would be unable to home back to the hatcheries as adults. The imprinting experience that provides the navigational clues by which salmon and steelhead find their way back to natal areas seems to be provided either at the time of release into the river system or shortly thereafter. It is this area of salmon and steelhead trout behavior and physiology that is being studied in this project. FY 1979 is the second year of the proposed research effort. Because the salmon and steelhead life cycle takes from two to five years to complete and results cannot be obtained until adults return to their hatchery of origin, there have been no substantive findings from this research effort to date.
Keywords: fishing industry; trout; salmon; inventories; population dynamics; aquaculture; dams; water reservoirs; behavior; physiology; *environmental impacts; biological effects.*

116007 Genetic Identification Study. Burley, C. (US Fish and Wildlife Service, 3207 NE 78th Street, Vancouver, WA, 98665). **Contract:** A179-79BP13552. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

To effectively manage fishery resources, it is becoming increasingly necessary for management agencies to have the ability to identify various stocks of salmon being harvested in mixed ocean and river fisheries. Currently, management agencies must rely on extensive tagging programs to provide this data. Research by various agencies and institutions has resulted in a promising new technique, known as starch-gel electrophoresis, for stock identification. This process is a rapid and inexpensive method of identifying fish from a geographical area by biochemical genetic markers. This study intiated in March 1976 had two major objectives: (1) to identify Columbia River anadromous fish stocks by biochemical genetic markers, and (2) to write and test a computer program to estimate the contribution of various stocks in a mixed ocean and river population. BPA funds were used to genetically type major populations of Columbia River salmon. To date, a workable model has been eveloped utilizing biochemical genetic markers. In FY 1980, the National Marine Fisheries Service will perform a test demonstration of this technique while monitoring the commercial and sport harvest of salmon in the Pacific Ocean off the Oregon and Washington coast. If this demonstration proves effective, it is probable that this technique will become the standard management tool of Pacific Northwest fisheries management agencies.
Keywords: fishes; population dynamics; fishing industry; salmon; behavior; biological indicators; rivers; seas; management.

116008 Evaluation of the Contribution of Chinook Salmon Reared at Columbia River Hatcheries to the Pacific Salmon Fisheries. Ebel, W.J. (National Marine Fisheries Service, 1700 Westlake Avenue N., Seattle, WA, 98109). **Contract:** A179-79BP10683. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

Current information on the distribution, contribution, and value of Columbia River Hatchery Chinook salmon is urgently needed by the Pacific Fishery Management Council. Available data on fall Chinook salmon is over 10 years old. The purpose of this study is to determine the distribution, contribution, and value of Columbia River artificially reared Chinook to the Pacific salmon fisheries. In cooperation with state and federal fishery agencies a portion of the fall Chinook salmon production at all Columbia River rearing facilities will be tagged. Tagged fish will be recovered in marine and Columbia River sport and commercial fisheries sampled routinely by the Pacific Coast State fishery agencies and the Canadian Fisheries and Marine Services. Major accomplishments of the research effort to date have been the marking and release of several million juvenile fall Chinook salmon. This long-term study, which includes the tagging of juveniles through 1982, will not be returning substantive data until adult salmon begin returning in 1980. However, the National Marine Fisheries Service has constructed and put into operation a mobile coded wire tagging unit which has greatly aided their effort.
Keywords: columbia river; fishing industry; salmon; behavior; fishes; reproduction; management; inventories.

116009 Continuation of Anadromous Fish Production Facility Studies. Burley, C. (US Fish and Wildlife Service, 3207 NE 78th Street, Vancouver, WA, 98665). **Contract:** A179-79BP13552. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

In FY 1978, BPA entered into a working agreement with the U.S. Fish and Wildlife Service and three Indian tribes represented by the Columbia River Inter-Tribal Fish Commission. The purpose of this agreement was to conduct feasibility studies for anadromous fish production facilities on these Indian reservations. Two fish passage problem areas were identified for study in FY 1979. The FY 1979 proposal is to evaluate and provide a design and associated construction costs necessary to improve fish passage facilities at these two locations. As a result of FY 1978 studies, BPA is providing funds to the Bureau of Indian Affairs during FY 1980 to modify an existing fish structure on Shitike Creek on the Warm Spring Indian Reservation. This modification will make available fourteen miles of spawning and rearing habitat, capable of producing 22,000 adult steelhead trout.
Keywords: fishing industry; columbia river; fishes; reproduction; feasibility studies; indian reservations; american indians; salmon; baseline ecology.

116010 Backwater Studies Above Bonneville. Burley, C. (US Fish and Wildlife Service, 3207 NE 78th Street, Vancouver, WA, 98665). **Contract:** A179-79BP13552. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Rising waters, resulting from the construction of hydroelectric dams, created many backwater areas along the Columbia River. At the present time, little data are available on the type of habitat provided by backwaters. Although juvenile salmonids are known to sometimes occur in backwaters, the extent of this occurrence has not been determined. These backwaters may provide or be capable of providing significant rearing habitat for andromous salmonids. The purpose of this study is to identify those backwater areas presently being utilized by anadromous fish. The type of use, whether for rearing, incidental or seasonal use will also be determined. Results of this study will not be available until the completion of the study effort in the fall of 1980.
Keywords: columbia river; water quality; hydroelectric power plants; salmon; population dynamics; *environmental effects; baseline ecology.*

116011 Study of Wild Spring Chinook in the John Day and Deschutes Rivers. Wagne, E. (Oregon Dept. of Fish and Wildlife, 303 Extension Hall, Oregon State Univ., Corvallis, OR, 97331). **Contract:** AC79-79BP10847. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE; ORFW/POGE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

There is little information on the migration, distribution, harvest, and survival of most of the wild Chinook salmon stocks in the Columbia River. The increased emphasis on hatchery production and subsequent demand for higher yields will increase the potential for over-harvesting wild stocks. It is necessary to determine optimum escapements, migration, harvest, and ocean distribution of John Day and Deschutes River Chinook salmon to formulate better management plans for this species. Results of this effort, in the form of baseline life history data, can be used by state and federal fishery agencies to develop or strengthen fishery management plans and to evaluate impacts of water development projects in the John Day and Deschutes Rivers as well as the Columbia River. To achieve the objectives of this proposal, large scale capture and coded wire tagging of juvenile wild Chinook salmon will be initiated in the study. Life history studies and subsequent evaluation of adult returns will also be carried out. By utilizing biological information developed from the project data, recommendations for the management of wild Chinook populations in the John Day and Deschutes Rivers

can be made. First returns on juvenile fish tagged under this research effort will not occur until the fall of 1980. To date no significant results have been obtained.
Keywords: fishes; population dynamics; salmon; fishing industry; management; baseline ecology; columbia river.

116012 UHV Transmission Biological Study. Lee, J.M. Jr. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** 846-902. **Contract:** 14-03-6033N. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE. **Related energy source:** hydroelectric(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purpose of this study is to determine what, if any, short-term effects a prototype 1200-kV ac transmission line has on natural vegetation, crops, wildlife, cattle, and honey bees. Of primary interest are possible effects on animal behavior, and on the vigor and growth of plants. Beginning one growing season before energization of the prototype 1200-kV line, plants and animals were systematically sampled on the right-of-way and in nearby control areas off the right-of-way. Sampling will continue for three growing seasons following energization, and comparisons will be made between populations in test and control areas. During summers, cattle and honey bee colonies are brought onto the site. Collection and preliminary analysis of data through the third growing season following energization of the 1200-kV line has been completed. Some effects have been noted in trees growing near the line and in honeybee hives placed beneath the line.
Keywords: uhv ac systems; overhead power transmission; power transmission lines; environmental effects; animals; insects; plants; research programs; growth; behavior.

116013 Transmission Line Effects on Bird Flights. Lee, J.M. Jr. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** 840-724. **Contract:** 14-03-7043A. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOE-$27,000.
Related energy source: hydroelectric(100) **R and D categories:** Environmental effects assessment.

The objective of this study is to determine the effects of a sample of BPA transmission lines on bird flight behavior and collision mortality. Study sites include a wood-pole 115-kV line and 230-kV and 500-kV steel tower lines. All sites are located in wetland areas utilized by waterfowl and a variety of other kinds of birds. Methodology includes dead bird counts and observations of bird flights near the transmission lines.
Keywords: hvac systems; ehv ac systems; power transmission lines; environmental effects; research programs; birds; safety; overhead power transmission.

116014 NOSR 1 Pre-Development Plan. Robertson, R.L. (TRW, Inc., 8301 Greensboro Drive, McLean, VA, 22102). **Project number:** RA-31. **Contract:** AC1-78RA3212. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: oil shale(100) **R and D categories:** Pollutant characterization and analysis.

The mission of this project is to prepare the Naval Oil Shale Reserves in Colorado for development as rapidly as possible as a contingency against the failure of incentives to promote commercialization of oil shale. The DOE plan for development of the Reserve is to prepare the way for an eventual lease sale, possibly as early as 1983. The pre-development program supports this strategy with needed technical and environmental information, and provides the back-up plan required for government funded commercialization of these resources if there is no private interest in leasing.
Keywords: leasing; oil shale deposits; colorado; planning; energy source development; environmental impacts; engineering.

116015 Endangered Species at NPR-1. O'Farrell, T. (EG and G, Inc., 611 Avenue H, Boulder City, NV, 89005). **Project number:** EY-76-C-08-1183. **Contract:** EY-76-C-08-1183. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: oil and gas(50); oil shale(50) **R and D categories:** Pollutant characterization and analysis.

The proposed program is a continuation of a previous effort to collect field data on endangered and threatened species at NPR 1. Biological assessments on the San Joaquin kit fox and the blunt-nosed leopard lizard will document the presence and distribution of these species on the Reserve and the impact of future activities on these species. Plans will be made to identify sensitive areas to be avoided and modify NPR-1 activities to minimize impacts on endangered species. Land use and reclamation plans will be made to mitigate long-term habitat impacts. Documentation will be made to support delisting of candidate threatened species, if justified. The requirements of the Endangered Species Act will be recognized and dealt with to preclude violation of the law.
Keywords: documentation; lizards; wild animals; endangered species; petroleum; natural gas; oil shales; energy source development; environmental impacts; land use; habitat; land reclamation; terrestrial ecosystems; baseline ecology; data acquisition.

116016 Geopressure Subsidence Research. Noble, J. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** LZJ-035. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The research objective is to evaluate the effects on land subsidence of long term production from geopressure reservoirs by data review, well log analyses, numerical analyses, and interpretation.
Keywords: gulf coast; geopressured systems; ground subsidence; well logging; production; evaluation; data analysis.

116017 Induced Seismics Program Management. (Holmes and Narver, Inc., 2753 South Highland Drive, Las Vegas, NV, 89114). **Project number:** NV0-004. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.
Keywords: research programs; management; seismology.

116018 Geothermal Subsidence Research. Noble, J. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.
Keywords: ground subsidence; geothermal resources; environmental impacts.

116019 Subsidence Program Management. Noble, J. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** LZJ-015. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.
Keywords: ground subsidence; geothermal fields; management; technology assessment.

116020 Demonstration on EIC's Copper Sulfate Process for Removal of Hydrogen Sulfide and Other Trace Contaminants from Geothermal Steam of Turbine In-Let Temperatures and Pressures. Allen, G.W. (Pacific Gas and Electric, 3400 Crow Canyon Rd., San Ramon, CA, 94583). **Contract:** FC03-78-EC 27181. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE; EPA; PGE.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this pilot scale field test program is to determine the feasibility of using the upstream EIC copper sulfate process to abate hydrogen sulfide emissions from geothermal steam. The test program is jointly funded by DOE, EPA, and Pacific Gas and Electric (PGE). The tests were done at PG and E's Geysers Unit 7. Results were encouraging with efficiencies reported to exceed 99% at times (97% average). Corrosion, erosion and entrainment problems were encountered but seem to be resolvable. A final report is expected by May 5, 1980.
Keywords: copper sulfates; geothermal fluids; hydrogen sulfides; removal; steam turbines; air pollution abatement; efficiency; pilot plants.

116021 New and Enhanced Processes to Remove Hydrogen Sulfide from Geothermal Fluids and to Produce a Useful By-Product. Urban, P. (VOP, Inc., Des Plaines, IL, 60016). **Contract:** AC03-79ET27203. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.
Related energy source: geothermal(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this laboratory scale test program is to determine the feasibility of using the VOP sulfex process to control hydrogen sulfide emissions from geothermal fluids (both liquid and vapor dominated) upstream of power generation facilities. The test program is on-going at this time. High removal efficiencies were found in liquid-dominated tests but corrosion problems occurred at acid conditions. Vapor-dominated tests will follow. A final report is due September 25, 1980.
Keywords: hydrogen sulfides; removal; geothermal fluids; by-products; bench-scale experiments; sulfex process; scrubbing; air pollution abatement.

116022 Induced Seismicity. (Univ. of Nevada, Las Vegas, NV). **Project number:** ETF006. **Supported by:** Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications. **Funding:** DOE.

Related energy source: geothermal(100) **R and D categories:** Pollutant measurements technology.

The objective is to monitor microseismic activity at Dixie Valley, NV, due to proximity of large active fault and utilization for future use in utilizing geothermal resources.
Keywords: nevada; seismic waves; monitoring; geologic faults.

119000 SPS Microwave Effects on Health Ecosystems. Cahill, D. (Environmental Protection Agency, Research Triangle Park, NC). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Pollutant measurements technology.

This work will: (1) provide an assessment of potential environmental impacts of microwave exposures resulting from operation of SPS Reference Systems, (2) provide a plan for the conduct of research and development needed to reduce uncertainties in the assessment, and (3) conduct research on microwave radiation effects.
Keywords: microwave radiation; health hazards; environmental impacts.

119001 Biological and Ecological Effects of SPS Microwaves on the European Honeybee. Gary, N. (Univ. of California, Davis, CA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOe.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This project will provide experimental information on the response of the European honeybee to microwave exposure. Complete experiments on survival and longevity, orientation and flight behavior, and dosage mortality bioassays will be conducted. Ongoing laboratory and field experiments on behavioral and biological responses will continue, and preliminary cost estimates and experimental design of microwave field exposure area will be prepared.
Keywords: microwave radiation; biological effects; environmental impacts; insects; sensitivity.

119002 SPS Non-Microwave Effects on Health and Ecosystems. White, M. (Lawrence Berkeley Lab., Berkeley, CA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This effort will: (1) provide a comprehensive assessment of impacts on human health and ecosystems (other than those produced by microwave exposures) that might be produced by SPS Reference Systems; and (2) prepare a plan for the conduct of research to reduce uncertainty in this assessment. The approach will be to: formulate a plan for non-microwave health and ecosystem impact assessment; prepare a non-microwave health and ecosystem assessment; assist in preparation, review and defense of an integrated environmental assessment; prepare a non-microwave effects R and D program plan; assist in developing integrated R and D program plan; prepare an assessment of the effects of SPS-reflected light on the human eye and on ecosystems; and manage and monitor other non-microwave health and ecosystem assessments and research.
Keywords: orbital solar power plants; biological effects; public health; ecosystems; eyes; visible radiation; reflection.

119003 Assessment of the Effects of the Zero Gravity Environment on the Health and Safety of Spaceworkers. Dietlein, L. (NASA, Lyndon B. Johnson Space Center, Houston, TX). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Health protection, safety, and industrial hygiene.

This effort will assess the spaceworker's health risks due to zero gravity and acceleration and deceleration. The approach is to: (1) review NASA data on prior manned space flights and related research; (2) identify zero gravity/acceleration-deceleration health effects; (3) estimate the probability of adverse effect; (4) describe the consequences to work efficiency and future health; and (5) prepare a plan for research to improve assessment.
Keywords: personnel; space flight; health hazards; gravitational fields; acceleration; risk assessment.

119004 Study of the Cataract-Inducing Potential of High-Energy, Heavy Ions (HZE). Ainsworth, E. (Lawrence Berkeley Lab., Berkeley, CA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This research will investigate the damage to the lens of the eye (opacification and/or cataract induction) due to high-energy, heavy ions (HZE). Previously collected data will be evaluated. Data from an ongoing study of Harderian-gland carcinogenesis, and data from an experiment with mice exposed to doses of 400 MeV carbon, 425 MeV neon, or 570 Mev argon ions will be collected and evaluated.
Keywords: radiation injuries; crystalline lens; heavy ions; data compilation; mice; carcinogenesis; evaluation.

119005 SPS Atmospheric Effects: Assessment and Planning. Rote, D. (Argonne National Lab., Argonne, IL). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This work will: (1) assess the potential climatic effects of SPS Reference Systems; (2) develop an atmospheric effects R and D plan; and (3) provide information on atmospheric effects required for other environmental assessments. The approach will be to: (1) manage and coordinate all SPS atmospheric effects work; (2) formulate a plan for assessing the climatic effects of SPS Reference Systems; (3) prepare climatic effect assessment; (4) prepare atmospheric effects in R and D program plan; (5) assist in developing integrated R and D program plan; (6) obtain and analyze archived data concerning ionospheric effects of rocket launches; (7) characterize the nature and extent of ionospheric holes produced by rocket exhausts; (8) investigate the effects of argon ion injections on the plasmasphere and natural radiation belts; and (9) conduct scientific observations of high-altitude clouds resulting from the Fall 1979 NASA Atlas/Centaur rocket launch.
Keywords: orbital solar power plants; environmental impacts; climates; ionosphere; rockets; launching; argon; background radiation.

119006 Estimation of Upper Atmospheric Composition Perturbations due to SPS-Related Spacecraft Activity. Whitten, R.C. (NASA, Ames Research Center, Moffett AFB, CA). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to estimate the extent to which upper atmospheric composition will be perturbed by HLLV and PLV launch and reentry for projected SPS-related levels of spaceflight activity. Available state-of-the-art one-dimensional (zonally and latitudinally averaged) simulation models will be used. Based upon the detailed rocket exhaust emission inventory and reentry NOx production estimates to be supplied by ANL subcontractors, these estimations will be made: (1) high altitude composition changes due to rocket launch and reentry emissions for various possible stratospheric and mesospheric chlorofluoromethane (CFM) levels predicted for the year 2000 and beyond; (2) maximum acceptable levels of injection of H2O and NOx for various CO2 and CFM levels; and (3) effects of, including temperature feedback, processes on model estimated composition changes, including effects of CO2, fuel impurities such as sulfur, and ablation material produced on reentry. Available state-of-the-art two-dimensional (zonally averaged) simulation models will also be used. Based upon the same exhaust emission inventory and reentry NOx production estimates as above, the latitudinal dependence of high altitude composition perturbations (corridor effect) for various projected levels of spaceflight will be estimated.
Keywords: earth atmosphere; ionosphere; air pollution; mesosphere; stratosphere; two-dimensional calculations; rockets; exhaust gases; mathematical models; research programs.

119007 Assessment of Effects Due to Changes in Noctilucent Cloud Formation. Whitten, R.C. (NASA, Ames Research Center, Moffett AFB, CA). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objective is to assess potential effects of changes in noctilucent cloud formation due to water vapor deposition from SPS-related spaceflight. The approach will be to: (1) survey the current state of knowledge regarding the formation and effects of noctilucent clouds; (2) acquire available data on mesospheric temperature and water vapor concentrations as necessary for estimating the extent of cloud formation; (3) estimate the expected change in the mesospheric water vapor concentration and estimate the extent to which noctilucent cloud formation will be changed; and (4) estimate the impacts of the expected change, based upon current understanding of the effects of noctilucent clouds.
Keywords: rockets; exhaust gases; earth atmosphere; noctilucent clouds; variations; research programs.

119008 Research of Archived Records Concerning Ionospheric Effects of Rocket Launchings. Chacko, C.; Mendillo, M. (Boston Univ., Boston, MA). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to research the archived data concerning ionospheric effects of rocket launches to help place our assessment of such effects on a firmer footing and also to search for any new

effects. The approach will be to: (1) gather together all available ionospheric observations appropriate for each of some 400 major NASA rocket launches; (2) categorize the launches by size, fuel composition, height of burning flight path, etc.; (3) differentiate among the various observations on a phenomenological basis or preferably on the basis of the causative processes involved; (4) determine the dependence of the observed phenomena on launch parameters; (5) specify extent and duration of each effect; (6) list new effects, if any; (7) prepare a scenario of possible effects to be expected from SPS rocket launches in accordance with NASA's SPS concept design; (8) complete collection of data base and prepare a preliminary report containing interim results in FY79; and (9) analyze the data in greater depth and prepare the final report during FY80.
Keywords: ionosphere; rockets; exhaust gases; air pollution; research programs.

119009 3-D Simulation of Local Ionospheric Effects of SPS Rocket Exhaust. Bernhardt, P. (Stanford Univ., Stanford, CA). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to characterize nature and extent of holes formed in ionosphere because of injection of rocket exhaust from the rocket traffic specified in the NASA SPS system design (October 1978). The approach will be to: (1) compare existing 3-D model simulation of history of ionospheric holes with observations; (2) simulate history of rocket exhaust injected into lower ioniosphere (D- and E- regions) by HLLV boosters and into the upper ionosphere (F region) by the circularization, maneuvering, and reentry burns; and (3) investigate lifetime of these holes and their potential for adverse impacts.
Keywords: rockets; exhaust gases; air pollution; ionosphere; three-dimensional calculations; e region; d region; research programs.

119010 Effects of Argon Ion Injection into the Magnetosphere. Chiu, Y.T. (Aerospace Corp., Los Angeles, CA). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives are: (1) to estimate the effects of Ar/sup +/ ion injection upon the plasmasphere and the natural radiation belts; (2) to calculate the time history of injected Ar ions and to assess their impacts on naturally occurring magnetospheric phenomena; and (3) to evaluate impacts on communication systems, optical earth sensors, and other impacts including modification of the radiation environment of the Van Allen Belts. The approach to Phase I is to: (1) theoretically investigate, using existing available simulation techniques or minor refinements thereof, modifications of the natural plasmasphere and Van Allen radiation belts by injection of energetic non-thermalized Ar/sup +/ ions and by the modified background plasma that is the resultant of the redistributed natural plasma and thermalized Ar/sup +/ ions; (2) make comparisons with calculations and information available from observations of natural, unperturbed phenomena; (3) summarize preliminary results; and (4) deliver preliminary results by October 1979. The approach to Phase II is to: (1) make quantitative estimates of consequential effects of radiation belt modification including change in airglow background and change in auroral and magnetic storm dynamics; (2) deliver Phase II results by October 1980; and (3) provide theoretical support and interpretation, for SPS assessment of results on beam-plasma turbulence to be obtained in the CAMEO and SCATHA rocket experiments to be conducted in FY79.
Keywords: plasmasphere; argon ions; radiation belts; magnetosphere; rockets; research programs.

119011 Modeling of Global Ionospheric Effects of SPS Rocket Exhaust. Zinn, J. (Los Alamos Scientific Lab., Los Alamos, NM). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

This work will estimate the effects of rocket exhaust products on the upper atmosphere created during the construction and operation of the SPS Reference System. Computer codes will be used to model the ionosphere and results will be compared with observations. Ground-based observations will be made of the launch of NASA Atlas-Centaur Rocket Satellite HEAO-C. Electron distributions and temperatures and airglow will be measured.
Keywords: global aspects; ionosphere; rockets; exhaust gases; air pollution; monitoring; orbital solar power plants; mathematical models; electrons; distribution; temperature measurement; airglow; earth atmosphere; construction; operation; environmental impacts.

119012 Electron Density and Conductivity Changes in D- and E-Regions. Whitten, R.C. (NASA, Ames Research Center, Moffett AFB, CA). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

The objectives are: to determine electron density changes caused by ion composition changes resulting from water injection in D- and E-regions; to determine if conductivity changes in dynamo region can significantly alter magnetospheric processes; and to coordinate results with investigation of atmospheric electricity impacts in a timely manner. The approach will be to: (1) review literature and existing experimental observational data; (2) carry out appropriate calculations using available methods; (3) share results with those responsible for atmospheric electricity impacts; and (4) prepare final report.
Keywords: d region; e region; electric conductivity; water vapor; research programs.

119013 SPS Ionospheric Heating and Telecommunications Impacts. Rush, C. (ITS, Boulder, CO). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this effort will: (1) assess potential impacts on telecommunications services of ionospheric disturbances produced by SPS Reference Systems operation, and (2) prepare a plan for activities required to reduce uncertainty in the assessment. The approach used will: provide management and technical direction for the SPS Ionospheric Heating and Telecommunications Impacts Program and prepare an assessment; prepare a plan for future research; perform theoretical studies of plasma instabilities driven by ohmic heating-enhanced electron heating and thermal self-focusing; and conduct experiments to demonstrate whether or not adverse telecommunications performance impacts should be expected because of SPS-produced thermal self-focusing instabilities.
Keywords: satellites; spacecraft power supplies; electromagnetic radiation; ionosphere; aerodynamics; communications; environmental impacts; heating.

119014 Electromagnetic Compatibility (EMC). Davis, K. (Battelle Pacific Northwest Labs., Richland, WA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This work will: (1) provide an assessment of the electromagnetic compatibility of a Satellite Power System (SPS), and (2) provide a plan for research and development required to reduce uncertainty in this assessment. The approach will be to: (1) formulate plan for SPS electromagnetic compatibility assessment; (2) prepare SPS Reference System electromagnetic compatibility assessment; (3) assist in preparation, review and defense of integrated environmental assessment; (4) prepare an SPS electromagnetic compatibility R and D program plan; (5) assist in developing an integrated R and D program plan; (6) manage and monitor other SPS electromagnetic compatibility assessments and research; (7) maintain active liaison with EMC and astronomy communities; (8) perform an analysis of atmospheric light scattering impacts on optical astronomy; and (9) perform an analysis of microwave field pattern modulations arising from the operation of a multisatellite SPS.
Keywords: satellites; spacecraft power supplies; compatibility; electromagnetic radiation; research programs; technology assessment; earth atmosphere.

119015 Electromagnetic Compatibility Support. Morrison, E.; Grant, W. (ITS, Boulder, CO). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This work will: (1) support the preparation of an assessment of the electromagnetic compatibiity of the SPS, and (2) prepare a plan for activities required to reduce uncertainty in the assessment. The approach is to: measure the effects of 2.45 GHz illumination on sensitive receiving systems; develop plans for future measurement programs; and verify mitigation methods and extend sensitivity measurements to demonstrate the efficacy of mitigation recommendations.
Keywords: satellites; spacecraft power supplies; compatibility; electromagnetic radiation; technology assessment; research programs.

119016 SPS Environmental Assessment Program: Integration and Documentation. Valentino, A.R. (Argonne National Lab., Argonne, IL). **Project number:** 49576. **Contract:** 49576. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This effort will produce an integrated Environmental Assessment (EA) and a plan for R and D to reduce the uncertainty in this assessment. The approach is: to provide management support by defining tasks, analyzing funding requirements, monitoring the progress of work, and coordinating with EA Task Managers; to integrate the environmental assessments prepared by each of the EA Task Managers; and to integrate the R and D plans prepared by each of the EA Task Managers.
Keywords: orbital solar power plants; environmental impacts; management; research programs.

119017 Characterization of Reflected Light from the Satellite Power System (SPS). Liemohn, H. (Boeing Aerospace Co., Seattle, WA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Health effects assessments.

This effort will: (1) quantify and describe the light-reflecting characteristics of SPS vehicles and satellites, and (2) provide data for assessments of SPS-reflected light effects on the human eye, ecosystems, and optical astronomy. The approach is to: (1) determine the reflected light data required for the environmental assessments; (2) establish the reflectance of the SPS Reference System vechicles, including the Support Base, Orbit Transfer Vehicles, and SPS; and (3) evaluate the illumination from baseline configurations including the level of sky brightness.
Keywords: satellites; space vehicles; reflectivity; research programs; orbital solar power plants; environmental effects.

119018 CTR Related Chemical Research Tritium Chemistry Associated with the Lithium Blanket and Container Materials. Carstens, D.H.W.; Anderson, J.L. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 168. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Areas studied are: solubility measurements of container materials (e.g., Ta, Mo, and W) in both La5Ni and Li over the temperature range 700 to 1100 degrees K; and removal of tritium by La5Ni from helium streams as a function of flow rate and temperature in the ppM range of tritium.
Keywords: tantalum; molybdenum; tungsten; solubility; lithium; lanthanum alloys; nickel alloys; intermetallic compounds; very high temperature; high temperature; tritium recovery; breeding blankets; solvent properties; flow rate; temperature dependence.

119019 Heat Transfer Materials and Salt Vapors. Curtiss, L.; Frurip, D. (Argonne National Lab., Argonne, IL). **Project number:** 77. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This project involves experimental and quantum mechanical studies on materials that exhibit molecular associations in the vapor and that may either have potential as heat-transfer fluids or can enhance gas phase mass transport. Emphasis is on the nature of the species, their structure, bond strengths and association constants. Systems under investigation include acetic acid, trifluoracetic acid, and binary mixtures of these compounds with water, as well as complexes formed between selected metals (e.g., beryllium and magnesium) and water. Also studied were thermal conductivities and vapor densities of high temperature associated systems and statistical mechanical prediction of the thermodynamic properties of high temperature ionic molecules.
Keywords: acetic acid; heat transfer fluids; mass transfer; beryllium; magnesium; thermodynamic properties; vapors; structural chemical analysis; binding energy.

119020 Liquid Metal Chemistry. Maroni, V.A.; Veleckis, E. (Argonne National Lab., Argonne, IL). **Project number:** 71. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Thermodynamic properties of liquid metals and intermetallic compounds is investigated with emphasis on: alkali-metal based systems; temperature, composition and pressure relationships in selected ternary hydrides (e.g., LiAlH, CaAlH, LiPbH) systems; solubilities and interaction chemistries of nonmetals in liquid metals; distribution of nonmetals (e.g., nitrogen and carbon) in lithium/molten salt and lithium/structural material systems; and corrosion mechanisms of refractory metals and alloys in liquid metals.
Keywords: liquid metals; chemistry; thermodynamic properties; intermetallic compounds; alkali metal compounds; corrosion; lithium; alloys.

119021 Chemistry of Materials. Kumar, R.; Holt, B. (Argonne National Lab., Argonne, IL). **Project number:** 72. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Chemistry of airborne particulates is investigated with emphasis on: (1) elucidation of formation mechanisms for sulfates, nitrates and organics; and (2) development of instrumentation for sampling and real time characterization of aerosols. The hydrolysis-oxidation conversion of sulfur dioxide to sulfate by stable isotope ratio measurements, the study of the influence of pH, oxides of nitrogen, and of reactive surfaces (e.g., airborne carbonaceous materials) on this conversion, kinetics and mechanisms of mineral-sulfur dioxide reactions and mineral regeneration reactions, the study of structure and morphology accompanying reaction sequence, and development of reaction models and prediction capability are also under investigation.
Keywords: aerosols; particles; atmospheric chemistry; sulfates; nitrates; organic compounds; sampling; sulfur dioxide; ph value; mathematical models.

119022 Characterization of Compounds and Alloys. Fraser, H.L.; Wert, C.A. (Univ. of Illinois, Urbana, IL, 61801). **Project number:** 101. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The development of microchemical and analytical methods on a 20 A scale using electron energy loss and energy dispersive spectroscopies is described. Applications to carbides, oxides, and nitride precipitates in bcc metals and the investigation of heavy metal sulfides and oxides in coal are reported.
Keywords: oxides; carbides; nitrides; bcc lattices; metals; alloys; electrons; energy losses; spectroscopy; sulfides; coal; microanalysis; chemical analysis.

119023 High Temperature Chemistry and Thermodynamics of Structural Materials. Bell, J.T.; Bittner, H.F. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 208. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The chemistry and thermodynamics of structural materials at temperatures in the 400 to 1000 degrees C range are investigated; reactions, kinetics and thermodynamics that describe sorption, corrosion and microphase formation are the primary objectives. Sorption studies include hydrogen isotope sorption by both pure metals and alloys. Measurements of tritium permeation rates through structural alloys into steam atmospheres are a major effort where the inherent permeabilities of materials, the effects of surface oxidation on the overall permeation process, and the chemical and physical characterization of the oxides are particular interests. These studies already have shown that the amounts and the compositions of the oxides formed by steam oxidation of a given alloy will depend on the composition of the alloy, the thermodynamic stabilities of the component metal oxides, the oxidation temperature, the type of surface pretreatment, and the bulk annealing conditions. Another major effort is the investigation of the thermodynamics and kinetics of formation and dissolution of carbide and nitride microphase precipitates. The formation of microphases also affects the corrosion properties, and this new correlation is investigated.
Keywords: high temperature; very high temperature; chemistry; thermodynamics; corrosion; adsorption; metals; alloys; tritium; microstructure; carbides; nitrides; sorptive properties; permeability; diffusion.

119024 Structure of Coal. Harris, L.A.; Yust, C.S. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** 178. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Areas of study are: TEM, SEM, microprobe, optical and infrared petrography of microporosity and microminerology of coal macerals; correlation of coal rank with microstructure; characterization of secondary minerals in microfractures; anthracite, bituminous, sub-bituminous, and cannel coals.
Keywords: coal rank; microstructure; macerals; porosity; anthracite; bituminous coal; subbituminous coal; cannel coal; petrography.

119025 Metals from Fly Ash. Burnet, G.; Murtha, M.J. (Ames Lab., Ames, IA). **Project number:** 35. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Recovery of iron oxide from power plant fly ash by magnetic separation and of alumina using calcination, selective chlorination, and hydro-chemical processing are studied.

Keywords: iron oxides; recovery; fly ash; aluminium oxides; calcination; chlorination; fossil-fuel power plants; air pollution.

119026 Electronic Properties of Amorphous Silicon Dioxide and Metallic Ions in Silicate Glasses. Ching, W.Y. (Univ. of Missouri, Columbia, MO). **Project number:** 375. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The electronic properties of crystalline silicon dioxide, amorphous silicon dioxide, and silicate glasses are to be studied by means of a first principle orthogonalized linear combination of atomic orbitals (OLCAO) method. Special emphasis will be placed on the nature and location of impurity states of various ions in the silicate glass network as well as the interaction between the impurity ions and their host.
Keywords: silicon oxides; silicates; glass; amorphous state; crystals; impurities; electrical properties.

119027 Radiation Damage and Environmental Effects in High Level Storage Glasses Using Transmission Electron Microscopy. Howitt, D.G. (Univ. of California, Davis, CA). **Project number:** 310. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The response of high level waste storage glasses (HLWSG) to irradiation will be studied over a range of temperatures in a variety of irradiation environments to determine the microstructural features, enhancing deterioration and radiation instability in these materials. The effects of microstructural features, including phase separation, precipitation, devitrification, particle size, and composite annealing temperatures on the properties of HLWSG will be investigated. Experimental efforts will involve (1) transmission, high voltage, and analytical electron microscopy; (2) alpha, neutron, electron, and heavy ion radiation; and (3) leaching experiments.
Keywords: radioactive waste storage; high-level radioactive wastes; glass; microstructure; radiation effects; solidification; leaching.

119028 Heavy Element Chemistry Research. Carnall, W.T.; Sullivan, J.C. (Argonne National Lab., Argonne, IL). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The Heavy Element Research effort at ANL comprises several closely interacting programs in crystal and molecular spectroscopy, dynamics of reactions in solution, and inorganic solid-state chemistry. The focal point of the spectroscopy effort is the development of a fundamental understanding of energy transfer processes in the actinides and lanthanides. Absorption and fluorescence spectra of the elements in various oxidation states and phases are measured. High-resolution laser techniques and measurement of excited state lifetimes are emphasized in these studies. The data provide the basis for extensive theoretical interpretation in terms of energy level structure and mechanisms of excited-state relaxation. Fundamental mechanisms of oxidation-reduction reactions in solution are probed in a unique manner using a 20-MeV electron linac as a pulsed source of radiation. Conventional and stopped-flow spectrophotometric techniques as well as pulse radiolysis are exploited in a unique comprehensive experimental effort that provides a sound basis for interpretation of the thermodynamic and dynamic processes that characterize the chemistry of solvated actinide ions. New sensitive techniques are being developed to extend pulse radiolysis studies to extremely dilute solutions in order to probe the chemistry of actinide ions under environmental conditions. A major goal of the inorganic solid-state program is to identify and characterize stable complex phases that will be formed in the course of long-term irradiations as heavier actinides and fission products accumulate in reactor fuel elements.
Keywords: actinides; rare earths; energy transfer; absorption spectra; excited states; chemical reaction kinetics; oxidation; reduction; mev range 10-100; electron beams; radiolysis; actinide compounds; rare earth compounds; chemistry.

119029 Actinide Chemistry. Edelstein, N.M.; Anderson, R.A. (Lawrence Berkeley Lab., Berkeley, CA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The basic purpose of this project is to study lanthanide and actinide materials in order to provide the basic knowledge necessary for their safe and economic utilization in present day and future technology. This program includes studies of the preparation and physical and chemical properties of a variety of new gaseous, liquid and solid phases. Synthesized compounds will be identified and characterized by x-ray diffraction, optical and vibrational spectroscopy, and magnetic resonance and magnetic susceptibility techniques. Equilibrium constants for complex formation will be measured. Neutron diffraction studies will be done in cooperation with other laboratories. From the complementary studies, new insights into the structural and chemical principles of actinide compounds will be gained to imagine new bonding situations and to design new synthetic schemes to produce new materials. A major aspect of the program is concerned with the design of sequestering agents for the actinide ions (in particular plutonium(IV)) which can engulf the ion and generate neutral or negatively charged complexes. Both large absolute formation constants and a very high specificity for the actinide ions will be essential properties of these new sequestering agents. Such compounds are intended to be used in the treatment of actinide poisoning as well as for possible applications in the treatment of spent nuclear reactor fuels. Research to date has demonstrated the feasibility of an approach based on the chemistry of similar sequestering agents of biological origin which are used in microbial iron transport. Chelating agents incorporating hydroxamate and catecholate functional groups as the chelating moieties will continue to be investigated. The preparation, structural, and physical studies of new types of organoactinide, related organolanthanide, and new actinide inorganic complexes will continue to be studied.
Keywords: rare earths; actinides; chemical preparation; physical properties; chemical properties; actinide complexes; rare earth complexes; chelating agents; organometallic compounds; chemistry.

119030 Chemistry of Transuranium Elements and Compounds. Hahn, R.L.; Beall, G. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to obtain fundamental information about oxidation states and potentials, electronic configurations, electron interactions, thermodynamic data such as heats of solution and sublimation, and crystal structures of the actinides and transactinides. It is achieved in two distinct ways: (1) by studying weighable amounts of HFIR-TRU produced actinide elements (up to einsteinium) at the Transuranium Research Laboratory with such measurement techniques as x-ray and electron diffraction, photoelectron and x-ray spectroscopy, spectrophotometry, and magnetic susceptibility; and (2) by using targets of the heaviest actinides such as 248Cm, 249Bk, 249Cf, and 254Es with heavy ions at ORIC to produce atoms of the transfermium elements, often at the rate of a few atoms per experiment. A systematic study is being conducted on the ion-exchange behavior of different minerals with such elements as cesium, strontium, the rare earths and the actinides. A second program is being initiated on the study of the solution chemistry of heavy elements. A third program has begun to investigate the feasibility of assaying underground fluids, such as oil, water and gas, for uranium decay products as a way of exploring for uranium.
Keywords: transuranium elements; chemistry; chemical state; oxidation; structural chemical analysis; crystal structure; actinides; curium 248; berkelium 249; californium 249; einsteinium 254; radioactive waste disposal; environmental transport; uranium deposits; exploration; petroleum deposits; natural gas deposits; feasibility studies; geological surveys.

119031 Research in Actinide Element Chemistry. Choppin, G.R. (Florida State Univ., Tallahassee, FL). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Thermodynamic parameters for complexation of the actinide and the chemically analogous trivalent lanthanide cations by carboxylate, hydroxy and phosphate ligands and by humic acid and fulvic acids will be measured by solvent extraction, potentiometry and calorimetry in order to ascertain the complexing formation constants and the relative role of the enthalpy and entropy changes. 1-H and 13-C NMR studies of the complexes of both diamagnetic and paramagnetic lanthanides will be used to obtain information on the structure of these complexes in solution. 89-Y and 139-La NMR will be investigated to ascertain the utility of these nuclei in solution structure studies. The study of the kinetics and mechanisms of solvent extraction of actinides and of their complexation by aminocarboxylates and humate will continue.
Keywords: actinide complexes; rare earth complexes; chemical reaction kinetics; solvent extraction; stability; molecular structure; chemical preparation; thermodynamic properties; ligands; fulvic acids; humic acids.

119032 Physical-Chemical Studies of the Transuranium Elements. Peterson, J.R. (Univ. of Tennessee, Knoxville, TN). **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The program provides for continuing investigations of the basic physical-chemical properties of the transuranium elements and the interpretation and correlation of the results obtained. New knowledge is expected to be accumulated in the role of the 5f electrons in bonding in actinide elements and compounds; the relationships of metallic structures to metallic valence and radius; the extent and magnitude of the actinide contraction; the magnetic, thermodynamic, spectroscopic, and crystallographic properties of these materials as related to general theories; the effect of self-irradiation of chemical and physical properties; and in general, the range of validity of the actinide hypothesis. Specific projects include: (1) synthesis of Cm-248, Bk-249, and Cf-249 metals, chalcogenides, and pnictides for x-ray diffraction (varying temperature or pressure), magnetic susceptibility (SQUID magnetometer), and heat of solution (solution microcalorimeter) studies; (2) determination of the stability constants of actinide cryptate complexes in aqueous solution and the crystal structures of the corresponding solid cryptate compounds; (3) spectral and x-ray diffraction studies of mixed-valence lanthanide, actinide, and mixed lanthanide-actinide halide compounds, transamericium element fluorides, and halide compounds resulting from the radioactive decay series Es-253 yields Bk-249 yields Cf-249; (4) development of techniques for spectroelectrochemical studies of actinides to characterize Am(VII), Cf(V), and Es(IV); and (5) polarographic and cyclic voltammetric studies of the reduction of Cf(III) and Es(III).
Keywords: transuranium elements; chemical properties; physical properties; chemical bonds; self-irradiation; berkelium 249; curium 248; californium 249; synthesis; actinide complexes; stability; americium; californium; einsteinium.

119033 Kinetics and Mechanisms of Chemical Processes Related to the Development and Use of Energy. Sutherland, J.W. (Brookhaven National Lab., Upton, NY). **Project number:** 20. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: solar(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to develop basic kinetic and mechanistic information about selected chemical systems which are associated with the development and use of energy sources and for which present data are inadequate or unavailable. Short-lived transient chemical species are characterized by flash photolytic and pulse radiolytic techniques, while steady-state photolytic, steady-state radiolytic and standard kinetic methods are used to identify and measure yields of final products of a particular overall reaction. Principal topics being investigated are the photochemistry of selected molecules adsorbed on high surface area solids and the chemistry of transient nitrogen compounds. Some aspects of the reactivity of sulfur dioxide are also being studied. Information developed in this program is relevant to investigations into systems being considered for the photochemical conversion and storage of solar energy, into methods for nitrogen fixation, and to problems in sulfur chemistry associated with the development and use of geothermal energy sources and of fossil fuels. The results of this investigation, in addition to their intrinsic value to the general field of chemical kinetics, are available as quantitative input data for models designed to assess the impacts of using various energy sources.
Keywords: photochemistry; nitrogen compounds; sulfur dioxide; photochemical reactions; solar energy conversion; nitrogen fixation; fossil fuels; chemical reaction kinetics; energy source development.

119034 Crossed Molecular Beams. Lee, Y.T. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 60. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Investigations are underway of the dynamics of elementary atomic and molecular processes and the energetics and the structure of exotic radicals, ions, and ion clusters using the crossed molecular beam method. Information on mechanism and dynamics of chemical reactions is obtained from the direct identification and measurements of velocity and angular distributions of product molecules from single collisions. Significant advancement was made recently in combustion-related elementary reactions. In the reaction of oxygen atoms with benzene, the importance of a substitution channel was elucidated for the first time. Successful crossed molecular beam studies on O(/sup 1/D) + H2, D2 as well as O(/sup 1/D) + CH4 were also carried out. The significant and exciting resonance phenomenon in chemical reactions which was predicted in quantum mechanical calculations was observed in the angular distribution of HF(v=2) formed in the F + H2 reaction. By use of the autoionization process for the preparation of vibrational state-selected H2/sup +/, the effect of translational and vibrational energy in H2/sup +/ + D2 yields HD2/sup +/ + H was studied in great detail. By using the vibrational predissociation process, the infrared spectrum of isolated water molecule clusters was obtained in a molecular beam.
Keywords: colliding beams; molecular beams; reaction kinetics; velocity; angular distribution; atom-molecule collisions; benzene; oxygen; hydrogen; deuterium; methane; d states; combustion; hydrogen; fluorine; atom-molecule collisions; deuterium; hydrogen ions 2 plus; ion-molecule collisions; hydrogen deuteride; hydrogen; water; infrared spectra.

119035 Radiation Chemistry and Photochemistry. Hochanadel, C.J.; Sworski, T.J. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 39. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(50); solar(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This is a program of basic research in photochemistry and chemical kinetics. The immediate goal is to obtain kinetic information that will allow meaningful modeling of the chemistry in systems of interest for the development and use of energy. These systems include combustion, coal conversion, atmospheric chemistry, and solar energy. The reactions studied generally involve small free radicals such as H, OH, O, HO2, CH3, CH3O2, HCO, CN, NCO, NH, and NH2 that are produced in model systems by flash photolysis. The research involves identifying the reactive intermediate, establishing the reaction mechanisms, and evaluating absolute rate constants for elementary reactions. The photolytic flash is either a 3 microsecond Xe flash or a 30 nanosecond flash from an excimer laser. The reactions are observed by time resolved kinetic spectrophotometry. Theoretical curves for comparison with experimental data are obtained by numerical modeling; kinetic parameters are adjusted by the method of least squares to fit the data to these curves with error limits established by sensitivity analysis. In recent studies of the CH3 and HCO radicals produced by the photodissociation of H2 in the presence of CH4 or CO, the absorption spectrum of HCO was measured and the following rate constants were evaluated: k(H + HCO), k(HCO + HCO), k(H + CH3), k(OH + CH3), k(OH + CH4), k(OH + H2), and k(H + CO + M) for M = CO, H2, and CH4.
Keywords: photochemistry; photolysis; chemical reaction kinetics; radicals; reaction intermediates.

119036 Analytical Separations. Fritz, J.S. (Ames Lab., Ames, IA). **Project number:** 158. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

The primary objective of this research is to develop innovative methods of separation and chemical analysis. A unique and effective system for separation and measurement of anions in aqueous samples is being developed. The most essential parts of the new system are an anion exchange column for separation and a conductance detector. Success is achieved by two principal innovations: (1) use of new low-capacity anion-exchange resin developed by this group, and (2) use of a eluent having a very low conductance. Many successful separations have been obtained with samples containing anions of very low concentrations, and the applicability to analysis of real samples is being proven. Other work in progress concerns development of a method for determination of organic pollutants in water and synthesizing new resins for removal of poisonous or valuable metal ions from aqueous solutions. The method for analyzing organic pollutants solves most of the existing water sampling problems and permits concentration and analysis of pollutants present in water at concentrations as low as 0.01 ppB (one part pollutant in 10/sup 11/ parts of water). It uses a small, disposable resin tube for sampling followed by thermal desorption of the concentrated organic pollutants into a gas chromatograph.
Keywords: aqueous solutions; anions; ion exchange; resins; synthesis; organic compounds; gas chromatography; chemical analysis; separation processes.

119037 Lasers in Analytical Chemistry. Yeung, E.S. (Ames Lab., Ames, IA). **Project number:** 161. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

With the projected increase in the use of coal and other fossil fuels the emission of various forms of pollutants into the environment can become a serious problem. The need for sensitive, selective, and reliable monitoring methods for these pollutants therefore also increases. Several laser analytical techniques are being developed so that one can gain some unique insignts into the production and the transport of trace elements, organics, and gaseous pollutants resulting from fossil fuel utilization. Emphasis is on (1) atomic emission and atomic fluorescence studies on the disposition of trace elements; (2) liquid chromatographic determination of organic pollutants using more selective detectors; (3) inverse Raman excitation and acoustic detection of trace gases; (4) time-synchronous Raman spectroscopy as a remote monitoring tool for combustion chambers; (5) studies of spectral interference in long-path infrared absorption and infrared photoacoustic measurements of gaseous pollutants with the hope of eliminating such interferences; and (6) evaluation of

practical pollution monitoring instruments based on lasers at representative pollution sources, including smokestacks and automobile exhausts.
Keywords: elements; trace amounts; environmental transport; gaseous wastes; fluorescence spectroscopy; emission spectroscopy; liquid column chromatography; gases; monitoring; air pollution; lasers; organic compounds; air pollution monitors.

119038 Combustion and Atmospheric Pollution Chemistry. Gordon, S.; Closs, G. (Argonne National Lab., Argonne, IL). **Project number:** 6. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this program is to study in detail chemical reaction mechanisms of importance in combustion and in atmospheric processes over a wide range of experimental parameters to allow extrapolation of results from one set of conditions to another with greater confidence. To accomplish this objective, the program utilizes free radicals involved in the combustion process, generated by an electron linac and a Febetron, in order to study reactions of the radicals with organic compounds over a wide temperature range to evaluate their non-Arrhenius behavior. Parallel with these studies are photochemical studies to evaluate the role of excited states of the reactive species in the reactions. Free radical reactions of sulfur-containing compounds are being examined to explore the possible application of radiation to the study of potential methods for desulfurizing coal.
Keywords: combustion kinetics; radicals; organic compounds; photochemical reactions; chemical reactions; atmospheric chemistry.

119039 Inorganic Chemistry. Appelman, E.H.; Malm, J.G. (Argonne National Lab., Argonne, IL). **Project number:** 98. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This program concentrates on the chemistry of fluorine, reactive flourides, and compounds derived from them. This effort involves searching for and characterizing new and unusual inorganic oxidants and fluorinating agents in order to explore their chemical behavior and to identify promising applications of these new substances to other areas of science and technology. Major current areas of investigation are: (1) reaction of fluorine and reactive fluorine compounds with aqueous solutions; (2) reaction of powerful oxidants and fluorinating agents with organic compounds; (3) new aspects of noble gas chemistry and applications to the development of chemical methods of collection of noble gases; and (4) studies of unusual chemistry in anhydrous HF, particularly involving uranium fluorides. Of particular current interest are studies of the chemistry of two newly discovered species, the fluoroxysulfate ion, SO4F/sup -/, and the dixenon cation, Xe2/sup +/.
Keywords: fluorine; fluorides; fluorine compounds; aqueous solutions; organic compounds; chemistry; inorganic compounds.

119040 Study of Atmospheric Trace Gases by Mass Sepctrometry. Stevens, C.M. (Argonne National Lab., Argonne, IL). **Project number:** 163. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The major objective of this program is to determine the sources and production rates of atmospheric CO on a global scale by means of isotopic distribution measurements. Another very important objective of this work is the determination of the atmospheric concentration of the OH radical and any changes in this key species over the last decade. These studies of atmospheric CO produce what may be the only existing data for determining whether the concentration of OH has decreased over the past decade due to the increasing amounts of pollutant trace gases. Since OH is the principal scavenger of almost all pollutants such as CO, SO2 and NOx, any significant reduction in its concentration would result in increased residence times and higher concentrations of these pollutant gases with possible long-range deleterious effects on agriculture, health and climate. Since the atmospheric methane cycle is related to the atmospheric CO and OH cycles, another phase of the experimental program is to determine the sources and production rates of this trace gas more accurately. The determination of carbon-14 in atmospheric CO is a long-range objective. Such determinations give an independent measure of the production rate of natural CO from the isotopic dilution effect on cosmogenically produced 14Co.
Keywords: mass spectroscopy; trace amounts; carbon monoxide; hydroxyl radicals; atmospheric chemistry; photochemical reactions; carbon 14 compounds; methane; air pollution; quantity ratio; measuring methods.

119041 Cyclic Separations Process Research. Hill, F.B.; Wong, Y.W. (Brookhaven National Lab., Upton, NY). **Project number:** 141. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

This program consists of a study of the application of cyclic separation processes to separations problems arising in energy technology. The purposes of the program are two-fold: to obtain understanding of the characteristics and basis of operation of cyclic separation processes as a class, and to explore the feasibility of using these processes to perform specific separations of interest in the energy field. The cyclic processes of interest include pressure and temperature swing adsorption, parametric pumping, cycling zone adsorption, and various forms of preparative chromatography. Applications presently under study involve isotope separations of interest in nuclear technology, specifically tritium removal and heavy water production. Future work may include applications such as hydrogen purification, pollutant removal from gases, and additional separations of interest in energy technologies. Elements of the program include development of the theory of cyclic processes, measurements of equilibrium and kinetic properties of selected fluid-solid separation systems, measurement of the characteristics of cyclic separation processes employing these systems, and process design and evaluation studies. The work accomplished in this program will permit rational design and assessment of cyclic separation processes and will identify promising methods of solution for specific separation problems in the energy field.
Keywords: separation processes; adsorption; chromatography; uses; tritium; removal; heavy water; production.

119042 Determination of Fragile Molecules in the Environment. Tanner, R. (Brookhaven National Lab., Upton, NY). **Project number:** 167. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant measurements technology.

This research project has the long-term goal of devising and developing fundamentally new analytical methods which are sufficiently sensitive and selective to determine traces of potentially reactive substances in the environment. The fundamental approach is the use of derivatization-chromatograhic separation-selective detection techniques. Development of a method for the detection of nanogram quantities of nitrate in a variety of environmental samples by nitro-derivatization-GC has been essentially completed. A new technique for the determination of atmospheric levels of ammonia and primary amines is being developed, based on fluorescent derivatization with o-phthalaldehyde. Optimization of a continuous analysis system for ammonia is well advanced and the incorporation of a gaseous scrubber of known, reproducible efficiency in the analysis system is in progress. Preliminary studies on the determination of acidic sulfur compounds by methylation-GC with flame photometric detection and of trace carboxylic acids by ion pair extraction and derivatization with an electron-capture sensitive alcohol have begun.
Keywords: nitrates; gas chromatography; ammonia; amines; sulfur compounds; carboxylic acids; trace amounts; photometry; quantitative chemical analysis.

119043 Chemical Analysis. Clem, R. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 169. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant measurements technology.

The overall goal of this program is the development of a trace element methodology that can routinely be used in energy-related research. Exploratory studies are undertaken to point the way toward possible applications of this methodology. Trace multi-element x-ray fluorescence analytical techniques are being developed. Presently up to 42 elements are determined in a variety of samples, including raw and spent oil shales, shale oils, oil shale retort waters, industrial waste liquids, coal, and industrial solid wastes. Improved sensitivities for a broader range of sample types will be obtained. Electroanalytical techniques are being developed for use in energy-related research. Ozone, in conjunction with uv irradiation, is being assessed as a means to destroy matter in oil-shale retort waters, prior to trace metals analysis. Chemically modified glassy carbon surfaces, on which quarternary ammonium bases are synthesized, are used for trace determination of metal chloro-anions.
Keywords: trace amounts; elements; multi-element analysis; x-ray fluorescence analysis; chemical analysis.

119044 Photochemistry of Materials in the Stratosphere. Johnston, H.S. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 23. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

This project is concerned with the photochemical processes that contribute to the production and destruction of stratospheric ozone. Laboratory studies are carried out to obtain optical cross

sections, quantum yields, and rate constants for species that occur in the stratosphere. Recently, temperature dependent cross sections have been determined for nitrous oxide and for nitrogen pentoxide. The quantum yields as a function of wavelength have been obtained for two product channels of the nitrate free radical. As others measure the concentrations of trace species in the atmosphere, this project interprets these results in terms of its method of instantaneous rates. In favorable cases, these interpretations extend to the full three-dimensional atmosphere, for example, the photolysis of nitrous oxide and its reactions with singlet atomic oxygen. Conventional one-dimensional models of atmospheric dynamics and photochemistry are used to support the interpretation of atmospheric observations and in the planning and interpretation of laboratory experiments.
Keywords: stratosphere; ozone; nitrogen oxides; nitrous oxide; ozone layer; photochemical reactions; photochemistry; chemical reaction kinetics; air pollution; radicals; temperature dependence; frequency dependence.

119045 Formation of Oxyacids of Sulfur from SO2. Connick, R.E. (Lawrence Berkeley Lab., Berkeley, CA). **Project number:** 115. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The basic chemistry of sulfur dioxide and species formed from it are being investigated. The results are pertinent to the removal of sulfur dioxide from stack gases of power plants and to the behavior of sulfur dioxide in atmospheric pollution. Attention is being focused on the reactions of SO2, HSO3/sup -/ and SO3/sup 2-/ with various oxidizing and reducing agents and the disproportionation reactions of these sulfur species. One particular reaction - the oxidation by oxygen - will be studied in detail because of its overriding importance in the practical chemistry of SO2. The reaction is known to be a chain reaction in aqueous solution, both thermally and photochemically, but the chain carriers and mechanism are unknown. An important aspect is the pronounced effect of a wide variety of substances in either initiating or terminating the chain reaction and thus altering the rate drastically. Attempts are being made to detect the chain carriers directly, using flash photolysis to initiate the reaction and rapid scan spectrophotometry or other rapid detection techniques to detect them.
Keywords: sulfur dioxide; sulfites; chemical reactions; oxidation; reduction; chemical reaction kinetics; oxygen.

119046 Labile SO2 Complexes. Kubas, G.J. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 122. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The synthesis, reactivity, structure, and bonding of transition metal SO2 complexes are being investigated in order to advance the basic chemistry of small molecule pollutants and to develop new scavenging methods. Reactions of coordinated SO2 are being explored in the hope of promoting its conversion to useful or innocuous products. Discoveries in this program of complexes containing side-on bonded (eta squared-) SO2 and others with ligand-ligand interactions are closely aligned with this goal. Binding of both the sulfur and one oxygen to a metal can be expected to activate SO2 towards novel reactions; this is demonstrated by the interaction of Ru(CO)2(PPh3)2(eta squared-SO2) with a second SO2 to give a sulfate Ru(CO)2(PPh3)2(SO4) and Ph3PS (oxidation and reduction of SO2). Other current investigations show that the hydrogen reduction of SO2 to sulfur and water occurs at lower temperature (approx. 50 degrees C) by use of ruthenium on alumina catalyst compared to alumina alone. Also, new molybdenum(0) complexes are being studied in which the SO2 coordination can readily be converted between eta squared- and S-bonded. In the absence of SO2, coordinative unsaturation and reversible binding of other small molecules (C2H4, H2, N2) can occur.
Keywords: chemical reactions; sulfur dioxide; atmospheric chemistry; air pollution control; waste product utilization; sulfur complexes.

119047 Investigation of the Mechanisms of the Removal of Radioactive Nuclides from Waste Streams. Silver, G.L. (Mound Lab., Miamisburg, OH). **Project number:** 145. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Waste water contaminated with radioelements such as uranium, neptunium, and plutonium is generated in commercial nuclear fuel cycles, by nuclear weapons manufacture, radioisotope research facilities, heat source fabrication, and medical research. Before such waste water can be returned to the environment, it must be decontaminated. Although certain inorganic compounds can diminish the concentration of plutonium in waste water to the point that the water is no longer an environmental hazard, the mechanism of the decontamination process is not understood. The purpose of this project is to study the decontamination of waste water by radioelement adsorption onto inorganic compounds. Several classes of inorganic compounds have been selected for this study, the most promising of which appears to be the phosphates of the alkaline earth elements. These compounds may be used in primary or secondary waste treatment procedures, and do not present the disposal or storage problems associated with organic adsorbants such as ion exchange resins. The goals of this project are to study the adsorption process as a function of the nature of the inorganic adsorbent compound, the chemistry of the radioelement, the chemical properties of waste water which influence the decontamination process, and application of this knowledge to an efficient, economical procedure for treating waste water prior to discharge to the environment.
Keywords: radioactive waste processing; waste water; adsorption; alkaline earth metal compounds; phosphates; chemical properties; sorptive properties; liquid wastes.

119048 Atomic and Molecular Properties and Their Relationship to Separation Processes. Taylor, W.L. (Mound Lab., Miamisburg, OH). **Project number:** 146. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this research is to investigate the physical properties of isotopes and their mixtures. Currently, experiments are being conducted to measure the total scattering cross section, the thermal diffusion factor, the diffusion coefficient and vapor pressure of the permanent gases and their isotopes. The resulting data are analyzed to probe and ascertain fundamental atomic interactions and to provide information necessary for the design and operation of isotope separation systems. Total cross sections have recently been measured for the Ne-Ar system and are presently underway for He-Ar. A unique velocity selector is being tested which will reduce the energy spread of the molecular beams used in this work. Thermal diffusion factors have been measured for all noble gas isotopes and their binary mixtures. Ordinary diffusion coefficients have been measured for the majority of noble gas isotopes and mixutres, and experiments are continuing on the remaining systems. Vapor pressure work is concentrating on the hydrogen isotopes using ultrapure deuterium in the experiments. A new and improved interaction potential for helium atoms was recently determined and published as a result in part of the current work.
Keywords: separation processes; mixtures; physical properties; radioisotopes; vapor pressure; cross sections; isotope separation; neon; argon; helium; rare gases; hydrogen isotopes; atom-atom collisions; diffusion; interatomic forces.

119049 Isotope Separation Research and Development. Rutherford, W.M.; Jepson, B.E. (Mound Lab., Miamisburg, OH). **Project number:** 144. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant measurements technology.

This program is concerned with the investigation of chemical exchange and liquid phase thermal diffusion as techniques for stable isotope separation. The primary objectives of the chemical exchange work are to find significant isotope effects in metal isotope exchange between aqueous and organic ligand phases and to develop closed cycle methods of refluxing chemical exchange systems with oxidation state changes between the exchanging species. The liquid thermal diffusion work is directed, in part, toward developing a basic understanding of the behavior of liquid phase thermal diffusion columns and, in part, toward gaining experimental information about the isotopic thermal diffusion factor in the liquid phase. The successful development of these lines of research will lead to improved methods for separating stable isotopes required for physical, chemical, biomedical, and energy applications.
Keywords: isotope separation; isotope effects; thermal diffusion.

119050 Mass Spectrometry R/D for Organic Analyses. Rainey, W.T.; Canada, D.C. (Oak Ridge National Lab., P.O.Box X, Oak Ridge, TN, 37830). **Project number:** 172. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

This program has the following primary objectives: (1) to study ionization processes and the chemistry of gas-phase ions in the mass spectrometer, including both unimolecular field-free dissociations and dissociations induced by collision or photon activation; (2) to develop instrumentation and methodology for carrying out these studies; and (3) to develop new techniques for organic analyses, with particular emphasis on problems involving structural configurations. A system with ultra high sensitivity and mass resolution and various scanning modes is being used to rigorously study the chemistry of ions such as the C7H7O/sup +/ ion as obtained from a variety of precursor molecules. The capabilities of the mass spectrometer are being further expanded by the addition of a mass marker and

circuitry for scanning of the magnet (B) and electric sector (E) voltage maintaining the ratio B/E constant, yielding higher sensitivity without source defocusing. The ORNL double focusing instrument has been converted to a three-sector instrument by adding a second electric sector and, with the addition of gas collision cells and a xenon arc lamp, is being used in the study of induced dissociation reactions. The three-sector instrument is capable of high resolution mass analysis prior to the dissociation process with high energy resolution performed by the second electric sector.
Keywords: mass spectroscopy; mass spectrometers; ionization; structural chemical analysis; precursor; cations; organic compounds; gases.

119051 Waste Stream Processing Studies. Lloyd, M.H. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 154. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This research provides basic support to nuclear fuel reprocessing in the area of loss mechanisms for plutonium into waste streams. Plutonium complexes as well as insoluble molybdates which incorporate plutonium are identified. The nature of plutonium polymer is also elucidated. Spectrophotometric analyses of plutonium complexes in solutions of tributyl phosphate in n-dodecane are made. Complexation of radiolytic decomposition products of tributyl phosphate as well as its hydrolysis products with plutonium are studied. The relative strength of plutonium, uranium, zirconium and thorium complexes with monobutyl and dibutyl phosphates are determined. Formation rates as functions of nitric acid and metal concentrations as well as temperature are studied during preparation of insoluble molybdates carrying plutonium. X-ray powder patterns are used to identify and characterize molydbate compounds that precipitate from solution.
Keywords: plutonium; tbp; solvent extraction; plutonium complexes; spectrophotometry; radiolysis; nitric acid; uranium complexes; zirconium complexes; thorium complexes; spent fuels; reprocessing; fuel reprocessing plants; radioactive wastes; stability.

119052 Fundamental Concepts for Resource Recovery. Kelmers, A.D.; Canon, R.M. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 153. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This program investigates chemical concepts for recovering useful resources from energy and industrial wastes, low-grade ores, and tailings from mining operations. Metal values are recovered from wastes produced by coal utilization, especially fly ash and coal conversion ash. Ashes are potentially important sources of aluminum, iron, and titanium and could reduce our dependence upon imported aluminum and titanium ores rather than create significant disposal problems which could become especially acute with implementation of the Resource Conservation and Recovery Act. Chemical techniques are studied for recovering these materials and for removing hazardous metals which may hamper disposal of the ash or process residue. Potentially marketable trace metals are identified. Extraction of mineral values from processing residues and wastes provides an important source of several metals, reduces environmental problems associated with disposal of the waste, reduces requirements for fresh ores, conserves energy, and reduces the U.S. dependence upon foreign minerals.
Keywords: materials recovery; fly ash; ashes; metals; aluminium; iron; titanium; waste management; by-products; waste product utilization.

119053 Fundamentals of Separation Chemistry. Baes, C.F. Jr.; Arnold, W.D. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 147. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Improved separations methods and processes for recovering strategic materials are being developed. In cooperation with TVA, the chemistry related to the recovery by solvent extraction of the approximately 4000 tons of uranium dissolved in the phosphoric acid processed annually by the U.S. fertilizer industry is being developed. In another study, high-resolution pressurized ion exchange is used for difficult separations such as Co-Ni and Zr-Hf. In still another study, the complexing ability of various cage-like diazopolyoxamacrocyclic molecules (cryptands) for lanthanide ions is being explored as a basis for the separation of lanthanide and actinide elements. Because the complexes formed contain the cation inside the molecular cavity or cage, a strong correlation of stability with structure and cation size is expected. Finally, statistical-mechanical and thermodynamic theories for liquids, liquid crystals, and other ordered fluids and polymers are being developed to explain and predict solute-solvent interactions, aggregation and phase separation important in solvent extraction processes. Particular attention is being focused on the effects of the shapes, flexibilities and specific interactions of mixture components. These theoretical and selected experimental studies are being used to predict behavior in both new and existing separation processes.
Keywords: phosphoric acid; uranium; recovery; solvent extraction; ion exchange; cobalt; nickel; zirconium; hafnium; actinides; rare earths; separation processes.

119054 Development of Predictive Models for Fluidized Bed and Entrained Suspensions in Coal Conversion. Li, C.T. (Battelle Pacific Northwest Labs., Richland, WA). **Project number:** 182. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The purpose of this program is to develop mathematical models which allow reliable design and evaluation of fluidized bed and entrained-suspension systems used in coal conversion processes. Models developed in this project can predict the performance of fluidized beds and entrained-suspension reactors as a function of system size and configuration, chemical reactions, and physical changes occurring within various coal conversion reactor systems. The main concern is to develop a mathematical model to describe the phenomenon of bubble coalescence in fluidized beds. The model is based on the collision equation and physical parameters measured from laboratory-scale gas fluidized beds. The model is mathematically solved by the similarity method, and is being combined with the gas-jet model developed in previous work and checked for overall reliability.
Keywords: mathematical models; design; evaluation; fluidized bed; entrainment; suspensions; bubbles; in-situ gasification.

119055 Research in Chemical Kinetics. Rowland, F.S. (Univ. of California, Irvine, CA, 92717). **Project number:** 217. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The techniques of radiochemistry and photochemistry are applied primarily to the study of small molecules in the gas phase in order to understand the mechanisms and rates of chemical reactions. Many of the molecules and chemical reactions have geochemical significance because of their occurrence in the atmosphere of the Earth or other planets. The program primarily depends upon laboratory measurements, but has lesser components of theoretical calculation and atmospheric field measurements. The molecules under study include hydrocarbons, halocarbons, and organometallic species. Some specific topics include (1) absolute calibrations of electron capture detectors for CCl3F, CCl2F2, CCl4, CH3CCl3, CHCl = CCl2 and CCl2 = CCl2 as the basis for continued monitoring of these compounds in the troposphere; (2) ultraviolet absorption measurements of CCl2, CClFO, and CF2O plus mechanistic studies of their photodecomposition with reference to stratospheric processes; (3) addition of thermal 18-F and 38-Cl to asymmetric alkenes and alkynes to determine the directional factors controlling such reactions; (4) direct substitution reactions of F and Cl at C-M (M = Pb, Sn, Ge, Si) bonds in organometallic compounds; (5) reactions of 1-Ch2 and 3-CH2 with simple hydrocarbons and methyl halides; (6) thermal 38-Cl reactions with CH4 and C2H2 for stratospheric comparisons; and (7) observation of the reactions of non-RRKM radicals formed by thermal 18-F addition to tetraallyl organometallic compounds.
Keywords: radiochemistry; photochemistry; chemical reaction kinetics; hydrocarbons; organometallic compounds; carbon tetrachloride; chlorinated aliphatic hydrocarbons; fluorinated aliphatic hydrocarbons; atmospheric chemistry.

119056 Mechanism of Fluid Permeation Through Polymer Membranes: Tests of a Free Volume Model of Permeation. Stern, S.A. (Syracuse Univ., Syracuse, NY, 13210). **Project number:** 358. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

A recent model of fluid permeation through nonporous polymeric membranes, based on free-volume concepts offers a comprehensive theoretical description of the permeation behavior of pure gases and gas mixtures. The purpose of this study is to subject the model to rigorous tests in order to assess its regimes of validity. The tests consist of the prediction of permeability coefficients for selected penetrant-polymer systems, including both pure gases and their mixtures, by means of specified free-volume parameters and solubility data. The required parameters are determined from high-pressure diffusivity measurements. The predicted permeability coefficients are then compared with experimental values over a wide range of pressures and temperatures. Diffusivity and solubility measurements are being performed simultaneously in a new high-pressure apparatus under isobaric and isothermal conditions. Permeability coefficients

are also being determined for several binary gas mixtures in selected polymeric membranes at high pressures, since very few data reported in the literature are suitable for tests of the free-volume model. The free-volume model of permeation, if confirmed, will prove extremely useful for the development of membrane separation processes. Extensions of the model will also offer a fresh insight into the nature of interactions between polymers and small penetrant molecules.
Keywords: membranes; permeability; polymers; gases; mixtures.

119057 Fundamental Studies in Isotope Chemistry. Bigeleisen, J. (State Univ. of New York, Stony Brook, NY, 11794). **Project number:** 347. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A program of experimental and theoretical investigations of isotope effects in physical and chemical processes is underway. Fundamental understanding of isotope effects has broadened the knowledge of the behavior of matter and provides the basic science from which new isotope separation processes are developed. The experimental investigations are being principally directed at the behavior of condensed media, a relatively unexplored and fruitful area of investigation for which a unique experimental facility has been established. The theoretical program is concerned with the correlation of isotope effects with molecular and intermolecular forces.
Keywords: isotope effects; isotope separation.

119058 Solvent Extraction Studies of Metals Using High Molecular Weight Amines. McDonald, C.W. (Texas Southern Univ., Houston, TX, 77004). **Project number:** 355. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The primary objective of this research project is to provide the basic data needed to develop highly efficient extraction methods for removing a number of toxic metal ions from aqueous solutions using high-molecular-weight amines and quaternary ammonium salts. There is also concern for determining reaction stoichiometry, mechanisms and efficiencies of the new extraction systems. In order to accomplish these objectives, a number of high-molecular-weight amines and quaternary ammonium salts are being purchased for use in the extraction studies. Xylene and other non-polar solvents are being used as solvents for the amines. The extraction efficiencies are being determined by use of an atomic absorption spectrophotometer. The goal of the project is to demonstrate on the bench scale the feasibility of developing commercial scale processes for the simple, inexpensive removal of toxic metal ions from polluted industrial wastewater.
Keywords: amines; solvent extraction; aqueous solutions; salts; quaternary compounds; xylenes; metals; waste water.

119059 Development of New Methods for Quantification of Fossil Fuels by Mass Spectrometry. Sieck, W. (National Bureau of Standards, Washington, DC, 20234). **Project number:** 369. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

New methods are being developed for the rapid chemical ionization-mass spectrometric screening and quantitation of selected components in petroproducts. The cationic analyses involve photoionization of various solvents for fuel samples in order to produce specific reagent ions which react only with certain classes of compounds present in the fuel. Negative ion spectra of aromatic derivatives are obtained by OH/sup -/ reactions, where OH/sup -/ is generated by the reactions of O/sup -/, from N2O, with aliphatic solvents for liquid fuels. Both methods provide two minute turnaround times between successive samples and batch introduction, and eliminate the necessity for prior separation or fractionation. Quantitation of aromatic components by molecular weight is carried out using deuterium-labelled marker compounds (isotope dilution), and it appears that the type of information provided by the mass spectra is ideally suited to quality control during petroleum refining. A feasibility study concerning the use of photoionization, as opposed to electron impact, in mass spectrometers which are directly interfaced with liquid chromatographs, is also in progress.
Keywords: mass spectroscopy; aromatics; isotope dilution; petroleum products.

119060 Rotating Fluidized Bed Combustor. Hill, F.B. (Brookhaven National Lab., Upton, NY). **Project number:** 179. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

This program consists of a study of the rotating fluidized bed as a chemical reactor for the conduct of fast reactions such as combustion and includes experimental and theoretical studies of the fluid dynamics and reaction properties of the rotating fluidized bed. Measurements are being made of the properties of gas bubbles in rotating liquids and in rotating gas-solid fluidized beds. These will be followed by measurements of the exchange between bubbles and the emulsion phase and by studies of the chemical reaction properties of the rotating system using a well characterized model fast reaction. A parallel theoretical effort on the influence of rotation on fluidization is underway.
Keywords: fluidized-bed combustors; gases; solids; chemical reactions.

119061 Tokamak Fusion Test Reactor (TFTR). Reardon, P. (Princeton Plasma Physics Lab., Princeton, NJ, 08544). **Contract:** EY-76-C-02-3073. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

This program was undertaken in order to develop and procure tritium cleanup systems to contain routine and accidental spills of tritium within TFTR facility.
Keywords: tftr reactors; tritium; tritium recovery; surface cleaning; accidents; leaks.

119062 Fusion Materials Irradiation Test Facility (FMIT). Trego, A.L. (Hanford Engineering Development Lab., Richland, WA). **Contract:** AC14-76FF02170. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

This program was undertaken in order to develop methods of cleaning up tritium from liquid lithium systems.
Keywords: fmit linac; tritium recovery; lithium; cleaning; surface cleaning; tritium.

119063 Tritium Systems Test Assembly. Anderson, J.L. (Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 8103-E759. **Contract:** AL-ENG36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

The Tritium Systems Test Assembly (TSTA) is dedicated to the development, demonstration, and interfacing of technologies related to the deuterium-tritium fuel cycle for fusion reactor systems. The first such system to be built will be the Engineering Test Facility (ETF). This ETF will be followed by an Experimental Power Reactor (EPR). These devices will build on and expand on the tritium handling system developed at TSTA. The principal objectives for TSTA can be rather concisely stated: (1) demonstrate the fuel cycle for fusion power reactors; (2) develop, test, and qualify equipment for tritium service in the fusion program; (3) develop and test environmental and personnel protective systems; (4) provide a final facility that can be used for demonstration and as an example that could be copied directly for fusion facilities; (5) demonstrate long-term reliability components; (6) demonstrate long-term safe handling of tritium; and (7) investigate and evaluate the response of the fuel cycle and environmental packages to normal, off-normal, and emergency situations. TSTA construction will be completed in late FY 1981.
Keywords: tritium; tritium recovery; test facilities; thermonuclear reactors; fuel cycle; radiation hazards; safety; thermonuclear fuels.

119064 Fusion--Fission Hybrid Reactor Safety. Schultz, K.R. (General Atomic Co., 10955 John Jay Hopkins Drive, San Diego, CA, 92121). **Project number:** 3235.878.001. **Contract:** AT03-76ET51011. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

The preliminary study of the safety of fusion--fission hybrid reactors will concentrate initially on the accident behavior and safety implications of hybrid systems. It will then focus on the different hybrid blanket concepts making generic safety comparisons of uranium- and thorium-based blankets. The most promising concepts from a safety standpoint will be chosen to be evaluated further in greater detail.
Keywords: hybrid reactors; safety; accidents; breeding blankets; thorium cycle; thermodynamics; hydraulics; neutron transport.

119065 Tritium Permeation in Steam Generator Material. Ferris, L.M. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 3420-0140. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

The primary effort is to measure tritium permeabilities of steam generator materials at high steam pressures under dynamic conditions, i.e., conditions that are anticipated in the steam generator of a fusion power plant. The most likely path for tritium to be released from a fusion power plant to the environment is through the steam generator system. Calculations based on present power plant designs indicate that permeation barriers are needed on the structural material to reduce permeation of tritium into the steam cycle by 2 or 3 orders of magnitude. Steam oxidation of the steam generator material will produce an oxide film which may substantially reduce the tritium permeation, but there is no quantitative information on the effectiveness of such oxide films in steam generators. This program measures the effects of oxides formed on different steam generator materials to impede tritium permeation and correlates the chemical and physical properties of the oxides with the permeability of the oxidized material. This program supports the fusion energy programs concerned with tritium management, steam generator materials, and environmental impacts.
Keywords: thermonuclear power plants; steam generators; tritium; permeability; steam; oxidation; materials testing; diffusion; containment; environmental effects; radiation hazards.

119066 Magnetic Fusion Energy Generic Environmental Impact Statement. Cannon, J.B. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 3345-0986. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this task is to develop a generic Environmental Impact Statement (EIS) in support of the Magnetic Fusion Program. The generic EIS will address the potential environmental implications of commercial applications of magnetic fusion energy. As such, the statement will assess the environmental impacts associated with a conceptual magnetic fusion reactor industry composed of a reactor plant with supporting fuel cycle facilities. The EIS will be written by an ORNL team consisting of a project manager and a multidisciplinary team of experts. The program will involve collaboration between principal research, design, and environmental analysis personnel within the fusion community to adequately scope the fusion plant design and effluent data (source terms) necessary for the proposed level of environmental analysis.
Keywords: thermonuclear power plants; environmental impact statements; fuel cycle; environmental effects; radioactive effluents.

119067 Fusion Safety Studies. Crocker, J.G. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** 745000000. **Contract:** ID-01570. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

The DOE in FY 79 had chosen Idaho National Engineering Laboratory (INEL) to have the lead lab role in Fusion Safety Research. The objectives of their program are to (1) assist DOE in the management of the Fusion Reactor Safety Research Program, and (2) provide timely information to support fusion power development. The major effort in FY 79 was the preparation of a Fusion Safety Research Program plan which is needed to help identify and guide the specific activities that need to be addressed in order to help demonstrate the environmental acceptability of fusion. In addition to developing the plan, INEL is conducting programs in lithium fire safety, activation product analysis, superconducting magnet safety, safety design criteria, safety analysis methodology safety data base development, and tritium and lithium fire modeling.
Keywords: safety; thermonuclear power plants; lithium; fire hazards; radioactivation; superconducting magnets; specifications; tritium.

119068 Improved Tritium Getters. Souers, P.C. (Lawrence Livermore Lab., P.O. Box 080 L-365, Livermore, CA, 94550). **Project number:** 6179-11. **Contract:** SF-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to find a chemical and then to use that chemical as part of an improved tritium getter which would absorb tritium without deliberately forming tritiated water. They are currently reacting air-tritium mixtures with the organic acetylene compound 1,4-diphenylbutadiyne using a palladium catalyst at room temperature. The organic-to-water forming ratio must be high, and they have reached 168 as a maximum. This encourages further work in the as-yet-untried organometallic family of compounds. They are also synthesizing a set of new metal-organic compounds. These will combine the organic and the catalyst in the same compound. Most of this chemistry is brand new, and it offers a new opportunity to approach the tritium getter problem. Our task, then is to cover the broad organometallic field to find the most efficient tritium-in-air reacting compounds. These they will engineer for actual getter use.
Keywords: tritium; decontamination; absorption; organometallic compounds; air pollution abatement; sorptive properties; chemical bonds; cleaning; gettering; getters.

119069 Production and Selection of Duckweed (Lemnaceae) Strains for the Removal of Inorganic and Organic Materials From Water Polluted Areas. Hillman, W.S. (Brookhaven National Lab., Biology Department, Upton, NY, 11973). **Project number:** 001800. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$40,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The production and use of energy is inextricably related to environmental water quality. Energy-related pollutants include heavy metals and acidic oxides from fuel combustion brought down in precipitation; runoff from mining; water from boilers and heat exchangers; and runoff from agricultural land and feed lots operated at high energy expense. Thus the treatment of water to remove such substances and recover those that are useful is crucial to energy management. The advantages of using biological components in such treatment include the possible use of the organisms involved as either biomass energy sources--e.g., in methane fermentation--or as animal feeds. The Lemnaceae--duckweeds--have the most rapid sustainable vegetative growth rates known among higher plants; their floating habit and small but macroscopic size make their separation from water far simpler than that of other organisms used or proposed for similar purposes. Preliminary work elsewhere with wild material is encouraging with regard both to the removal of pollutants and subsequent use of the plants. The goal of this project is thus to develop strains with high capacities for the removal or destruction of specific pollutants and with other properties desirable in integrated water-management systems.
Keywords: water pollution; removal; zinc; lead; cadmium; purification; combustion products; runoff; acid mine drainage; cooling; water; heat exchangers; agriculture; biodegradation; water treatment; plants; water pollution control; preferred species; environmental effects.

119070 Plant Biomass and Energy Conservation. Constantin, M.J. (UT-DOE Comparative Animal Research Laboratory, 1299 Bethel Valley Road, Oak Ridge, TN, 37830). **Project number:** 002655. **Contract:** EY-76-C-05-0242. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$315,000.
Related energy source: Coal(75); conservation(25) **R and D categories:** Biological effects of pollutants in experimental systems.

Biomass, the result of solar energy storage by plants through photosynthesis, represents a unique, renewable resource which can be converted either to fuels or to chemical feedstocks. Our present knowledge of the biological limits to exploitation of this resource is inadequate, and further research is required to adapt biomass production as an alternate energy source. The objective of this project is to gain an understanding of the biological processes involved with biomass, and to develop methods leading to improved biomass yield and quality. Our attention is currently focused on: (1) the effects mechanism of sulfur dioxide on photosynthesis, and the assessment of the feasibility of developing mutants resistant to this pollutant; (2) the regulation and synthesis of aspartate-derived amino acids and the identification of methionine-rich protein fractions; (3) development of screens to determine genetic resistance to energy pollutants and environmental stress as well as improved protein quantity and quality; and (4) regulation of photosynthate partitioning into starch, cellulose or protein.
Keywords: biomass; yields; sulfur dioxide; biochemical reaction kinetics; photosynthesis; feasibility studies; mutants; amino acids; proteins.

119071 Gene-Enzyme Relationships in Somatic Cells and Their Organismal Derivatives in Higher Plants. Jensen, R.A. (State University of New York, Binghamton, NY, 13901). **Project number:** 007971. **Contract:** EP-78-S-02-4967.A000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$71,000.
Related energy source: general science(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The biochemical pathway in plants which guides the formation of innumerable aromatic metabolites is the proposed focal point for the establishment of a well-defined system of biochemical genetics using cultured somatic cells of tobacco (Nicotiana sylvestris). Essentially microbiological techniques, together with rigorous molecular and biochemical approaches, will be combined with emerging techniques of plant-cell biology. Phenylalanine ammonia lyase will be studied as a convenient enzymological indicator of secondary metabolism that derives from phenylalanine and tyrosine. The biosynthetic pathway enzymology will be characterized in cell suspension cultures of tobacco, which produces active enzyme extracts in our hands. Parallel enzymological characterizations are in progress with root, stem, and leaf tissues sacrificed at different ages. Haploid protoplasts will be mutagenized in order to isolate auxotrophic and

regulatory mutants. The possibility that auxotrophic mutants may be leaky (because of multiple pathways) is anticipated and selection procedures will include screening for analogue-hypersensitivity. Sequential induction of mutations may be necessary to acquire tightly blocked auxotrophs. Newly acquired mutants will be regenerated as soon as possible, even before fully characterized from materials of differing ploidy, at both the cultured-cell and organismal levels. **Keywords:** nicotiana; leaves; plant stems; roots; plant cells; cell cultures; metabolism; aromatics; metabolites; biological pathways; lyases; enzyme activity; mutants; biochemistry; genetics.

120000 Shoreline Erosion Study at Ludington Pumped Storage Project. Roellig, D. (Army Engineer District, 477 Michigan Ave., Detroit, MI, 48226). **Contract:** DR-05-02-05-1-25. **Supported by:** Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation. **Funding:** DOE.
Related energy source: hydroelectric(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to conduct an investigation of the erosion of the shore of Lake Michigan near the Ludington Pumped Storage Project (FERC Licensed Project No. 2680) which would identify the causes of erosion, measure the rate of erosion attributable to each cause, and recommend remedial measures if necessary.
Keywords: pumped storage; pumped storage power plants; environmental effects; land pollution abatement; soil conservation; lakes; erosion.

120001 Review of the 1978 Version of the LMS Real-Time Life Cycle Model. Norton, W. (Resource Management Associates, 3738 Mt. Diablo Blvd., Lafayette, CA, 94549). **Project number:** 39-79RC10112. **Contract:** AC39-79RC10112. **Supported by:** Federal Energy Regulatory Commission, Washington, DC (USA). **Funding:** DOE.
Related energy source: hydroelectric(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to identify acceptability of mathematical model presented, on behalf of licensee FERC Project No. 2338, to estimate impact of proposed pumped storage hydroelectric facility on the Hudson River anadromous and resident fisheries.
Keywords: hydroelectric power; pumped storage; fishes; hudson river; environmental impacts; mathematical models; fishing industry.

120002 Endangered Shortnose Sturgeons of the Hudson River: Their Life History and Vulnerability to the Activities of Man. Dovel, W. (Oceanic Society, Magee Ave., Stamford, CT, 06902). **Project number:** 39-79RC10074. **Contract:** AC39-79RC10074. **Supported by:** Federal Energy Regulatory Commission, Washington, DC (USA). **Funding:** DOE; DOD.
Related energy source: hydroelectric(100) **R and D categories:** Environmental effects assessment.

This project will identify life history of shortnose sturgeon in Hudson River, NY, through various biological techniques in order to determine probable impacts of licensed project. Over 2000 adult and subadult sturgeon have been tagged through the first year of contract. Second year recovery will permit accurate estimates of population abundance, movement, and growth.
Keywords: fishes; endangered species; population dynamics; hudson river; aquatic ecosystems; animal growth; hydroelectric power; environmental impacts.

120003 Preparation of Environmental Impact Statement on Proposed Cross Steam Generating Plant, South Carolina. Murthy, K.S. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 06-79-79RC10104. **Contract:** EY-76-C-06-1830. **Supported by:** Federal Energy Regulatory Commission, Washington, DC (USA). **Funding:** DOE.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

Battelle is to undertake an environmental study and prepare an Environmental Impact Statement on the proposed Cross Steam Generating Plant at the licensed Santee-Cooper hydroelectric project, FERC No. 199, South Carolina. Battelle will base its study on the following: (a) the environmental assessment report filed with the Commission as part of the application for the proposed development; (b) an independent interdisciplinary analysis by Battelle, including field investigations as necessary, and (c) interagency review comments to be filed with the Commission on the application for the proposed development, the formal response of the South Carolina Public Service Authority to such comments, and the later interagency review comments on the draft EIS to be prepared by Battelle. To date (January 22, 1980) Battelle has submitted a preliminary review draft of the EIS, and a revised review draft (sign-off copy) of the EIS. The final draft EIS is scheduled for completion January 29, 1980; the draft EIS will be sent out for agency review before February 1, 1980, which will also be the date for public notice in the Federal Register. The final EIS is tentatively scheduled for completion in late May 1980.
Keywords: hydroelectric power; environmental impacts; power plants; environmental impact statements; recommendations.

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130000 Development of a Computer Code for the Response of Submerged Structures to Seismic Excitation. Ko, D.R. (Dynamics Technology, Inc., Torrance, CA, 90503). **Project number:** 78-09666. **Contract:** 7809866 A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

New concepts and designs of oil storage tanks have been developed for all areas of the world. Some of the tanks rest on ocean floors and are either completely submerged or partially submerged with part of the tank protruding above water; other designs take the form of floating, bottomless tanks, moored to the ocean floors. This research will formulate a general finite element solution procedure and develop a computer program for calculating the response of submerged underwater tanks (rigid and flexible) to seismic actions. Specifically, the tanks will be of general but axisymmetric geometries and they will be completely filled with oil and water and sealed (although, it is realized that, in reality, the fluids inside the tanks do communicate with surrounding water). Moreover, the presence of interior compartments and arbitrary bottom topography will be investigated.
Keywords: storage facilities; underwater facilities; petroleum; seismic effects; finite element method; computer calculations; construction; engineering; hydrology.

130001 Earthquake Response and Aseismic Design of Underground Piping Systems. Ariman, T. (University of Notre Dame, Dept. of Aerospace and Mechanical Engineering, Notre Dame, IN, 46556). **Project number:** 77-23236. **Contract:** 77-23236. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

Lifelines represent about one-half of the total value of structures which are vulnerable to earthquakes. Underground lifelines fulfill a vital role in conducting and distributing energy, communications, transportation, and water. The disruption of the services by these facilities due to an earthquake could cause catastrophic problems. The damaging effect of earthquakes to lifeline systems could be greatly amplified by impeding firefighting, preventing essential communications, transportations, etc. In spite of the potential vulnerability of these essential services, until very recently no building code provisions existed to regulate the design and construction of these structures. Even today there are only minimal provisions in major national codes. The lack of these regulations is entirely due to an absence of scientific and engineering directed specifically to these topics. The objective of the proposed research is to investigate the earthquake response and earthquake-resistant design of underground piping systems utilized in energy transport; specifically, buried natural gas pipelines. An analytical study program will be conducted to analyze the seismic behavior and failure mechanisms of such systems and to develop improved design methods and guidelines for seismic conditions. Case studies will be made to survey the various causes of service interruption and consequences in connection with earthquakes. Analyses will consider the type, size and location of pipes and pipe breaks, mechanics and patterns of deformation and damage, frequency and distribution of damages, and so forth. An extensive literature survey, both domestic and foreign, will be made to study the seismic damage due to traveling seismic waves, relative ground movements, and their relation with the properties of soil media.
Keywords: underground; pipelines; energy transport; natural gas; transport; seismic effects; earthquakes; design; natural gas distribution systems.

130002 Structure-Fluid Interaction Due to Earthquakes. Mei, C.C. (Massachusetts Institute of Technology, Cambridge, MA, 02139). **Project number:** 77-10236. **Contract:** 77-10236. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental effects assessment.

The phenomenon of structure-fluid interaction has been one of the most difficult but least understood problems in earthquake engineering. Such a phenomenon occurs in dam-reservoir systems, offshore structures surrounded by water, etc. Induced by the oscillatory ground movement of earthquakes, the dynamic fluid pressure may interact with the structural vibration to cause near resonance and the eventual failure of the structure. This project is to conduct theoretical and numerical investigations of the structure-fluid interaction problems. Proper formulation of the general class of such problems will be established and effective treatment of the fluid dynamic aspects with infinite surrounding fluid will be carried out. Emphasis will be placed on gaining the detailed physical understanding and on extending an efficient hybrid finite element numerical

method for analyzing the formulated problem. Two-dimensional and three-dimensiona problems will be studied. Special attention will be directed to demonstrate the application of the research results in the analysis and design of dam-reservoir systems and in offshore storage tanks subjected to the combined excitations of earthquakes and waves.
Keywords: storage facilities; underwater facilities; petroleum; natural gas; seismic effects; finite element method; numerical solution; two-dimensional calculations; three-dimensional calculations; dams; fluids; water; mathematical models; construction; engineering.

130003 In-Situ Soil Dynamic Testing and Analysis to Determine Soil Constitutive Properties. Ibanez, P. (Anco Engineers, Inc., 1700 Colorado Ave., Santa Monica, CA, 90404). **Project number:** 79 00001. **Contract:** 79 00001. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The purpose of this research is to develop a coupled in-situ dynamic testing/nonlinear modeling technique for determining the in-situ dynamic properties of soils. Such an approach to site soils modeling and earthquake engineering could supplement and possibly supplant laboratory test techniques which of necessity involve disturbed soil samples and which require substantial engineering judgment to interpret. A major component of this research is the experimentally validated transfer of technology in nonlinear soil modeling and multi-dimensional nonlinear wave propagation computer methods from the defense community into the civilian sector. The research consists of execution of a series of in-situ dynamic tests at a previously studied site; use of advanced numerical techniques and nonlinear constitutive laws to model the experiments; sensitivity studies to establish a sensitivity matrix; and the use of this sensitivity matrix in parameter identification studies to establish the optimal nonlinear constitutive soil model, taking into consideration both model and experimental uncertainties. A better knowledge of subsurface in-situ properties will lead to greater confidence in the seismic safety of such structures as dams and power plants.
Keywords: soil chemistry; chemical composition; soils; chemical analysis; earthquakes; mathematical models; dams; power plants; site selection.

130004 Trailing Edge Carbonate Margins of Open Seas and Seaways. Neumann, A.C. (Univ. of North Carolina, 01 South Bldg., Chapel Hill, NC, 27514). **Project number:** OCE77-24639. **Contract:** OCE77-24639. **Supported by:** National Science Foundation, Washington, DC (USA). Submarine Geology and Geophysics Program. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This project is a continuing multiphase study of the subsurface structure and petrology of carbonate-platform continental margins in the northern Bahamas. The major objective is to explain the internal structure and stratigraphy of the carbonate margin in terms of significant depositional and erosional processes. The overall program is divided into five parts: (1) the shallow margin of the Northwest Providence Channel; (2) the shallow to deep margin of the Abaco reef tract; (3) transport and diagenesis of fine sediments; (4) the structure and stratigraphy of the deep flanks of little Bahama Bank; and (5) the lithoherms of the northern Straits of Florida.
Keywords: carbonates; geochemistry; aquatic ecosystems.

130005 Diagenesis of Silica in Different Depositional Environments. Kastner, M. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** OCE 78-09652. **Contract:** OCE 78-09652. **Supported by:** National Science Foundation, Washington, DC (USA). Submarine Geology and Geophysics Program. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Environmental effects assessment.

This project is a field, analytical, and experimental study of siliceous sediments, porcelanites, and cherts from different depositional environments. The study is concentrating on establishing geochemical criteria to distinguish between open ocean, near-shore marine, and alkaline saline lake cherts. Laboratory studies of low temperature hydrothermal reactions will define physical and chemical controls on the crystallization process and mineral states. Results from this project will provide insight into both the origin and geologic evolution of siliceous rock sequences.
Keywords: silica; sediments; geochemical surveys; chert; marine surveys; crystallization; origin.

130006 Calcium Carbonate and Organic Carbon in the Oceans. Chen, C.T.A. (Orgeon State Univ., School of Oceanography, Corvallis, OR, 97331). **Project number:** OCE78-20449. **Contract:** OCE78-20449. **Supported by:** National Science Foundation, Washington, DC (USA). Marine Chemistry Program. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

Simple stoichiometric calculations have revealed that in seawater the variations of calcium concentration correlate with the variations in titration alkalinity and total carbon dioxide, or nitrate according to the following equations: DELTA Ca = 0.46288 DELTA TA + 0.074236 DELTA SIGMA CO2, DELTA Ca = 0.5 DELTA TA + 0.53125 DELTA NO3. The estimated values for DELTA Ca from the above equations have a higher precision than the direct measurements, and have been used to evaluate and describe the vertical distributions of the ratios of in situ shell-derived to tissue-derived carbon in the Southern Pacific with promising success. Details that have not been indicated in the more traditional approach have been shown for the first time. This study proposed to investigate the vertical and horizontal distributions of calcium and the inorganic and organic carbon ratios in various chemical environments using literature data. The information obtained from this study is anticipated to lead to a better understanding of the calcium and carbon cycles in the oceans.
Keywords: calcium compounds; carbon compounds; seawater; quantity ratio; spatial distribution; pacific ocean; variations; carbon cycle; mineral cycling.

130007 *Petroleum Hydrocarbons in the Sediments of the Bermuda Platform.* Butler, J.N. (Harvard Univ., Holyoke Center 458, 1350 Massachusetts Ave., Cambridge, MA, 02138). **Project number:** OCE77-18662 A01. **Contract:** OCE77-18662 A01. **Supported by:** National Science Foundation, Washington, DC (USA). Marine Chemistry Program. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

Petroleum residues occur in the easily visible form of pelagic tar on most of the world oceans, with highest concentrations in the Sargasso and Mediterranean Seas. The estimated lifetime of pelagic tar lumps is probably less than a year, but the ultimate fate of petroleum residues in the open ocean is still a matter for speculation. One possible fate is accumulation in the sediments. On the basis of chemical composition, the relative contributions of petroleum residues (as distinct from hydrocarbons produced by marine algae and zooplankton, for example) can be inferred. Transitions in hydrocarbon composition with increasing depth can be particularly useful for understanding the mechanism by which hydrocarbons are removed from the open ocean. Bermuda has been an ideal location for this research, since its tourist-based economy introduces essentially no industrial waste (except for discharges of petroleum-derived products from ships and airplanes) into the marine environment. Because of its mid-ocean location, a cruise from shore to over 3000 m depth and return takes only one day. Furthermore, a well-equipped laboratory for hydrocarbon research is available at the Bermuda Biological Station. In the following year, Dr. Butler proposes to bring this study to a logical conclusion and publish the data and interpretations resulting from this study.
Keywords: sediments; seas; petroleum; hydrocarbons; seeps; atlantic ocean; water pollution; tar; natural occurrence.

130008 Trace Gases in the Ocean and Atmosphere. Weiss, R.F. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** OCE78-09038. **Contract:** OCE78-09038. **Supported by:** National Science Foundation, Washington, DC (USA). Marine Chemistry Program. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Environmental transport and conversion of pollutants.

This research is concerned with the distribution of trace gases in the atmosphere and the sea. Special emphasis is placed on the study of N2O, which has an important controlling influence on the stratospheric ozone layer. New data from Scripps Institution of Oceanography shows the distribution of N20 in marine air to be extremely uniform, as opposed to the large variations shown by measurements from other laboratories. The new data suggest a long tropospheric residence time for N2O, and cast doubt on the existence of a large flux of N20 from the oceans to the atmosphere. The new data include samples collected over the decade 1964 to 1974, showing that there may have been a small increase in atmospheric N2O as a result of the use of fixed nitrogen fertilizer. Further high precision monitoring of atmospheric N2O is proposed, together with an extensive study of N2O in the sea, including air-sea exchange at the surface, and consumption/production at depth. Similar studies of CH4 and CO will be carried out simultaneously. The solubilities of N20 and fluorocarbon-11 in pure water and seawater will also be measured.
Keywords: gases; trace amounts; earth atmosphere; seas; nitrous oxide; spatial distribution; troposphere; methane; carbon monoxide; carbon fluorides; solubility; seawater.

130009 Biological Energetics of the Deep-Sea Benthic Boundary Layer. Smith, K.L. (Scripps Institution of Oceanography, La Jolla, CA, 92037). **Project number:** OCE-79-20457. **Contract:** OCE-78-08640A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This study will produce a quantitative description of the flow of biological energy through the animal community living on and near the deep-sea bottom. Oxygen consumption measurements will allow for intercomparison of different parts of the ocean. Biochemical analysis of animal tissue will allow for determination of energy content of the biomass. Energy flux can be derived from the oxygen uptake and tissue data. This information will greatly increase our understanding of the deep-sea environment and will allow us to make informed decisions as of the capacity of the deep-sea to serve as a radioactive waste disposal site.
Keywords: benthos; physiology; biomass; oxygen; tissues; seawater; marine disposal; radioactive waste disposal; biological models; metabolism.

130010 In Situ and Laboratory Studies with Deep-Sea Amphipods and Microbial Interactions. Yayanos, A.A. (Scripps Institution of Oceanography, La Jolla, CA, 92037). **Project number:** OCE-79-29387. **Contract:** OCE-79-08972. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This project will study the physiology of amphipods and bacteria that can be captured in the deep-sea and sustained in the laboratory. Field work will consist of trap deployment and recovery at abyssal and hadal depths. Lab work will concentrate upon refinement of high pressure aquaria technology and metabolic measurement under pressure. This work will lead to the development of the methodology necessary to study the effects of pollutants upon deep-sea fauna.
Keywords: microorganisms; metabolism; amphibians; seawater; bacteria; water pollution; biological effects.

130011 Sea-Air Transport. Duce, R.A. (University of Rhode Island, Graduate School of Oceanography, Narragansett Bay Campus, Kingston, RI, 02881). **Project number:** OCE77-13071. **Contract:** OCE77-13071. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF-$837,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The objective of the project is to describe and quantify processes of material transport between the atmosphere and sea surface of the major oceans. Particulate matter will be trapped in tower-mounted collectors on two mid-Pacific islands near the equator and analyzed for stable metals, radiochemicals, and organic matter. These data are expected to provide estimates of accumulation rates and fluxes of major classes of pollutants. Incorporation of this information into appropriate models should provide a better understanding of how pollutants interact and exchange with the ocean. Energy conversion processes using fossil fuel can inject particles in the atmosphere. Attenuation of solar radiation can result and affect weather and climate.
Keywords: pacific ocean; islands; air pollution; lead; hydrocarbons; radioisotopes; monitoring; sampling; environmental transport; surface air; seawater; mixing; mathematical models; aerosols; particles.

130012 Pollutant Responses in Marine Animals. Giam, C.S. (Texas A and M Univ., Department of Chemistry, College Station, TX, 77843). **Project number:** OCE-78-023023. **Contract:** OCE-78-023023. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF-$550,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to develop and evaluate biological indices of impending organic pollutant damage to marine animals. Biochemical and morphological response to aromatic hydrocarbons and selected halogenated compounds using animals representing the phyla Annelida, Mollusca, Arthropoda, and Chordata will be measured. Investigators are intercalibrating their analytical methods and defining the study parameters. Experimental aspects of the project are expected to take shape during the next six months after test animals and equipment are collected. These studies will provide an assessment of specific effects from organic pollutants related to products from inefficient burning of fossil fuels and leakage from power transforming equipment.
Keywords: aquatic organisms; aromatics; organic halogen compounds; fossil fuels; power substations; biological effects; health hazards.

130013 Special Foreign Currency Award (in Indian Currency) for Research on Combustion of Alcohol and Biogas. Murthy, B.S. (Indian Inst. of Tech., Madras, India 600 036). **Project number:** INT7918702. **Contract:** INT7918702. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This award provides funds to support scientists at the University of Santa Clara in collaborative research with scientists of the Internal Combustion Laboratory, Indian Institute of Technology, Madras, India. Experimental and analytical studies will be conducted to develop the technology and generate information needed to design and build internal combustion engines capable of efficiently utilizing biogas and/or alcohol from agricultural products. Collaboration will be on various phases of the study, such as the characterization of ethyl and methyl alcohols combustion in spark ignition and compression ignition engines. In view of the worldwide petroleum shortage the search for new energy sources and the development of alternate fuels are of the utmost importance to the collaborating countries, the United States and India.
Keywords: internal combustion engines; design; fuel gas; methanol; ethanol; combustion properties; automotive fuels.

130014 Special Foreign Currency Award (Including Indian Currency and U.S. Dollars) for Development of Some Alternative Sources of Energy for Combustion Engines. Pefley, R.K. (Univ. of Santa Clara, Santa Clara, CA, 95053). **Project number:** INT7920329. **Contract:** INT7920329. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This award provides funds to support scientists at the University of Santa Clara in collaborative research with scientists of the Internal Combustion Laboratory, Indian Institute of Technology, Madras, India. Experimental and analytical studies will be conducted to develop the technology and to generate information needed to design and build internal combustion engines capable of efficiently utilizing biogas and/or alcohol from agricultural products. Collaboration will be on various phases of the study, such as the characterization of ethyl and methyl alcohols combustion in spark ignition and compression ignition engines. In view of the worldwide petroleum shortage the search for new energy sources and the development of alternate fuels are of the utmost importance to the collaborating countries, the United States and India.
Keywords: internal combustion engines; design; fuel gas; methanol; ethanol; combustion properties; automotive fuels.

130015 Collaborative Study of Anomaly Detection in Nuclear Reactors. Albrecht, R.W. (University of Washington, Department of Nuclear Engineering, Seattle, WA, 98105). **Project number:** NSF/INT77-21690. **Contract:** INT77-21690. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF-$9,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective of the project is to use the analysis and interpretation of signals from stochastically fluctuating nuclear reactor signals to improve the safety and reliability of nuclear power plants. Fundamental understanding of neutronic and acoustic signals generated by special test devices inserted into U of W nuclear reactor will be obtained by: (1) producing parametric variations in flow conditions in the anomaly generator; (2) modifying it to include steam generation; and (3) adding acoustic transducers to reactor to expand neutronic-acoustic cross-correlation methods, etc. The product expected is fundamental knowledge that will lead to specialized nuclear reactor instrumentation. This award supports U.S. cost of research collaboration in above project with the Brazilian Institute of Atomic Energy. It supplements infrastructure research support provided by the Nuclear Regulatory Commission to the principal investigator.
Keywords: uwnr reactor; in core instruments; reactor instrumentation; stochastic processes; monitoring.

130016 Mass and Energy Transfer in Chemical Reactions. Smith, J.M. (University of California at Davis, Department of Chemical Engineering, Davis, CA, 95616). **Project number:** FJ-7029. **Contract:** INT 77-12107. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF-$38,000.
Related energy source: conservation(100) **R and D categories:** Pollutant characterization and analysis.

This project addresses three topics: (1) extension of theoretical treatment of diffusivities to catalysts with monodispersive, broad pore-size distribution (such as activated carbon) and three-phase reactors (such as slurry and trickle bed reactors) where the pores are filled with liquid; (2) analysis of mass and heat transfer between fluid and solid particles (2-phase systems), particularly at low flow rates; and (3) study of heat transfer between gas and liquid (direct-contact heat transfer) in trickle-beds and in counter current flow packed beds (3-phase systems). Counter current flow of a gas and liquid in a packed bed offers a method for recovering thermal energy from low temperature (300 to 600 degrees F) gas streams such as turbine exhaust or stack gases, a problem of considerable industrial importance.

Keywords: flue gas; heat recovery; research programs; heat recovery equipment; industrial plants; thermal power plants; two-phase flow; heat transfer.

130017 Radioactive Aerosols and Effects. Martell, E.A. (National Center for Atmospheric Research, Boulder, CO, 80307). **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Atmospheric Sciences. **Funding:** NSF-$60,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The project objective is to contribute to an assessment of the atmospheric and health effects of airborne alpha radioactivity from natural and pollutant sources. Specific objectives include the experimental assessment of the size distribution and properties of radon daughters and alpha emitting particles in the atmosphere, their atmospheric effects and application in the assessment of aerosol residence time, their distribution in the biosphere, and their mutagenic and carcinogenic effects. Multistage impactors and air filter systems are employed for aerosol collection. Laboratory analysis techniques include low-level alpha spectroscopy, B/sup -/ counting and radon gas counting. The warm particle hypothesis of alpha radiation induced cancer is being tested by measurement of lead-210 and polonium-210 in autopsy tissue specimens provided by the Department of Pathology, University of Colorado Medical Center. The mutagenic effects of natural alpha emitters and their role in human skin cancer are being investigated . The results should contribute to an assessment of the chronic health effects attributable to various natural and pollutant sources of airborne alpha radioactivity. Energy related sources include coal burning power plants and the nuclear fuel cycle. Results are also pertinent to phosphate fertilizer contamination risks.
Keywords: radioactive aerosols; radon; daughter products; health hazards; lead 210; polonium 210; mortality; alpha particles; drosophila; radiosensitivity; radionuclide kinetics; mutagenesis; carcinogenesis; neoplasms; radioinduction.

130018 Brush Fire Project. Crutzen, P. (National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO, 80307). **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Atmospheric Sciences. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to define the atmospheric emission of the South American large-scale Savannah and brushland fires which are associated with shifting agriculture. These fires are responsible for a major source of trace gases to the global atmosphere. It is proposed to make research flights in the regions of these fires to measure CO2, CO, CH4, N2O, H2, CH3Cl, CH3CCl3, COS, NO, NO2 and O3. The emission factors associated with this major source will be defined.
Keywords: south america; carbon dioxide; carbon monoxide; methane; nitrous oxide; hydrogen; methyl chloride; nitrogen dioxide; ozone; nitric oxide; carbon oxysulfide; chlorinated aliphatic hydrocarbons; air pollution; fires; monitoring; ecological concentration; agriculture; environmental effects.

130019 Acid Precipitation Experiment (APEX). Lazrus, A.L. (National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO, 80307). **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Atmospheric Sciences. **Funding:** NSF-$45,000; EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The project goals are to examine the acidity of the atmosphere in the central and eastern region of the USA, to relate the concentrations of atmospheric acids to the composition and acidity of both cloud and precipitation water, to detect seasonal trends and geographical gradients of atmospheric acids, to explore the nature of possible reservoirs of atmospheric acids (e.g., above the boundary layer), to observe the concentration of dependence of atmospheric acids on sprecific meteorological conditions, and to explore several chemical conversion processes capable of producing acids. Atmospheric measurements of H, O2, O3, H2SO4, SO2, HNO3, NOx, NO3/sup -/, HCl, Cl/sup -/, NH3, NH4/sup +/, O3, elemental aerosol composition, and size distribution of aerosol are being conducted. Measurements of dissolved analogs of those atmospheric constituents are made on samples of cloud water and precipitation water collected while the air measurements have been made. Several case studies of warm frontal and cold frontal pecipitation have been investigated. Convective storms will be investigated during summer 1980.
Keywords: ph value; sulfuric acid; sulfur dioxide; nitric acid; nitrogen oxides; nitrates; hydrochloric acid; chlorides; ammonia; ozone; ammonium compounds; aerosols; chemical composition; acid rain; seasonal variations.

130020 Study of the Abundance of CO2 in the Atmosphere and Its Exchange with the Oceans. Keeling, C.D. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** ATM-77-25141. **Contract:** ATM-77-25141. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$150,000; DOE-$10,000; DOC.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

A study of the content and variability of CO2 in the atmosphere and in surface waters of the oceans, and the exchange between the atmosphere and oceans, is being investigated with joint support by NSF, NOAA, DOE, and WMO. The levels of CO2 in the atmosphere are being measured from land and marine stations. In addition, a feasibility study is being made of measuring the oceanic uptake of CO2. From the data collected, detailed models are being developed of the time dependent global carbon cycle in order to improve predictions of the fraction of CO2 from fossil fuel combustion which will accumulate in the atmosphere and oceans over the next several decades.
Keywords: air pollution; carbon dioxide; earth atmosphere; seas; environmental transport; carbon cycle; mathematical models; climates; fossil fuels; combustion.

130021 Antarctic Tritium. Ostlund, H.G.; Mason, A.S. (University of Miami, 14600 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** DPP7920766. **Contract:** DPP7920766. **Supported by:** National Science Foundation, Washington, DC (USA). Office of Polar Programs. **Funding:** NSF-$37,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The concentrations of tritium gas, tritiated water vapor, and tritiated hydrocarbons were measured at the Clean Air Facility at South Pole Station in Antarctica during 1978 and 1979. In addition, airborne samples were taken during the austral summers of 1977/78 and 1978/79 from one of the C-130 resupply aircraft in Antarctica. This project is expected to yield: (1) representative data for a global scale inventory of atmospheric tritum and its variation with time caused by releases from nuclear industry; (2) a measure of the amount of subsidence of stratospheric air as a part of the global circulation pattern of the atmosphere; and (3) information on the exchange of water between the air and drifting snow. In austral summer 1977/78, two people will install sampling equipment at South Pole Station, and one person will operate the sampling equipment on the C-130. In austral summer 1978/79, two persons will conduct measurements at South Pole Station and one will operate the equipment on the C-130.
Keywords: antarctic regions; tritium; radioecological concentration; inventories; global aspects; earth atmosphere; radionuclide migration; stratosphere; moisture; air quality; mathematical models; nuclear industry; sampling; air pollution.

130022 Dynamic Behavior of Photochemical Aerosols. McMurray, P.H. (Univ. of Minnesota, Dept. of Mechanical Engineering, Minneapolis, MN, 55114). **Project number:** ENG 78-05561. **Contract:** 78-05561. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$25,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the proposed study is to investigate theoretically and experimentally the dynamic behavior of photochemically generated aerosols. Smog chamber experiments will be performed to study the dynamics of secondary aerosols produced by photooxidizing SO/sub 2/ in air of known humidity. The influence of NH/sub 3/ and of a preexisting aerosol on secondary aerosol formation will be systematically investigated. Particular attention will be given to obtaining data for the concentrations and dynamics of very fine particles (particle diameter greater than or equal to .0056 mu-m) which are involved in the process of new particle formation. A theory which was recently developed by the author for new particle formation rates in the presence of an aerosol will be refined and applied to the modeling of photochemical aerosol dynamics. The theory has been formulated so that theoretical predictions can be compared directly with experimental results. The theory will be useful in predicting the number of new particles which will be formed when secondary aerosol is generated at a given mass rate for given initial conditions. The amount of preexisting aerosol required to suppress new particle formation is also predicted by the theory.
Keywords: photochemical oxidants; aerosols; photochemical reactions; sulfur dioxide; humidity; ammonia; smog; air pollution; chemical reaction kinetics; data acquisition; mathematical models.

130023 Aerosol Filtration by an Intergranular Dust Cake. Leith, D. (Harvard School of Public Health, 665 Huntington Avenue, Boston, MA, 02115). **Project number:** ENG-77-26975. **Contract:** ENG-77-26975. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$74,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This research is concerned with the fundamental factors responsible for the formation and persistence of intergranular deposits of solid aerosol particles in moving granular filter beds, and the properties of these deposits when they perform as very high efficien-

cy collection structures for submicrometer particles. The work will include both experiments and development of a theory to coordinate understanding of the acquired data. Experimentally, pressure drop and efficiency will be measured as a function of particle size for at least the following variables (and ranges): fact velocity (5 to 50 cm/sec), bed depth (8 to 24 cm), granular removal rate (0.001 to 0.05 times face velocity), granule size (0.5 to 2 mm), and gas temperature (ambient to 500 degrees C). Theoretical work will start with mathematical modeling of particle collection by filter cakes including such major parameters as Stokes, Peclet and interception numbers and the dimensionless cake thickness. This will be followed by the development of models which relate to fundamental physics of particle capture, unit mechanisms of particle collection and flux forces, depending on the intergranular cake filtration characteristics shown by the experimental data.
Keywords: granular bed filters; aerosols; filtration; particles; removal; pressure drop; efficiency; particle size; mathematical models; hot gas cleanup.

130024 Aerodynamic Problems of Large-Scale Cooling Devices. Moore, F.K. (Cornell University, College of Engineering, Ithaca, NY, 14853). **Project number:** ENG-76-02516-A01. **Contract:** ENG-76-02516-A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$55,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of the project are concerned with the improved performance of natural draft dry cooling towers for large power plants. The approach is largely theoretical but is supported by critical experiments on: (1) the behavior of a large plume near the tower exit, subject to the combined effects of buoyancy, wind, and mixing; (2) the effectiveness of heat-exchanger yield, as it relates to drag and end effects; and (3) the contrasting flows associated with competing entrance concepts. Results are advances in our understanding of aerodynamic problems of dry, natural draft cooling towers.
Keywords: natural draft cooling towers; power plants; behavior; plumes; air pollution; thermal pollution; aerodynamics; thermal effluents; environmental impacts.

130025 Energy/Environment Task Forces. Boyer, D.L. (University of Wyoming, Department of Mechanical Engineering, Laramie, WY, 82071). **Project number:** SER77-06904. **Contract:** SER77-06904. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Science Education Resources Improvement. **Funding:** NSF-$93,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The University of Wyoming has established the Rocky Mountain Institute of Energy and Environment (RMIEE) to focus energy research on the campus. This project received support to establish interdisciplinary task forces of young scientists to investigate some of the critical questions now facing the state, region and nation in the areas of energy development and environmental impact. The task forces will consist of a full-time RMIEE coordinator and young faculty from various University academic departments. The task forces will be assisted by interdisciplinary student cadres (upper division undergraduate and graduate students) and will interact with an Advisory Council composed of senior University faculty and representatives of state and federal agencies, industry and environmental groups. Accomplishment of the program will be assessed by an external program evaluator. The goals of the program are to establish an institutional framework whereby young scientists and students of diverse academic backgrounds can: (1) attack, as a team, some of the critical problems relating to energy development and environmental impact now facing the nation; and in the process to (2) develop a dynamic interdisciplinary academic program in the area of energy and the environment. The initial task force will consider the broad area of coal derived energy transport alternatives. Faculty from the following academic departments will participate on the Coal Task Force: Atmospheric Science, Civil Engineering, Economics, Geology, Geography, Mechanical Engineering, Sociology, and Zoology/Physiology.
Keywords: coal; transport; wyoming; energy source development; coal industry; environmental impacts; economic impact; education.

130026 Graduate Research and Training in Numerical Modeling and Alternate Energy Technology. Dunn, J.R. (Texas Tech University, Department of Mechanical Engineering, Lubbock, TX, 79409). **Project number:** SER77-06879. **Contract:** SER77-06879. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Science Education Resources Improvement. **Funding:** NSF.
Related energy source: solar(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The project is directed to an identified need for training and research opportunities in alternate energy technology and numerical analysis and design and for improved instrumentation and facilities for experimental research. These needs will be met through the development of new graduate courses in the areas of alternate energy technology and numerical modeling, the addition of needed research instrumentation, and an improved environment for research development. The program plan on which the proposed graduate rescarch and training improvements will be based consists of: (1) development of a library of computerized design, analysis, and simulation programs to be employed in new graduate course offerings and research efforts; (2) a broad range graduate seminar series with recognized experts presenting invited lectures; and (3) an improved quality of research instrumentation and development opportunities. These are consistent with University goals to strengthen research and participation in Agricultural and Engineering Sciences with emphasis in problems related to the energy needs and use of arid and semi-arid lands.
Keywords: energy sources; education; computers; measuring instruments; mathematical models; agriculture; engineering; arid lands; energy consumption.

130027 Development of an Integrated Laser-Low Energy Ion Accelerator Facility for the Training of Young Scientists in Energy-Related Atomic and Molecular Physics. Morgan, T.J. (Wesleyan University, Middletown, CT, 06457). **Project number:** SER77-06852. **Contract:** SER77-06852. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Science Education Resources Improvement. **Funding:** NSF-$62,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The study of highly excited atoms and molecules, made possible by tunable laser devices, is of much importance to physicists, chemists, and engineers concerned with new methods of energy production, isotope separation, and molecular synthesis. This program will (1) provide equipment needed for launching a long-range interdisciplinary study of certain highly excited atoms and molecules through a collaborative effort of young scientists; (2) inaugurate a Visiting Scientist Series to bring to the University recognized authorities in fields related to atomic and molecular physics and energy research; and (3) provide travel grants to graduate students, postdoctoral associates, and young faculty to allow them to visit academic and industrial laboratories where research on excited atoms and molecules is currently under way. As of April 1979, equipment had been purchased and planning for initial experiments begun. The Visiting Scientist Series had been instituted and was proving to be quite successful.
Keywords: atoms; molecules; excited states; energy levels; lasers; laser radiation; laser isotope separation; photon-atom collisions; photon-molecule collisions; accelerators; atomic beams; molecular beams; education; excitation; colliding beams.

130028 Organization of a Resource Recovery Experimentation Station. Rhyner, C.R. (University of Wisconsin, College of Environmental Science, Green Bay, WI, 53402). **Project number:** SER 76-18251. **Contract:** SER 76-18251. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Science Education Resources Improvement. **Funding:** NSF-$40,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The project is designed to improve the master's degree training program in waste management at U.W.G.B. Grant funds were used not only to improve the academic curriculum, but also to equip a resource recovery experimentation station. The availability of station facilities will enable graduate students to investigate alternative methods of processing and disposing of liquid and solid waste. As of the 1978-79 academic year, the waste management program has become established as a part of the environmental management track in the graduate program. The research activities associated with this program have been diverse, ranging from analytical identification techniques to the economic potentials of a resource recovery facility.
Keywords: liquid wastes; solid wastes; waste processing; waste disposal; energy demand; economics; environmental effects.

130029 Institute for Underground Space Utilization Studies. Karadi, G.M. (University of Wisconsin at Milwaukee, Department of Mechanics, Milwaukee, WI, 53201). **Project number:** SER77-06858. **Contract:** SER77-06858. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Science Education Resources Improvement. **Funding:** NSF-$67,000.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The establishment of an Institute for Underground Space Utilization Studies (IUSUS) within the College of Engineering and Applied Science of the University of Wisconsin at Milwaukee is being supported. IUSUS will provide unique research opportunities for young scientists at graduate and postgraduate levels to identify, evaluate and analyze the wide range of problems associated with the construction and utilization of underground space for such projects as deep tunnel systems to store storm water runoff, unconventional energy storage in rock caverns, underground hydroelectric pumped or compressed air storage and underground sewage treatment facilities. This work would involve synthesizing the varied disciplinary

aspects (hydrological, geological, geotechnical, structural, etc.) of a newly emerging and increasingly important field of engineering science.
Keywords: underground space; uses; construction; energy storage; pumped storage; compressed air energy storage; hydrology; geology; waste processing; cavities.

130030 Design and Synthesis of Electron Transfer Photocatalyst Systems. Ackerman, M.N. (Oberlin Coll., Dept. of Chemistry, Oberlin, OH, 44074). **Project number:** SPI 79-16601. **Contract:** SPI 79-16601. **Supported by:** National Science Foundation, Washington, DC (USA). Scientific Personnel Improvement. **Funding:** NSF.
Related energy source: solar(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

During the tenure of this grant expertise will be developed in the area of inorganic photochemistry. Both objectives will be achieved simultaneously through a year of interdisciplinary work in an industrial laboratory. The approach will be concerned with the design and synthesis of electron transfer photocatalysts systems for efficient conversion of solar energy into usable chemical energy. Molecules which undergo intramolecular electron transfer upon photoexcitation will be studied. Attempts will be made to generate excited states with long lifetimes and to control charge distribution and thereby chemical reactivity in the excited state through the introduction of appropriate functional groups. This project involves the collaboration of chemists from several fields and physicists.
Keywords: electron transfer; catalysts; solar energy conversion; design; synthesis.

130031 Energy: Putting It to Work. Hungate, F.P. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** SPI 79-68208. **Contract:** SPI 79-68208. **Supported by:** National Science Foundation, Washington, DC (USA). Scientific Personnel Improvement. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The Battelle Pacific Northwest Laboratories of Battelle Memorial Institute are heavily committed to research and development directed toward resolving technical and social issues associated with a broad spectrum of evolving energy technologies. The four areas identified for academic staff involvement are representative and typical of the many projects in progress. Two of the selected areas, Wind Energy and Gasification of Biomass, are concerned with technology development for specific applications. The work of Electro-optic Instrumentation will develop a technology base applicable to a wide variety of energy technologies and control applications. The area of Inhaled Pollutants is a natural counterpart of most energy scenarios, whether coal, geothermal, nuclear, or others, in that inhalation of potentially toxic materials is the most likely way by which health effects may occur in industrial workers or the general public. In these four areas there are many interacting studies in progress.
Keywords: wind power; biomass; gasification; air pollution; toxic materials; technology assessment; inhalation; energy; control; research programs.

130032 Photochemical Mechanism of the Production of Hydrogen. Chesick, J.P. (Haverford Coll., Dept. of Chemistry, Haverford, PA, 19041). **Project number:** SPI 79-14917. **Contract:** SPI 79-14917. **Supported by:** National Science Foundation, Washington, DC (USA). Scientific Personnel Improvement. **Funding:** NSF.
Related energy source: solar(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A ten month period working with Professor Harry B. Gray at the California Institute of Technology, beginning September 1, 1979, is proposed. The focus of this period would be a research project studying the photochemical mechanism of production of hydrogen from the visible irradiation of dinuclear transition metal complexes and aqueous acidic solutions. Work already published from that laboratory indicates great interest in these reactions as possible key steps in a method for conversion and storage of solar energy. In addition to the laboratory work, a complementary program of studies would be carried on by participating in courses in advanced inorganic chemistry and ligand field theory and in inorganic research seminars. Through this program of research, advanced level course work, and independent study, it is expected that background and practical experience in the areas of inorganic photochemistry and inorganic mechanistic studies would be acquired building on prior experience in chemical kinetics, quantum chemistry, and structural studies. This would lead to a new research emphasis in inorganic chemistry and in needed support of the inorganic chemistry part of the curriculum on return to Haverford College.
Keywords: hydrogen production; photochemical reactions; visible radiation; transition element complexes; solar energy conversion; photochemistry; energy storage.

130033 Faculty Research Residencies in Chemistry. Rauckhorst, W.H. (Argonne National Lab., Argonne, IL, 60439). **Project number:** SPI 79-09124. **Contract:** SOI 79-09124. **Supported by:** National Science Foundation, Washington, DC (USA). Scientific Personnel Improvement. **Funding:** NSF.
Related energy source: Coal(50); solar(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This proposal requests funding to enable four college or university faculty members to undertake summer research residencies in the Chemistry Division of Argonne National Laboratory. Faculty members selected for the project will be able to choose from research participation opportunities available with the following chemistry research groups: (1) Photosynthesis and Solar Energy Research - research directed in part to the study of natural photosynthesis and in part to the preparation of biomimetic synthetic systems; (2) Coal Chemistry - research to determine the precise composition and structure of coals; (3) Atmospheric Chemistry - studies of the cycle of atmospheric carbon monoxide; and (4) Structural Chemistry - synthesis and structural studies of materials potentially significant for energy-related applications. Although the faculty resident's time will be spent primarily in research, the research experience will be augmented by seminars, independent study, and other appropriate activities. In addition to his or her professional growth, the participant will acquire an understanding of how research is conducted in a non-academic setting. This experience as a summer research resident is expected to benefit the participant's undergraduate science teaching.
Keywords: structural chemical analysis; research programs; grants; photosynthesis; solar energy; biomimetic processes; coal; chemical composition; atmospheric chemistry; carbon monoxide.

130034 Energy Related Materials Research. Gentry, W.O. (Globe-Union Inc., 5757 N. Green Bay Avenue, Milwaukee, WI, 53201). **Project number:** SPI 79-07385. **Contract:** SPI 79-07385. **Supported by:** National Science Foundation, Washington, DC (USA). Scientific Personnel Improvement. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A proposal is made that interested academic faculty with backgrounds in pertinent engineering and scientific disciplines participate in a project on energy related materials research. The suggested topics of research are: (1) band gap energies in titanate solid solutions; (2) cellular precipitation in a complex lead alloy; (3) fuel cell electrodes; (4) low cost ceramics for the high temperature Li/S battery; and (5) the active mass in lead/acid electrical vehicle batteries.
Keywords: titanates; energy gap; solid solutions; lead alloys; precipitation; fuel cells; electrodes; lithium-sulfur batteries; ceramics; cost; lead-acid batteries; electric-powered vehicles.

130035 Onshore Impacts of Offshore Oil and Gas: Methodology Development and Test. Tencer, B. (Roy F. Weston, Inc., Weston Way, West Chester, PA, 19380). **Project number:** 78-15050. **Contract:** 78-15050. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Impending oil and gas developments on the U.S. Outer Continental Shelf (OCS) raise prospects that vital energy supplies will be expanded. Such activities are likely to produce a variety of benefits and costs to the U.S., while onshore communities and regions are particularly affected and already evidencing certain needs. In order to enhance benefits and limit social, environmental, and monetary costs, cognizant federal and state agencies must be able to accurately anticipate direct and indirect effects of OCS development. This research is intended to: (1) assemble, assess, and link appropriate economic and environmental assessment methodologies; (2) test this methodological package on the Baltimore Canyon Region; and (3) prepare documentation on impact methodologies for use by federal and state planning officials.
Keywords: offshore operations; petroleum deposits; natural gas deposits; continental shelf; social impact; environmental impacts; economic impact; mathematical models; baltimore canyon; socio-economic factors; ecosystems.

130036 Utilization of Waste Heat in Aquaculture. Guerra, C. (Public Service Electric and Gas Company, Newark, NJ, 07101). **Project number:** ENV76-19854. **Contract:** ENV76-19854. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF-$115,000.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This is an award for the third year of a planned three year experiment the objective of which is to determine the technical and economic feasibility of utilizing heat remaining in condensor cooling water at power generating stations for culturing of edible aquatic animals. This is a continuation of research initiated under NSF/RANN Grant No. ENV76-19854. The aquaculture research facility located at the Public Service Electric and Gas Company's Mercer Generating Station at Trenton, New Jersey, is being used for the sequential culture of freshwater shrimp from May through October and rainbow trout from November through April. The experiments

are being conducted at a sufficiently large scale for determination of reliability and reproducibility of the concept and acceptability of the products. A subcontract to Rutgers University for research directed by A. Farmanfarmaian is concerned with studies of nutritional factors including amino acid and calcium diet supplementation, food conversion efficiencies and physical factors influencing intestinal absorption of food and potential pollutants such as coal, chlorine and heavy metals. A subcontract to Trenton State College is supporting research under the direction of A.F. Eble to improve the aquaculture procedures being used at the Trenton site. This includes field application of nutritional data, intensification of culture techniques and brood stock management. Long Island Oyster Farms, Inc., is assisting in evaluation of commercial feasibility and the New Jersey Department of Agriculture's Division of Rural Resources is studying adaptation of conventional agricultural facilities to production of fingerling trout.
Keywords: waste heat utilization; aquaculture; thermal power plants; fishes; production; feasibility studies; cooling systems.

130037 Reliability Assessment of Linear Lifelines for Natural Hazards. Benjamin, J.R. (Engineering Decision Analysis Co., 480 California Avenue, Suite 301, Palo Alto, CA, 94306). **Project number:** 7724727. **Contract:** 7724727. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF-$50,000.
Related energy source: general science(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This research program is concerned with the mitigation of socioeconomic losses brought about by the loss of function of civil engineered lifelines exposed to natural hazards such as earthquake ground motion. The very nature of lifelines dictates that the consequences of even a single facility failure are greater than simply the loss of the facility. If key facilities of an energy supply, water supply, transportation or communications lifeline are destroyed, then the lifelines as a whole will not function. Therefore the losses to society from the loss of function of a lifeline are potentially far greater than simply the loss of the facility itself. For example, the breakdown of water supply lifelines during an earthquake due to the loss of function of a pumping station could result in fires from broken gas lines spreading uncontrolled and causing socioeconomic losses on the order of several magnitudes greater than the loss of the pumping station. The purpose of the research is to develop and apply a practical methodology for reliability assessment of linear lifelines under the influence of natural hazards. Reliability is defined to be the probability of attaining a specific level of a functional goal instead of simply the probability of success in a single trial. There are different reliabilities for different levels of lifeline functioning. The research plan is to employ the case method with practical lifeline problems in order to ensure that the results of the studies are of practical value and directly of interest to potential users of the methodology. An adequate theoretical base has been developed for applications to begin. Further theoretical work will be carried on but the focus will be on the solutions of specific problem types.
Keywords: socio-economic factors; earthquakes; reliability; energy supplies; risk assessment; power plants; mathematical models; transportation systems; terminal facilities; energy facilities; hazards; accidents; failures; safety.

130038 Progressive Collapse of Transmission Line Structures Due to Dynamic Loads. Fleming, J.J. (University of Pittsburgh, 3500 Victoria Street, Pittsburgh, PA, 15261). **Project number:** 7723519. **Contract:** 7723519. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$74,000.
Related energy source: Coal(50); oil and gas(25); nuclear fission(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This research will consist of an investigation to determine the displacements and forces, in electric transmission line structures, resulting from loss of support of the wires in a span. A typical cause of this loss of support could be a foundation failure in a tower due to localized consolidation, slippage or other earth movements during wind or seismic disturbances. The actual cause of the localized failure is not significant; the important consideration is its effect upon the total system and in particular the possibility of a cascading failure. The study will consist of three primary phases: (1) the development of the mathematical model for determining the displacements and forces induced in the system; (2) a parametric study to determine the effect of the system variables upon the behavior; and (3) the establishment of design criteria and procedures for longitudinal impact loads considering both economy and risk.
Keywords: power systems; power transmission lines; power transmission towers; failures; dynamic loads; foundations; mathematical models; design.

130039 Nitric Oxide from Flames: The Role of Manganese and Sulfur Compounds. Altwicker, E.R. (Rensselaer Polytechnic Institute, Department of Chemistry and Environmental Engineering, Troy, NY, 12181). **Project number:** ENG-7710029. **Contract:** NSF-ENG-7710029. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$27,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The research deals with the effects of Mn and S compounds on NO emissions from flames. The study will investigate the possible modes of Mn additive behavior in several flames and how these can be coupled to SO2 or other S compounds. The question of a metal-ligand effect will be studied. Comparison of results will be made to well-described flames and modes of NO formation in order to improve the correlation of the results with theory. It is proposed to use both gaseous and liquid fuels in these studies. In addition to No. 2 heating oil, it is planned to use N- and S-free liquid fuels such as octanes and gaseous fuels such as methane and ethylene.
Keywords: fuel oils; fuel gas; combustion; liquid fuels; manganese compounds; sulfur compounds; nitric oxide; flames; emission; nitrogen oxides.

130040 Flame and Detonation Propagation in Coal Dust, Methane, Air Mixtures. Nicholls, J.A. (University of Michigan, Ann Arbor, MI, 48104). **Project number:** ENG-76-22958. **Contract:** NSF-ENG-76-22958. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$61,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The research covers primarily three phases: (1) shock wave ignition and burning time of coal particles; (2) propagation of detonation in coal dust--methane--air mixtures; and (3) blast wave initiation of detonation. Under number 1, an important aim will be to identify the contribution of the reaction of the volatile of the coal as compared to heterogeneous surface reaction. Theoretical support of the experimental work will consist of the calculation of the rate of heat transfer to the particles, and the acceleration of the particles by the flow behind the shock. Under number 2, to the extent possible, uniform particles of coal will be injected into a shock tube. The prime variables to be investigated will include type of coal, particle size, particle loading fraction, oxidizer concentration and methane concentration. Experimental measurements will be made. A mathematical model will be used to interpret the experimental data. Under number 3, the research deals with the phenomenon of a blast wave, which is basically a shock wave followed by an expansion zone. The blast wave is to be calibrated using planar blast wave theory so that for any given operating condition the effective initiator energy will be known. The main information sought will be the determination of whether detonation is realized or not. The research is a part of a cooperative Polish-American research effort, OIP-7522131. The Polish research will be done at the Technical University of Warsaw with Dr. Stanislaw Wojcicki as principal investigator.
Keywords: coal; methane; dusts; air; mixtures; chemical explosions; ignition; detonations; flame propagation; shock waves; volatile matter; heat transfer; mathematical models; particle size; international cooperation.

130041 Formation of Oxides of Nitrogen from Fuel-Nitrogen. Knuth, E.L. (University of California at Los Angeles, Dept. of Energy and Kinetics, Los Angeles, CA, 90024). **Project number:** ENG77-09190. **Contract:** ENG77-09190. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$80,000.
Related energy source: oil and gas(100) **R and D categories:** Pollutant monitoring.

The objective of the research is to study the mechanisms for fuel-NOx formation. Details of the mechanism will be clarified by an experimental technique which will facilitate monitoring a number of chemical species without disturbing the chemical composition of the reacting mixture. The molecular-beam mass-spectrometer sampling technique will be used in the study of fuel-NOx formations. This technique will monitor simultaneously a number of chemical species in the flame. Composition and temperature profiles will be measured in premixed methane-air flames to which nitrogen-containing compounds with different nitrogen binding energies have been added. The research will: (a) evaluate reaction-rate coefficients for rate-controlling reactions, (b) evaluate partial-equilibrium approximations, and (c) apply these coefficients and approximations in predictions of NOx formations.
Keywords: nitrogen oxides; flames; methane; air; combustion kinetics; chemical reaction yield; chemical reaction kinetics.

130042 Diffusion Flame Energy Transfers. Emmons, H.W.; deRis, J. (Harvard Univ., Cambridge, MA, 02138). **Project number:** ENG78-23969. **Contract:** NSF ENG78-23969. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The research deals with diffusion flame energy transfers in the general area of combustion. This is a cooperative effort between investigators at Harvard University and at Factory Mutual Research

Corporation. At Harvard University the research is done using two sintered metals burners. One is for a relatively non-sooty diffusion flame and the other is for a very sooty process. Measurements are made of combustion products produced in an ordinary diffusion flame and when burning in the hot smokey layer under ceiling. At Factory Mutual Research Corporation the object is to compare soot absorption coefficients in laminar and turbulent diffusion flames. Knowledge of these coefficients is essential for predicting radiation from diffusion flames. The initial emphasis is on measuring peak soot concentrations and spatial distributions as well as the coefficients in laminar diffusion flames; laser scattering techniques to achieve high spatial resolution are used. Fundamental analytical studies of soot formation in diffusion flames are pursued concurrently. In this cooperative research effort theoretical considerations follow after the experimental results are available.
Keywords: combustion; burners; flames; soot; combustion products; laser spectroscopy; energy transfer.

130043 Development of Tunable Laser Absorption Spectroscopy and Applications to High Temperature Studies of NO-NH3 Kinetics. Hamson, R.K.; Kruger, C.H. (Stanford Univ., Stanford, CA, 94305). **Project number:** ENG 7826158. **Contract:** ENG 7826158. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

Research is conducted in four areas related to diagnostics and high-temperature chemical kinetics for combustion. They are: (1) Tunable Diode Laser - modify optical/electronic arrangement of existing tunable diode laser system for the measurement of minority species and select wavelengths and optimize system for measurement of nitrogen monoxide and nitrogen oxide; (2) Tunable Dye Laser - develop dye laser system for tunable laser absorption spectroscopy of specific radical species and optimize for fixed-wavelength probing of shock-heated flows and for high-resolution modulation spectroscopy of flat flame experiments; (3) Shock Tube Studies of Nitrogen Oxide-Ammonia Kinetics - conduct shock tube experiment in specific gas mixtures at temperatures of about 1500 to 3000 K and analyze data to define a consistent kinetic mechanism and determine rate constants; and (4) Flat Flame Studies of Nitrogen Oxide-Ammonia - modify existing flat flame facility for postflame injection of diluted ammonia, measure nitrogen oxide and ammonia by microprobe and chemiluminescent analysis, nitrogen oxide and nitrogen monoxide by tunable infrared laser absorption, and other components by tunable ultraviolet/visible laser absorption, and analyze data for mechanism constant with shock tube experiments and determine relevant rate constants. The research is a continuation in part of research done under NSF Grant ENG76-08279.
Keywords: combustion kinetics; dye lasers; shock waves; nitrogen oxides; ammonia; flames; absorption spectroscopy.

130044 Research Initiation: Sulfur Dioxide Combustion Kinetics. Smith, O.I. (Univ. of California, Los Angeles, CA, 90024). **Project number:** ENG-79-08081. **Contract:** ENG-79-08081. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

The goal of the research is to determine the rate coefficients for elementary reactions of sulfur dioxide found to play an important role in combustion devices. The kinetics of the reaction in the combustion temperature regime are being determined. Rate expressions are being deduced from concentration and temperature measurements in one-dimensional flames. A nozzle-beam-skimmer system is used to sample the flame. A quadrupole mass spectrometer is used to analyze quantitatively the extracted sample for a species of interest.
Keywords: sulfur dioxide; combustion; chemical reaction kinetics; temperature effects; mass spectroscopy; temperature measurement.

130045 Deposition of Energy from Low Energy Neutrons in Tissue Sphere and Dose Index Conversion Factors. Chilton, A.B. (Univ. of Illinois, Urbana, IL, 61801). **Project number:** ENG-7910853. **Contract:** ENG-791853. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The purpose is to establish the relationship between the radiation characteristics and the dose rate at the appropriate point inside an idealized sphere of tissue. The research, theoretical and calculational, deals with the determination of the energy deposition at various places in an idealized sphere of tissue, placed in beams of neutron energies from thermal up to 0.1 MeV. The response function to neutrons are determined as a function of energy. A Monte Carlo computer program is to be developed specifically for the foregoing energy range. Because secondary photons become more important in the low-energy-neutron case, the energy deposition along the track of the secondary electrons are taken into account. The Monte Carlo calculations are biased to maximize the accuracy at the point where maximum values are expected. The research provides a means on how to convert the beam flux data into equivalent index rates as a function of neutron energy.
Keywords: tissues; biological radiation effects; neutron beams; biological effects; dose rates.

130046 Technological Uncertainty in Policy Analysis: Techniques for Eminating Health Impacts from Coal-Fired Power Plants. Morgan, M.G. (Carnegie-Mellon Univ., Frew Ave. and Margaret Morrison, Pittsburgh, PA, 15213). **Project number:** PRA 79-13070. **Contract:** PRA 79-13070. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Policy Research and Analysis. **Funding:** NSF.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A large amount of uncertainty is inherent in society's attempts to understand the effects of air pollution and to determine how much emissions ought to be abated. Much of this uncertainty is introduced through incomplete understanding of the physical, chemical, and biological processes involved. In the specific context of estimating the health impacts of sulfur air pollutants from coal-fired power plants, the principal investigator has developed a family of computer models which allows incorporation of this inherent uncertainty into the assessment process and exploration of its policy implications. This award supports research on five important additions to this earlier analysis: (1) extension of work on incorporating expert opinion and updating subjective distributions; (2) empirical examination of model robustness; (3) investigation of the value of information and the marginal benefits of research investment; (4) extension of results to geographical regions other than the upper Ohio River basin; and (5) examination of the problems of dealing with long-range transport.
Keywords: biological effects; health hazards; air pollution; air pollution abatement; sulfur dioxide; fossil-fuel power plants; mathematical models.

130047 Physical and Chemical Phenomena Responsible for Odor Formation in Diesel Engines. Cervansley, H.P. (Drexel Univ., 32nd and Chestnut St., Philadelphia, PA, 19104). **Project number:** DIAR 76-19752 A03. **Contract:** DIAR 76-19752 A03. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Applied Research. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Diesel engines are well known for their fuel economy but they do emit combustion products which have unpleasant odors. This research is aimed at determining the engine conditions which produce the odors and thereafter decreasing the amount of odor. The present award builds on a previous grant AER 76-19752. The main objectives of this award are: (1) to refine the methodology of measuring the amounts of odoriferous materials in a combustion gas stream; (2) to test specific hypothesis of the formation and destruction of odoriferous materials; and (3) to define the effects of important factors controlling the dynamics of combustion on odor emission.
Keywords: diesel engines; combustion products; odor; diesel fuels.

130048 Equity Issues in Radioactive Waste Management. Kasperson, R.E. (Clark Univ., 950 Main St., Worcester, MA, 01610). **Project number:** OSS 77-16564. **Contract:** OSS 77-16564. **Supported by:** National Science Foundation, Washington, DC (USA). Office of Science and Society. **Funding:** NSF.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Continuing experimental and theoretical investigation of the bulk mechanical behavior of particulate solids is focusing on the influence of gaseous environments upon such behavior. A theoretical framework based on capillary condensation of vapor at the points of particle contact is being explored as a means for explaining the diametrically opposite response of mechanical shear strength of different powders to changes in humidity. Measurements of a wide range of different types of powders in different environments of varying composition are also currently in progress. These experiments are providing data to aid understanding and test the theoretical results. Similar studies of the electrical resistance properties of such particulate systems are being performed as part of the work. Bulk mechanical properties are important for design of handling systems for bulk particulate solids. Electrical resistivity of such solids is of importance for the performance of electrostatic precipitators for removing fine particles from gases.
Keywords: gaseous wastes; particles; electrostatic precipitators; mechanical properties; powders; humidity; shear properties; electric conductivity; vapors; radioactive waste management.

130049 Interaction Between Bulk Particulate Solids and Gaseous Elements. Coughlin, R.W. (Univ. of Connecticut, Box U-37, Storrs, CT, 06268). **Project number:** ENG-79-08779. **Contract:** ENG-79-08779. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.

Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Technologies that pose equity questions need to be assessed in a framework of changing social values and evolving institutions. This project will study how equity considerations enter into public decisions regarding technological developments, focusing on radioactive waste management as a problem which poses unique and significant combinations of ethical issues and technological uncertainties. Decisions as to whose back yards will be selected as waste disposal sites raise ethical questions as to the degree to which a relatively small number of people should bear risks attendant upon large scale development of nuclear power. Equity issues are also raised by questions of whether those people should be compensated for their risks and if so, how. Questions of temporal equity are also raised by the radioactive waste management issue, since risks as well as a managerial burden are exported to future generations. This project has three major phases: (1) an examination and analysis of equity issues associated with various technical options for radioactive waste disposal; (2) development and testing of methods to elicit the values and trade-offs of individual citizens on the complex radioactive waste disposal problem; and (3) monitoring developing public policy for radioactive waste management in the United States in the light of the ethical analysis of Phase I. The final monitoring phase of the project will involve a systematic collection of public documents and reports and articles from the mass media.
Keywords: radioactive waste management; decision making; ethics; site selection; radioactive waste facilities; radioactive waste disposal; risk assessment; public opinion; public relations; social impact.

130050 Laser-Excited Matrix-Isolation Fluormetric Analysis or Polycyclic Aromatic Hydrocarbons. Webry, E.L. (Univ. of Tennessee, W. Cumberland Ave., Knoxville, TN, 37916). **Project number:** CHE77-12542. **Contract:** CHE77-12542. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Chemistry. **Funding:** NSF.
Related energy source: Coal(50); oil shale(50) **R and D categories:** Pollutant measurements technology.

Laser-excited matrix isolation (MI) fluorescence spectrometry is being developed as an analytical technique for characterizing polycyclic organic matter, with special emphasis on characterization of the chemical carcinogen content of coal liquids and shale oils. In MI, sample molecules (in the gas phase) are mixed with excess inert matrix gas; the gaseous mixture is then deposited as a solid on an optical surface at low temperature for subsequent spectroscopic examination. The objective of MI is to increase the selectivity of fluoremetric analysis (by minimizing solute-solute interactions in the sample) and to decrease the amounts of individual substances which can be detected (by eliminating background fluorescence from the solvent). Dr. Wehry and co-workers have established that MI fluorometry can yield reliable quantitative analysis for individual compounds in complex mixtures, using gas-discharge lamps as spectroscopic sources. The utility of the method will be greatly increased by application of procedures requiring use of a laser source. In one such method, site-selection spectroscopy, characteristic highly resolved spectra of individual compounds are obtained by selective excitation of molecules occupying identical sites in the MI sample, using a narrow-bandwidth laser source. In another technique, time-resolved spectroscopy, resolution of spectra of complex mixture proceeds by using both the temporal and spectral characteristics of the emitted light, using a laser source emitting very short-duration light pulses.
Keywords: polycyclic aromatic hydrocarbons; fluorescence spectroscopy; shale oil; coal liquids; chemical analysis; matrix isolation.

130051 Geochemical Ocean Section Study, Atlantic--Pacific--Indian Oceans Program: Operations Group. Williams, R. (Scripps Institution of Oceanography, P.O. Box 1529, La Jolla, CA, 42638). **Project number:** OCE 77-22876 A03. **Contract:** OCE 77-22876 A03. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The Geochemical Ocean Sections Study, GEOSECS, is a coherent oceanographic research project whose purpose is to make detailed measurements of oceanic constituents at all depths from the Arctic to the Antarctic. The purpose of these measurements is to provide, for the first time, a set of physical and chemical parameters measured on the same water and applying the same analytical techniques for each compound on an oceanwide basis. The results of these measurements will provide data for quantitative studies of oceanic mixing and organic productivity and simultaneously serve as a baseline for the levels of fission and waste products being added to the sea. This award would provide facility and logistic support to revisit GEOSECS Station No. 347 off San Diego. This completes the intercalibration study and field work for GEOSECS and provides data to complete the interpretation of the chemical and physical measurement in the Atlantic, Pacific, and Indian Oceans.
Keywords: geochemical surveys; water chemistry; seas; marine surveys; data compilation; water pollution; field tests; atlantic ocean; pacific ocean; indian ocean.

130052 Geochemical Ocean Sections Study: Indian Ocean Carbonate Chemistry. Takahashi, T. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** OCE 77-22891 A01. **Contract:** OCE 77-22891 A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: general science(100) **R and D categories:** Pollutant measurements technology.

The Geochemical Ocean Sections Study, GEOSECS, is a coherent oceanographic research project whose purpose is to make detailed measurements of oceanic constituents at all depths from the Arctic to the Antarctic. The purpose of these measurements is to provide, for the first time, a set of physical and chemical parameters measured on the same water applying the same analytical techniques for each compound on an oceanwide basis. The results of these measurements will provide data for quantitative studies of oceanic mixing and organic productivity and simultaneously serve as a baseline for the levels of fission and waste products being added to the sea. This award supports calibration studies for total CO2 and alkalinity off San Diego (GEOSECS Station No. 347). These data are required to interpret results from Pacific and Indian Ocean studies.
Keywords: geochemical surveys; water chemistry; seas; marine surveys; data compilation; water pollution; field tests; pacific ocean; indian ocean.

130053 Dynamic Analysis of Earthquake Shaking Deformations for Large Caverns in Jointed Rock. Belytschko, T.B. (Northwestern Univ., 633 Clark St., Evanston, IL, 60201). **Project number:** PFR7809271. **Contract:** PFR7809271. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: oil and gas(50); nuclear fission(50) **R and D categories:** Pollutant measurements technology.

This research will concentrate on the development of analytical procedures to predict the response and stability of rock caverns to earthquake shaking. The computer programs to be developed during this study will be able to account for rock mass inhomogeneities in the form of continuous joints or shear zones, irregular geometry of both the opening and intact rock blocks, and seismic excitation. As an integral part of this effort, procedures and guidelines for modeling jointed media in the vicinity of an excavation will be investigated. Rational procedures for devising prototypical joint configurations will be developed through a combined effort of exercising the model and calibrating it with recorded experiences. The anticipated outcome will be not only a computational tool, but also guidelines for engineering analysis. Even though this project focuses primarily on earthquake response, the results will have application in other fields of study such as feasibility studies for underground nuclear reactors, underground storage of oil and radioactive waste in seismically active areas, and hazard assessment studies for lifeline systems.
Keywords: analytical solution; caves; cavities; underground space; seismic effects; earthquakes; stability; computer calculations; mathematical models; risk assessment; underground storage; radioactive waste storage; petroleum; reactors; feasibility studies; underground; ground motion; deformation; reactor sites.

130054 Theoretical Dynamics of Buoyant Plumes in Coastal Waters. Garuine, R.W. (Univ of Delaware, School of Marine Studies, Lewes, DE, 19958). **Project number:** OCE 7821318. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant characterization and analysis.

This report will investigate the dynamics of buoyant plumes in coastal waters. These plumes are a common feature of coastal waters, and are generated by such natural processes as the discharge of brackish water from rivers, bays, and estuaries and by such human activity as large plant cooling water effluent. Such plumes have an important impact on coastal sedimentation, coastal circulation and the distribution in coastal waters of trace elements, nutrients, and pollutants, including oil spills. Buoyant plumes may be divided into three fields: a source field, near field, and far field. In the proposed study the dynamics of the near field will be examined. This part of the plume is where the major change occurs in water properties between source and ambient water. Often this part of the plume structure is clearly bounded by sharp frontal zones. The theoretical model will divide the motion field into a large scale, inviscid region where the dynamics are dominated by nonlinear internal waves and a small-scale frontal zone bounding the inviscid region where dissipative processes are dominant. The work will proceed in five principal states, beginning with horizontally one dimensional plume, driven by steady source discharge into still ambient water, to horizontally two-dimensional plumes, driven by time dependent source discharge into an ambient fluid with its own time dependent motion.
Keywords: coastal regions; plumes; power plants; thermal effluents; environmental impacts; metals; mathematical models.

130055 Effects of Vertical Mixing in Sediments on the Chemical Interactions Between Deep Sea Sediments and Sea Water. Scherik, D.R. (Texas A and M Univ., College Station Campus, College Station, TX, 77843). **Project number:** OCE7821170. **Contract:** OCE7821170. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Organisms and abyssal currents mix deep sea sediments, distorting the geologic record and modifying the chemistry of interstitial waters. An accurate mathematical description of sediment mixing would enable the record of past conditions to be sharpened and provide a basis for more accurate models of sediment-seawater interactions to be developed. The depths at which chemically active particles actually react need to be determined. Substantial progress has been made to date in analyzing a collection of box cores from the Atlantic, Caribbean and Gulf of Mexico, and the data are in the process of being evaluated. From these data sea floor bioturbation rates have already been estimated at a variety of locations. The continuation of this research will extend the theoretical work and extend the scope of the sampling program into the Pacific.
Keywords: sediments; atlantic ocean; gulf of mexico; caribbean sea; pacific ocean; water; interfaces; mixing; chemical reactions; mathematical models; evaluation; age estimation.

130056 Intergenerational Ethics and National Energy Policy. MacLean, D. (Univ. of Maryland, College Park Campus, College Park, MD, 20742). **Project number:** 05579-09907. **Contract:** 05579-09907. **Supported by:** National Science Foundation, Washington, DC (USA). Office of Science and Society. **Funding:** NSF.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this project are to develop a set of consistent ethical principles that will illuminate policy analyses involving issues of obligation to future generations, and to demonstrate the applicability of those principles in determining or evaluating national energy policies. Its focus will be on the basic philosophical work required to develop principles of justice that apply to the distribution of benefits and burdens between people who are alive today and potential future people whose existence and quality of life will be determined in part by current choices. These principles will be applied to: (1) the production of toxic substances as by-products in energy production, and (2) the use of non-renewable resources. The project aims to show that these principles can be useful in helping to determine priorities for research and development. The project methodology will include three two-day meetings of a fifteen member working group of scientists, social scientists, philosophers, and policy makers, some of whom will be selected by means of open application procedures. Agendas for these meetings will be based on papers commissioned from group members. These papers and critical discussions of them by the group will provide material on which the principal investigator will base a book which critically examines the grounds for justifying principles of intergenerational justice and discussion of the policy implications of those principles. Several of the papers by several working group members will also be submitted for publication either as separate articles in professional journals or collectively as an edited anthology.
Keywords: public policy; energy policy; ethics; sociology; toxic materials; renewable energy sources; meetings; research programs; usa.

130057 Investigation of the Interaction of Fluid Dynamics, Electrostatic, and Fine Particles in Electrostatic Precipitators. Bernstein, S. (Flow Research, Inc., 21414 68th Avenue S, Kent, WA, 98031). **Project number:** DAR79-10363. **Contract:** DAR79-10363. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Applied Research. **Funding:** NSF.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of the proposed research project is to provide a fundamental understanding of the basic processes of interaction between fluid dynamics, electrostatic, and particle dynamic effects such as occur in electrostatic precipitators. A theoretical and experimental effort over a two-year period will be focused on (1) the interaction between turbulent flow field and intense electric field, (2) the transport of fine particles in the coupled electrohydrodynamic flow field, and (3) the possible modes of interaction between the fluid dynamics, electrostatics, and particle dynamics, and their dependence on the electrode geometry. Preliminary studies, both theoretically and experimentally, have shown that the above interaction plays a significant role in the transport of fine particles in the electrohydrodynamic flow field. While it is expected that the results of the research will be scientifically significant, the outcome of the work will pave the way for developmental work and application for better emission control devices. An advisory group consisting of regulatory agency personnel, utility, manufacturing and scientific personnel will assist in expediting the utilization of this work.
Keywords: electrostatic precipitators; fluid mechanics; electrostatics; particles; electrohydrodynamics; research programs; turbulent flow; electric fields; operation.

130058 Evaluation of Effects of Acid Mine Drainage on Microbial Community Structure and Function in a Freshwater Lake. Mills, A.L. (Univ. of Virginia, Garrett Hall, Charlottesville, VA, 22903). **Project number:** PFR79-06298. **Contract:** PFR79-06298. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(25); oil shale(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A great deal of past research has been focused on the formation and effects of acid mine drainage. Most of this work has been concerned with small streams where the runoff remains concentrated. Virtually no publications have dealt with the chronic impact of acid mine water on ecological processes in large bodies of water such as reservoirs or estuaries where considerable dilution occurs. The proposed research will investigate the effects of drainage from 19th century pyrite mines into Lake Anna, Virginia. Emphasis will be placed on the effects of low pH, high heavy-metal concentration runoff on the structure and function of microbial communities in the most contaminated arm of the lake. The operating hypothesis is that both the microbial communities and the processes which they control have been severely altered. A series of techniques has been selected to test the basic hypothesis. Functional parameters such as heterothrophic potential, substrate decomposition, 14Co/sup 2/ uptake by phytoplankton, nitrification, denitrification, and sulfur oxidation will be measured. Stations for sampling have been selected to investigate the extent of the effects of contaminated drainage into the reservoir. A series of experiments involving metal uptake by bacteria, phytoplankton, and detritus is planned in order to determine the amount of metal made available for passage into higher trophic levels of aquatic food chains.
Keywords: acid mine drainage; environmental effects; coal mining; surface mining; environmental impacts; ph value; metals; carbon dioxide; nitridation; sulfur oxides; nitrogen oxides; food chains.

130059 Satellite Power Systems. Kasper, R. (National Academy of Science, 1800 G Street NW, Washington, DC, 20550). **Project number:** PRM 79-19687. **Contract:** PRM 79-19687. **Supported by:** National Science Foundation, Washington, DC (USA). Office of Planning and Research Management. **Funding:** NSF.
Related energy source: solar(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The National Academy of Sciences through the National Research Council will review studies, especially those pursued by the Department of Energy, of the concept of solar power satellites. The NAS work plan will focus in particular on environmental, technological, socio-economic, and international concerns that may derive from the execution and operation of satellites to be used for the generation and transmission to earth of solar power. The NAS study will attempt to identify critical scientific and technical issues in the evaluation of the satellite solar energy system as well as point out gaps in the studies undertaken by the Department of Energy. The independent critiques to be provided by the Academy will also include a comparison of solar energy satellite systems with alternative collection and transmission energy mechanisms. The National Research Council through its Environmental Studies Board will establish a Committee on Satellite Power Systems. This committee, in cooperation with other pertinent units of the NRC, will conduct the study. The committee may make use of panels, workshops, symposia, public meetings, consultants, or other arrangements. The committee will also maintain close contact with both the Department of Energy and the National Aeronautics and Space Administration.
Keywords: orbital solar power plants; environmental impacts; socio-economic factors; evaluation; microwave power transmission.

130060 Engineering Research Initiation: In-Situ Methods for Aerosol Characterization in Combustion Environments. Hirleman, E.D. (Arizona State Univ., School of Engineering and Applied Science, Tempe, AZ, 85281). **Project number:** ENG-78-06210. **Contract:** ENG-78-06210. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant measurements technology.

Aerosol concentrations and size distributions are of fundamental importance in the areas of particulate emissions and fuel spray combustion. Accurate diagnostic techniques for the measurement of these properties are of increasing national concern considering the shift from gas and oil to dirty fuels, such as coal, heavy residual fuel oils, and synthetic alternate fuels. The initiation of a research program on advanced laser techniques for in-situ, real-time analysis of particulates or droplets in the adverse environments associated with combustion systems is proposed. Specific research objectives involve two applications of optical particle diagnostics. First, the effects of non-spherical particles and the dependence of

optical sampling volume on particle size for ratio-type single particle counters will be investigated. These tasks are crucial for further substantiation of the applicability of ratio counters in combustion exhaust particulate measurements. Secondly, development of a new dual beam laser technique for localized measurements of fuel spray droplet sizes and velocities is proposed. Research on some data acquisition considerations common to both laser techniques will also be performed.
Keywords: lasers; aerosols; particles; aerosol monitoring; emission; gaseous wastes; coal; fuel oils; research programs; laser spectroscopy; engineering.

130061 Engineering Specialized Research Equipment: Measurement of Trace Metals. Young, T.C. (Clarkson Coll. of Technology, 51 Main St., Potsdam, NY, 13676). **Project number:** ENG 79-10858. **Contract:** ENG 79-10858. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF. **Related energy source:** Coal(100) **R and D categories:** Pollutant measurements technology.

This research equipment consists of an atomic absorption spectrophotometer. It is essential for research concerning metals in the aquatic environment. Examples of research requiring this equipment are the following: (1) evaluation of trace metals in lakes which have become acidic due to the phenomenon of acid rain; (2) examination of trace metal content of fly ashes; (3) trace metals associated with drinking water and treatment of drinking water; and (4) adsorption of inorganic phosphorus by colloidal inorganic iron and organically-complexed iron movement and fate of heavy metals in the eutrophic lake ecosystems.
Keywords: absorption spectroscopy; metals; water chemistry; trace amounts; lakes; acid rain; ph value; drinking water; water treatment; adsorption; phosphorus; iron; colloids; complexes; fly ash.

130062 Engineering Specialized Research Equipment: Infrared Studies of Surface Dynamics During CO Oxidation on Pt Supported Catalysts. Wolf, E.E. (Univ. of Notre Dame, Notre Dame, IN). **Project number:** ENG 79-11459. **Contract:** ENG 79-11459. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this research is to study the dynamic behavior of surface adspecies during carbon monoxide oxidation on platinum supported catalysts by means of an infrared-cell reactor system capable of unsteady state operation. Dynamic measurements of surface species coupled with bulk measurements yield more information than steady state experiments and can provide a better understanding of this reaction which is important in automobile emission control. Since automakers are today's largest users of platinum catalysts, an improvement in the understanding of this catalytic system can lead to the formulation of more efficient catalysts that will require less platinum, thus decreasing the impact of importing this precious metal. More efficient catalysts for automobile emission control can also result in fuel savings which can help to alleviate the energy problem.
Keywords: automobiles; air pollution control; catalysts; carbon monoxide; oxidation; platinum; catalytic effects; sorptive properties; infrared spectra; dynamics; chemical reaction kinetics.

130063 Ecological Study of the Terminos Lagoon (Campeche, Mexico) with Special Reference to Fishery Resources and the Potential Impact of Man. Day, T.W. (Louisiana State Univ., Baton Rouge, LA, 70803). **Project number:** INT 78-20788. **Contract:** INT 78-20788. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF.
Related energy source: oil and gas(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Terminos Lagoon, like many others, is a large brackish bay possessing extensive mangrove swamps, fresh marshes and beds of submerged grasses. The Lagoon and nearby Bay of Campeche enjoy the most extensive fishery in Mexico. Although not conclusively demonstrated, the wetlands and grassbeds undoubtedly serve as nurseries for this fishery. Similar areas exist in southern Louisiana and elsewhere but Terminos is an unusually healthy estuarine ecosystem because its environment is still largely undisturbed and uncontaminated. However, petroleum exploration and production as well as potential upland agricultural changes may soon affect both the ecology and economy of the area. The overall objective of this project is to develop an environmental framework for documenting the functioning and value of natural resources of the Terminos Lagoon, and predicting changes which may occur due to the activities of man. Three specific tasks are being carried out: (1) identification and quantification of ecological connections between Terminos Lagoon and the fisheries, (2) implementation of a hydrodynamic-ecological model of the lagoon, and (3) development of a series of conceptual models for the analysis of ecological and economic connections in the Terminos region.
Keywords: fishing industry; mexico; fishes; population dynamics; water pollution; aquatic ecosystems; petroleum industry; environmental impacts.

130064 Special Foreign Currency Award (in Egyptian Pounds) for Study of Electrochemical Concentration of Sulfur Dioxide in Molten Salts. Abdelsalam, O.E. (Cairo Univ., University Street, Cairo, Egypt). **Project number:** INT78-01472. **Contract:** INT78-01472. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

In a collaborative research program of the University of Missouri, Columbia, MO, and Cairo University, Cairo, Egypt, it is proposed to study the feasibility of an electrochemical process for the removal of sulfur oxides from the stack gases of power plants and similar sources using molten salt electrolytes. The removal is achieved by passing the stack gases past the cathode of an electrochemical cell where the chemical and electrochemical reactions convert the sulfur oxides into sulfite and sulfate which migrate to the anode. They oxidize, releasing sulfur or sulfuric acid. An external power source supplies the electric energy required to drive the proposed reactions. The process has a great potential and may prove to be economically competitive with current flue gas desulfurization methods. However, extensive studies both on fundamental and engineering levels are required before a detailed evaluation can be prepared.
Keywords: sulfur oxides; gaseous wastes; stacks; electrochemistry; molten salts; feasibility studies; electrochemical cells; anodes; cathodes; pollution control equipment; sulfur dioxide; air pollution control.

130065 Dynamic Behavior and Collection of Aerosol Particles. Wang, C. (Syracuse Univ., Link. Hall, Syracuse, NY, 13210). **Project number:** INT78-21376. **Contract:** INT78-21376. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

This award will support Professor Chiu-sen Wang of Syracuse University for a period of two years in a program of cooperative research in chemical engineering with Professor Hitoshi Emi of Kanazawa University in Japan. The investigators will make use of complementary skills in studying the behavior of aerosol particles. The research will be conducted in four areas: collection mechanisms of fibrous air filters, high-temperature gas-particle separation, behavior of hygroscopic aerosols, and inhaled particles. Advances in these areas will have practical applications in the conservation of the atmospheric environment as well as the production of clean energy.
Keywords: air pollution; aerosols; monitoring; air filters; performance; vapor separators; adsorption.

130066 Experimental Investigation of Aerosol Formation in the Atmosphere and Aerosol Acoustic Agglomeration. Shaw, D.T. (State Univ. of New York, 3435 Main St., Buffalo, NY, 14214). **Project number:** INT 78-18657. **Contract:** INT 78-18657. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The research focuses, first, on heteromolecular nucleation processes on gaseous ions in the atmosphere. This will include the identification of reaction pathways and the determination of the rates of cluster and particle formation. The second focus is on acoustic agglomeration. Here, the research will attempt to measure the particle size of pool-fire sodium oxide aerosols and the effects of various acoustic fields on depleting these particles. This project is a joint U.S.-French effort under the auspices of the cooperative program between NSF and the National Center for Scientific Research. The U.S. team is responsible primarily for the atmospheric related studies, whereas the French team (University of Paris) will concentrate on acoustic agglomeration.
Keywords: condensation nuclei; nuclear explosions; nuclear power plants; environmental impacts; sodium oxides; particle size; agglomeration; nucleation; aerosols; sound waves; radionuclide migration; gaseous wastes; radioactive materials; fission products; radioactive aerosols.

130067 Sources, Transformation, and Chemical Nature of Atmospheric Pollutants. Gordon, G.E. (Univ. of Maryland, College Park, MD). **Project number:** PFR 750266-7A06. **Contract:** PFR 750266-7A06. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: Coal(50); oil and gas(25); nuclear fission(25) **R and D categories:** Pollutant characterization and analysis.

This is a continuation of work under Grant ENV75-02667-A05 on the trace elements in size-graded particulates emitted by power plants, refuse and sludge incinerators, automotive traffic, airports, copper smelters, steel mills, and cement plants. The objec-

tive is to identify the sources of toxic elements in the atmosphere and to measure the relative contributions of natural and individual man-made sources to the particulates of urban atmospheres. This grant extends the study to a more complete characterization of copper smelters, a cement plant, and a steel mill, and to the aircraft sampling of two or three other non-ferrous smelters (zinc, lead, or nickel). This extension will add size-graded particulate analyses of the copper smelter plumes (and of the other smelters), expand the list of elements to be measured, determine solubilities of toxic elements in the particulates, and provide analyses of in-plant materials to determine the role of fractionation processes governing the composition of the stack emissions. The resulting expanded data base will be used to refine the existing model for estimating source contributions to urban air particulates.

Keywords: air pollution; stationary pollutant sources; mobile pollutant sources; trace amounts; elements; aerosols; particle size; copper; foundries; cements; steels; aerial monitoring; zinc; lead; nickel; plumes; chemical properties; chemical composition; gaseous wastes.

130068 SO2 Oxidation Rate on Well-Characterized Surfaces: a Laboratory Study. Mohnen, V.A. (State Univ. of New York, 1400 Washington Ave., Albany, NY, 12222). **Project number:** PFR 76-81817 A01. **Contract:** PFR 76-81817 A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The first phase of the research will involve the study of oxidation rates of SO2 on two well-characterized surfaces that can serve as paradigms for the wide range of surface types on typical stack particles. These surfaces are polycrystalline V205 (representing the metal oxides) and carbon on pyrolytic graphite (representing carbonaceous particles). Oxidation of V205 is hypothesized to occur in two stages: oxygen adsorption at reduced vanadium sites, and then oxidation of SO2 by an Elev-Rideal Mechanism. Oxidation on carbon surfaces is hypothesized to occur in two similar phases. The objectives are to determine whether the proposed reaction schemes are valid and to deduce the rate-controlling step. Methods of analysis include mass spectrometry, molecular beam and auger spectroscopy. The second phase of the research will involve the study of sulfate concentration from in-stack coal and oil flyash samples. Measurements will be made of total sulfate per unit weight, surface vanadium content, and surface areas per unit weight for each type of ash. Determinations will be made of the degree to which sulfate concentration from SO2 oxidation is related to the total surface area and to the vanadium concentration of the ash. These studies will elucidate the relative importance of vanadium and the carbonaceous surfaces of flyash as oxidizing agents for SO2. Analysis will include use of BaC12 precipitating agent, ion liquid chromatography, BET surface analysis, and electron microscopy and energy dispersive x-ray microanalysis.

Keywords: sulfur dioxide; surfaces; oxidation; stacks; particles; polycrystals; carbon; vanadium oxides; mass spectroscopy; sulfates; coal; petroleum; fly ash; oxidizers; liquid column chromatography; electron microscopy; x-ray diffraction; chemical reaction yield.

130069 Field Studies of Biologically Produced Atmospheric Suflur Compounds. Bandy, A.R. (Drexel Univ., 32nd and Chestnut St., Philadelphia, PA, 19104). **Project number:** PFR76-80322 A02. **Contract:** PFR76-80322 A02. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Advanced Environmental Research and Technology. **Funding:** NSF.

Related energy source: Coal(50); oil and gas(50) **R and D categories:** Environmental transport and conversion of pollutants.

Worldwide emissions of volatile sulfur compounds of biogenic origin are commonly believed to exceed the total flux of sulfur dioxide released to the atmosphere as a result of human activities. Unlike the anthropogenic sources, which emit mostly sulfur dioxide, the biogenic sources are believed to contribute hydrogen sulfide, dimethyl sulfide, and minor amounts of other sulfur compounds. Like sulfur dioxide, the latter sulfur carriers seem likely to oxidize in the air to form sulfuric acid or some other particulate sulfate. These sulfate forms are believed to be hazardous to human health. This project addresses the question whether the biogenic emissions believed to be dominant on the global scale are also significant for the production of airborne sulfate particulates in regions impacted by anthropogenic sources of sulfur dioxide like coal- or oil-burning plants. The research will be done by gas-chromatographic analysis of estuarine waters and the overlaying air in a pristine area (Wallops Island, Virginia). Samples will be analyzed for hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl suflide, carbon disulfide, and carbonyl sulfide. Meteorological observations will be made as aids to the identification of sources. Surface emission rates will be estimated by model calculations based on wind velocities and air analyses at different elevations.

Keywords: air pollution; sulfur compounds; atmospheric chemistry; sulfates; sulfur dioxide.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

140000 Advanced Low Emissions Combustion. Petrash, D.A. (NASA, Lewis Research Center, 21000 Brookpark Rd., Cleveland, OH, 44135). **Project number:** 511-55-02. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). Office for Aeronautic and Space Technology. **Funding:** NASA.

Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to investigate and establish the technology to reduce exhaust emissions from gas turbine engines to environmentally acceptable levels over the entire subsonic flight regime while being consistent with the requirements for improved durability, performance and fuel flexibility and with minimum adverse effects on weight and complexity. Emissions will be reduced by applying the lean-burning, premixed, prevaporized combustion technique. Benefits in addition to low emission include increased combustor liner life and increased turbine durability due to more uniform burning zones and burning at lower primary zone equivalence ratios; and improved combustor altitude relight capability through the use of combustor variable geometry. Several configurations of three combustor concepts will be designed and fabricated. Screening tests will be conducted in full scale sector or full annular combustor rigs over a range of conditions typical of the operation of advanced aircraft engines.

Keywords: gas turbine engines; exhaust gases; air pollution abatement; aviation fuels.

140001 Propulsion Pollution Reduction Research Combustor and Augmentation Systems Research. Petrash, D.A. (NASA, Lewis Research Center, 21000 Brookpark Rd., Cleveland, OH, 44135). **Project number:** 505-03-22, 505-04-32. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). Office for Aeronautic and Space Technology. **Funding:** NASA; DOD.

Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the programs conducted under these RTOP's are to develop, evaluate, and demonstrate technology that will significantly reduce gas turbine engine emissions without adversely affecting efficiency, operating range, durability, and temperature distribution, and that will meet future environmental requirements. The activities include both basic and applied emissions research and technology for advanced low emissions combustors. Fundamental combustion studies will be conducted in flame-tube type facilities to gain a better understanding of pollutant formation. Complementary analytical modeling activities will be explored to develop analytical models of the fundamental combustion process and the factors affecting pollutant formation. Investigations in combustor segment, sector, and full-scale facilities will be aimed at providing the technology data base for the design of future advanced low emission combustor concepts. As appropriate, studies will be undertaken to evaluate and verify the adaption of this emission reduction technology to modern aircraft engine in sector and full-scale facilities and in engine tests.

Keywords: gas turbine engines; exhaust gases; efficiency; air pollution; design; aircraft.

140002 Fuels Research. Grobman, J. (NASA Lewis Research Center, 21000 Brookpark Rd., Cleveland, OH, 44135). **Project number:** 505-04-52. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). Office for Aeronautic and Space Technology. **Funding:** NASA.

Related energy source: Coal(50); oil shale(50) **R and D categories:** Environmental transport and conversion of pollutants.

The potential properties of future aviation turbine fuels derived from nonpetroleum sources such as oil-shale and coal will be determined by synthesis and characterization techniques. The effects of these fuels, as well as petroleum based fuels synthesized to broader specifications than currently required, on the performance and durability jet engine components and materials will be determined. Sufficient quantities of these fuels must be procured and/or simulated by blending of petroleum based fuels and will be used to conduct research tests required to evolve the technology that may be needed to use these fuels in current and future jet aircraft engines. A joint program has been developed with the AFAPL and Lewis to implement an overall integrated effort to best utilize the technical capabilities of the AFAPL and Lewis to conduct the various activities necessary in conducting this program. Cooperative efforts on contract funding and management, and in-house test activities are currently underway and will be used throughout the planned life of this program. Overall coordination with other government agencies such as the USN, DOE, and EPA and with industry will also be maintained in order to provide proper direction and scope to the program as it develops and proceeds.

Keywords: jet engine fuels; aviation fuels; aircraft; synthetic fuels; combustors.

140003 Broad Specification Fuels Technology. Grobman, J. (NASA, Lewis Research Center, 21000 Brookpark Rd., Cleveland, OH, 44135). **Project number:** 511-59-02. **Contract:** NAS3-22063. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). Office for Aeronautic and Space Technology. **Funding:** NASA.
Related energy source: oil and gas(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of this effort are to evolve and demonstrate the technology required to utilize broad specification fuels in current and next generation commercial jet aircraft. The intention of this project is to extend the current R and T base Fuels Research Program to an integrated component investigation resulting in engine verification tests. The engines to be selected will be suitable and available advanced high-bypass ratio turbofan engines and will preferably incorporate the latest E(3) and Clean Combustor technology. The effort will be conducted through multiphase contracts using two parallel contractors throughout the length of the project. The technical conduct of this project effort will be similar to the multiphase approach used in the NASA Experimental Clean Combustor Program. The multiphase contract effort will consist of three consecutive phases which will: (1) systematically screen out the more promising combustor and fuel system concepts for using broad specification fuels; (2) evolve these concepts into component hardware which is compatible with an existing engine; and (3) conduct actual verification tests to document engine performance and durability.
Keywords: jet engine fuels; aircraft; engines; combustors.

140004 Energy Related Remote and In-Situ Instrument Development. Mugler, J.P. Jr. (NASA Langley Research Center, Hampton, VA, 23665). **Project number:** EPA-IAG-DG-E771-EU. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). **Funding:** EPA; NASA.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of this project is to develop and apply advanced electro-optical techniques to the measurement and characterization of powerplant and other source effluents. The tasks are as follows: Task I, Raman Lidar - evaluate Raman lidar for remote measurement of the concentration of SO2 and NO at a powerplant stack exit; Task 2, Plume Dispersion Studies - apply aerosol scattering lidar techniques to the study of plume dispersion; Task 3, IR DIAL - develop and apply the tunable ir differential absorption lidar (DIAL) technique to the remote measurement of molecular plume effluents; Task 4, Laser Heterodyne Detector - evaluate the use of the laser heterodyne detector technique as a means to increase the sensitivity of long path continuous wave absorption measurements using diffuse reflectors; Task 5, HCl Monitor - develop and deliver to EPA an improved in situ HCl chemiluminescent monitor (the monitor will be evaluated at concentrations as low as 5 ppB HCl in ambient and polluted air; and Task 6, UV DIAL - evaluate the uv differential absorption lidar (DIAL) technique for remote measurements of the concentration of SO2, O3, and aerosols at a powerplant stack exit and within the stack plume. All FY 79 tasks have been completed with results submitted to EPA.
Keywords: fossil-fuel power plants; sulfur dioxide; nitrogen oxides; hydrochloric acid; monitoring; aerosols; plumes; lasers; environmental transport; measuring instruments; flue gas; air pollution control; air pollution monitors; research programs.

TENNESSEE VALLEY AUTHORITY

150000 Regional Atmospheric Transport of Coal-Fired Power Plant Emissions. Crawford, T.L. (TVA, Air Quality Research Section, E and D Building, Muscle Shoals, AL, 35660). **Project number:** 80BDL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$80,000; TVA-$40,000.
Related energy source: Coal(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to develop a quantitative regional model to describe the transport and transformation of the SO2-sulfate complex in the Tennessee Valley region. This model will be useful in determining the relative importance of TVA emissions as compared with other upwind sources of emissions. Measurements of the SO2-sulfate complex and other pollutants are all made using an instrumented aircraft at various locations and altitudes in the region of interest. Data collected at various meteorological stations are used to study air-parcel trajectories. Intensive field studies will be conducted under various meteorological regimes. Additional small field studies will be conducted at steam plants with different boiler configurations to determine what effect boiler configuration has on the primary emission of sulfate. Data obtained will help in understanding transport, diffusion, and chemical transformation of species of interest. Correlations with the meteorological data will explain relative importance of temperature inversions, wind velocity, climatic regime, and precipitation. A quantitative model will be the final product. Additional model verification and upgrading will be performed.
Keywords: fossil-fuel power plants; environmental effects; air pollution; environmental transport; sulfur dioxide; sulfates; tennessee valley authority; diffusion; mathematical models; chemical reactions.

150001 Field and Filtered/Unfiltered Exposure Chamber Studies of Effects of Coal-Fired Power Plant Emissions on Crop and Forest Species of Economic Importance in the Southeastern United States (Task 1). Noggle, J.C. (TVA, Air Quality Research Section, E and D Building, Muscle Shoals, AL, 35660). **Project number:** 80BDO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$150,000; TVA-$45,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to identify and quantify the impact of coal-fired power plant emissions on crop species of economic importance to the southeastern United States. The approach is to determine the impact on yield and crop appearance through the use of field (polluted) air exclusion system and charcoal-filtered air greenhouses. The air exclusion plots will be established to enable isolation of the effects caused by exposure to SO2 from the power plant from those caused by ambient levels of ozone and to determine whether SO2/O3 synergistic effects occur in the ambient environment. Relationship between crop appearance and yield will be determined. Relationhip between exposure dose and yield will be determined. Effects of other environmental parameters on modifying plant response to SO2 and O3 will be determined.
Keywords: fossil-fuel power plants; environmental effects; crops; sulfur dioxide; ozone; yields; synergism; dose-response relationships; terrestrial ecosystems; exposure chambers; air pollution; biological effects.

150002 Determine Dose-Response Kinetics for Effects of Atmospheric Emissions from Coal-Fired Power Plants on Soybeans and Other Crop and Forest Species of Economic Importance in the Southeastern United States (Task 2). Noggle, J.C. (TVA, Air Quality Research Section, E and D Building, Muscle Shoals, AL, 35660). **Project number:** 80BDO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$45,000; TVA-$45,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to determine the individual and combined effects on vegetation of SO2, NO2, and O3 exposures at concentrations, dosage rates, and environmental conditions typically occurring during surface exposures in the vicinity of large coal-fired power plants. By using a fumigation chamber within a growth chamber and a pollutant injection system capable of duplicating actual field fumigations, crop species will be exposed to power plant emissions and other atmospheric pollutants to determine their effects on field and plant sensitivity. The relationship between pollution dose, foliar injury, and yield for stage of growth of crops most sensitive to atmospheric pollutants will be determined for the ambient environment.
Keywords: dose-response relationships; air pollution; fossil-fuel power plants; sulfur dioxide; nitrogen dioxide; ozone; plant growth; plants; environmental effects; crops; biological effects; soybeans; glycine hispida.

150003 Characterize and Quantify the Transfer, Rate, and Effects of SOx, NOx and Acid Precipitation in Terrestrial Ecosystem Representative of the Tennessee Valley Region (Task 3). Kelly, J.M. (TVA, Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 80BDO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$184,000; TVA-$30,000.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to characterize and quantify the transfer, fate, and effects of SOx, NOx, and acid precipitation on terrestrial ecosystems representative of the Tennessee Valley region. The approach is to establish, instrument, and calibrate a series of forested watersheds to evaluate atmospheric inputs of SOx and NOx. An acid rain simulator will be used to evaluate plant and soil response to precipitation pH. A compartmental mass balance will be developed for selected elements in several biotic and abiotic compartments. This information will be used to evaluate atmospheric input in relation to system alteration and response.
Keywords: sulfur oxides; nitrogen oxides; acid rain; terrestrial ecosystems; environmental transport; ecological concentration.

150004 Evaluate the Beneficial Effects of SO2 and Other Pollutants Emitted from Steam Plants on Crops and Forest Species, Particularly Soybeans and Pines (Task 4). Noggle, J.C. (TVA, Air Quality Research Section, E and D Building, Muscle Shoals, AL, 35660). **Project number:** 80BDQ. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$44,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to assess the contribution of sulfur and other plant nutrients to the terrestrial ecosystem from the atmosphere. Sulfur and other plant nutrients in rainfall and dry particulates are collected and analyzed. Crop species are grown in containers of low-sulfur soil that has been labeled with radioactive sulfur. These crops are grown near coal-fired power plants and remote to sources of SO2 to allow the measurement of the contribution of atmospheric SO2 to the sulfur budget of the soil. Samples of native soil are collected on different radials from coal-fired power plants and the sulfur content is compared with samples collected from areas remote to the power plants. Results will be used to estimate the amount of sulfur contributed by coal-fired power plants to meet the sulfur requirements of vegetation. The consequences of a possible sulfur deficiency occurring if this source of sulfur is eliminated can be evaluated.
Keywords: soybeans; pines; sulfur dioxide; terrestrial ecosystems; fossil-fuel power plants; nutrients; environmental transport; air pollution; plants; nitrogen; sulfur; environmental effects.

150005 Remote Sensing of SO2 Effects on Vegetation. Sapp, C.D. (TVA, Mapping Services Branch, 216 Haney Building, Chattanooga, TN, 37401). **Project number:** 80BDJ. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$85,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to develop and refine remote sensing techniques for monitoring and evaluating the effects of SO2 emissions from coal-fired power plants on terrestrial vegetation. The approach is to compare ground-truth data of vegetation (primarily soybeans and pines) affected by SO2 and color, color-infrared, and multispectral imagery obtained by conventioanl aircraft. If these methods prove satisfactory, then the feasibility of satellite imagery for effects monitoring will be evaluated. The results are expected to demonstrate the usefulness of remote sensing methods for routine surveillance of effects on large areas. This would permit permanent, quantitative documentation of the extent and severity of effects for economic assessment and determination of trends.
Keywords: sulfur dioxide; monitoring; fossil-fuel power plants; chemical effluents; plants; remote sensing; biological effects; environmental effects; soybeans; pines.

150006 NOx Technology. Kee, B.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.01. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology. **Funding:** TVA-$25,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the programs are to ensure that adequate data from TVA's power plants are available, that TVA is informed on the state-of-the-art of NOx removal or control, that NOx removal or control projects are well defined, and that implementation of project plans is adequate. The approach consists of: reviewing and commenting on advanced concepts associated with NOx removal or control; assisting in developing and reviewing project plans for EPRI programs related to NOx removal or control; and testing at TVA's power plants, where data are not available, to determine NOx emissions. The scope of this program consists of obtaining NOx emission data; reviewing and visiting advanced NOx removal or control systems; and reviewing, developing, and commenting on proposals. Work is in progress reviewing and commenting on advanced NOx removal or control systems.
Keywords: fossil-fuel power plants; air pollution control; nitrogen oxides; removal; control; gaseous wastes.

150007 Particulate Technology. Huang, C.M.; Frank, R.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.09. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the project are to summarize and evaluate data pertaining to particulate emissions from fossil-fired power plants, to review advanced concepts in the area of particulate emission control, and to develop and coordinate research to improve collection efficiencies and to reduce the environmental impact of particulate emissions. The scope of the program includes summarizing and evaluating data, reviewing concepts, and developing test programs for improving the techniques of particulate control. Funds are not provided for an extensive experimental program.
Keywords: particles; technology assessment; flue gas; air pollution control; fossil-fuel power plants; fly ash; pollution control equipment.

150008 Lime/Limestone Advanced Concepts--TVA's 1-MW Pilot Plant (Colbert) for EPA. Hollinden, G.A.; Robards, R.F. (TVA, 1130 Chestnut Street Tower II, Chattanooga, TN, 37401). **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The major objectives of the project are to: develop reliable closed-loop mist eliminator systems for lime/limestone processes now in operation or planned in the near future; and, to the extent possible, develop less costly advanced high velocity scrubbers. A study to determine the factors adversely affecting the mechanical and process reliability of mist eliminators in lime/limestone scrubbing systems will be undertaken to define and evaluate advanced high velocity scrubbers. The scope of the project will be to test as many different alternative designs and operating modes as possible within the budget allocation. All non-TVA monies to carry out this project will be EPA pass-through funds. Operation of the mist eliminator in the vertical and evaluation of an advanced high velocity scrubber have been completed.
Keywords: lime-limestone wet scrubbing processes; fossil-fuel power plants; closed-cycle systems; mist extractors; performance testing; scrubbers; reliability; design; flue gas.

150009 Trace Element and Radionuclide Study. Flora, H.B. II. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Water Research Program has an Effluent Control Subprogram which has among others an objective to evaluate the chemical composition of various effluent discharges from a fossil-fired power plant. The primary objective of this project is to summarize and evaluate data pertaining to concentrations of trace elements and radionuclides associated with coal-fired power plants, to improve our knowledge of potential environmental hazards of trace elements, and to review and comment on trace element studies being conducted by other organizations. The scope of the program includes summarizing and evaluating data obtained in the TVA program, reviewing concepts, and developing an experimental program to provide necessary additional data. Funds for an extensive experimental program are provided under another project and not under this project.
Keywords: fossil-fuel power plants; elements; trace amounts; chemical effluents; particles; radioactive effluents.

150010 Beneficial Uses of Waste Heat: General. Snipes, R.L.; Goss, L.B. (TVA, 1060 Chestnut Street Tower, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology. **Funding:** TVA-$40,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Waste Heat Utilization Project which has, among others, an objective to develop, through research and demonstration, systems which beneficially use reject heat from electric generating facilities. The primary objective of this project is to develop and coordinate an overall TVA waste heat utilization program. A second objective of this project is to coordinate the waste heat utilization projects under the National Energy Demonstration Program. These projects include a review and evaluation of research programs on beneficial uses of heated water discharges from power plants. These projects will also involve the outlining and coordinating of the overall TVA waste heat utilization plan incorporating the proposed National Energy Demonstration waste heat projects.
Keywords: waste heat utilization; research programs; demonstration programs; co-generation; thermal power plants; tennessee valley authority; thermal effluents.

150011 Membrane Processes for Refurbishing Power Plant Water Supply. Flora, H.B. II; Boroughs, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: Coal(50); nuclear fission(25); nuclear fusion(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Water Research Program has an Effluent Control Subprogram which includes in its objectives the assessment of technology for effluent control. The objective of this project is to determine whether one or more membrane proceses could be beneficially utilized for refurbishing TVA power plant discharge waters. The project's scope will cover review of available information, a study to

evaluate the use of membrane processes for refurbishing TVA power plant discharge waters to make them acceptable for reuse, basic studies, and evaluation if a test facility is desirable.
Keywords: power plants; thermal effluents; waste heat; control; screens; intake structures; cooling systems; water pollution abatement; thermal pollution; membranes.

150012 Fly Ash Characterization and Disposal for EPA. Flora, H.B. II. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4009. **Contract:** TV-4196A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA; EPA-$155,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Water Research Program has an Effluent Control Subprogram which has among others, an objective to investigate ashes and their effluents. The objectives of this project are to characterize ashes and their waste effluents, examine fly ash handling systems and problems associated with ash handling, and determine promising cost-effective systems to reduce disposal problems. The scope of this project includes summarizing available information on ashes and effluents, wet and dry handling system, and disposal and utilization of fly ash; characterizing ashes and effluents of several TVA plants; evaluation of handling systems; and determination of promising handling systems. Monies to carry out this project will be EPA pass-through funds.
Keywords: fly ash; waste management; fossil-fuel power plants; waste disposal; waste product utilization; materials handling; coal.

150013 Widows Creek Unit 8--Limestone Wet Scrubber. Wells, W.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$100,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The main objective of this project is to install a full-scale research and demonstration limestone wet scrubber on the 550-MW Widows Creek Steam Plant unit 8 for the purpose of removing both fly ash and SO2 from the stack gases. Also, another objective is to make an engineering and environmental evaluation of the system after the system is installed and operational. The scope of the project is to design, construct, operate, and evaluate a full-scale SO2 scrubber on the 550-MW unit 8 at Widows Creek Steam Plant. Evaluations concerned with the process chemistry, process optimization, engineering assessment, water quality effects, and air quality effects will be conducted. All major construction and design associated with the project is basically complete. Startup is underway and a tentative commerical date is December 31, 1977.
Keywords: fossil-fuel power plants; lime-limestone wet scrubbing processes; demonstration programs; fly ash; sulfur dioxide; flue gas; technology assessment; environmental impacts; evaluation; removal.

150014 SOx Technology. Wells, W.L.; Hollinden G.A. (TVA, 1170 Chestnut Street Tower, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology. **Funding:** TVA-$40,000.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the program are to ensure that TVA is informed on the state-of-the-art of SOx removal, that SOx removal projects are well defined, and that implementation of project plans is adequate. Work is in progress reviewing and commenting on advanced SOx removal, and assisting in developing and reviewing project plans for EPRI projects related to SOx removal. The scope of the program consists of reviewing and visiting advanced SOx removal systems and reviewing, developing, and commenting on proposals. Funds are not provided for an extensive experimental program.
Keywords: sulfur oxides; control; removal; air pollution control; fossil-fuel power plants.

150015 Characterization of Effluents from Caol-Fired Utility Boilers for EPA--Assessment of Gaseous Emissions from Different Boilers Task. Zielke, R.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4008.6. **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; EPA-$300,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Air Research Program has a Trace Elements and Hazardous Emissions Technology and Particulate Technology Subprogram which has as its objectives the task to identify the physical and chemical characteristics of combustion products leaving the stack of a coal-fired utility boiler, to relate the formation of combustion products to boiler operations, and to determine the effect of a highly efficient electrostatic precipitator and/or a limestone scrubber on the control of gaseous emissions. The scope of the tasks includes sampling the emissions from different boilers equipped with electrostatic precipitators or limestone scrubber and correlating the fly ash particle size, particle geometry, and chemical properties of the particulates and vapor phase trace elements to boiler operation. A sampling program has been conducted at Colbert and Kingston. Final testing at Widows Creek will be completed during the summer of 1978.
Keywords: fossil-fuel power plants; flue gas; coal; combustion products; electrostatic precipitators; scrubbers; sampling; fly ash; particle size; chemical properties; trace amounts; quantitative chemical analysis; boilers; air pollution control.

150016 Advanced Waste Heat Control for EPA. Flora, H.B. II. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4010. **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; EPA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant characterization and analysis.

The Water Research Program has an Effluent Control Subprogram and a Thermal Control Subprogram which have, among others, objectives to evaluate technologies to reduce thermal discharges and chemical effluents from power plants. The primary objectives of this project are to investigate and evaluate mechanisms for the reduction of intake structure effects at power plants, and to investigate the application of membrane technology for the treatment of effluents from a power plant. The scope of this project includes: (1) laboratory test on an intake system to reduce the entrainment of larval fish; (2) field test of a prototype wet/dry cooling tower system; and (3) laboratory test on various membrane technologies for their application to power plant effluents.
Keywords: power plants; thermal effluents; intake structures; cooling towers; design; fishes; entrainment; screens; waste heat; control; water pollution abatement.

150017 Fine Mesh Screening Alternatives for Power Plant Intakes. Tomljanovich, D.A. (TVA, Forestry Building, Ridgeway Road, Norris, TN, 37828). **Contract:** EPA-IAG-D8-E-721;TV-41967A. **Supported by:** Tennessee Valley Authority, Norris (USA). **Funding:** EPA-$60,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of this study are: (1) to determine the feasibility of using fine-mesh intake screening to reduce entrainment of ichthyoplankton; (2) to determine the optimal combination of mesh size, intake velocity and duration of exposure for a system to screen ichthyoplankton and obtain survival of same; and (3) to incorporate findings in the design of best available technology intake systems for steam-electric power plants. The approach is to (1) test flume studies to elucidate effects of fish size, mesh size (opening), velocity and duration of exposure on entrainment or impingement of ichthyoplankton; and (2) determine entrainment percentage and mortality of impinged fish under test conditions.
Keywords: thermal power plants; cooling systems; intake structures; impingement; screens; fishes; entrainment; design; appropriate technology; size; velocity; mortality.

150018 Ecological Recovery after Reclamation of Toxic Spoils Left by Coal Surface Mining. Zarger, T.G. (TVA, Division of Land and Forest Resources, Norris, TN, 37828). **Project number:** EPA ID No. 80 BDQ. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$67,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

A program is reported designed to determine the rate of recovery of a damaged ecosystem in response to intensive remedial treatment of a problem surface mine. The project involves a watershed in which approximately 162 hectares of forested land were disturbed by coal surface mining between 1970 and 1972. Unsuccessful reclamation efforts by the mine operator resulted in adverse environmental impacts within a 28-square kilometer watershed that includes a city water supply reservoir. The objectives will be accomplished by applying intensive remedial land treatments (TVA funds) and measuring the degree of recovery of the affected terrestrial and aquatic ecosystems to evaluate the effectiveness of the treatments. Data collected during the period of mining and early reclamation efforts will serve as baseline information. Monitoring (soil, vegetation, stream ecology) is being conducted through treatment period and will be continued thereafter on a more limited basis as long as significant recovery is noted. Results should provide new and significant information in the evaluation and correction of problems associated with future mining of a coal seam found extensively in east Tennessee.
Keywords: coal mines; surface mining; ecosystems; land reclamation; evaluation; contamination; environmental effects.

150019 Response of Freshwater Systems to Electric Power Production. Isom, B.G.; Murray, S.A.; Tennessen, K.J.; Dycus, D.L. (TVA, Fisheries and Aquatic Ecology Branch, E and D Building, Muscle Shoals, AL, 35660). **Project number:** 80BDR. **Supported by:**

Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$314,000.
Related energy source: Coal(70); nuclear fusion(30) **R and D categories:** Environmental effects assessment.

Task 1 will help identify research priorities and make recommendation for future research. The planning and integration task will result in periodic collection, synthesis, and publication of decision-making information. Publications resulting from this task will focus on national issues and problems, such as siting multiple power plants on a single body of water, thermal effects, identification of critical habitat, the refinement of water quality criteria, standards, and relevant design constraints for energy systems.
Keywords: decision making; power plants; electric power; power generation; thermal pollution; water pollution; water quality; energy policy; environmental policy.

150020 Production of Arthropod Pests and Vectors in Strip-Mine Ponds. Pickard, E. (TVA, E and D Building, Muscle Shoals, AL, 35660). **Project number:** EPA-IAG-D8-E721-DT. **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$31,000.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The study is designed to determine what species of medically important arthropods, particularly mosquitoes, are breeding in coal strip-mine ponds and to what extent, and whether these breeding sites will serve as a focus of annoyance or a potential outbreak center of arthropod borne diseases to surrounding communities. Emphasis of study involves a comparison of pond age with physical and chemical characteristics of the water and associated vegetation communities. Mosquito larvae of four genera including eight species have been collected from 9 strip-mine study ponds.
Keywords: surface mining; mosquitoes; insects; animal breeding; ponds; water pollution; larvae.

150021 Thermal Effluent Computer Modeling Research. Waldrop, W.R. (TVA, Engineering Laboratory, P.O. Drawer E, Norris, TN, 37828). **Contract:** EPA-IAG-D8-E721. **Supported by:** Tennessee Valley Authority, Norris (USA). **Funding:** EPA-$27,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Environmental effects assessment.

The objective is to extend and verify theoretical computer models of thermal effluents from power generating plants. One model to be used is a two-dimensional, laterally averaged, unsteady finite difference simulation of an entire reservoir. The model is designed to accommodate hourly changes in boundary conditions consisting of dam discharges, tributary inflow conditions, power plant intake and discharge conditions, river inflow rates and temperatures, meteorology and wind velocity. The other model is a three-dimensional, unsteady finite difference simulation of a reservoir in the vicinity of a power plant. With this model, small-scale geometry effects can be modeled with greater accuracy than can be done with the two-dimensional model. TVA has been investigating these phenomena for a number of years and, from numerous field and laboratory investigations, has amassed a large amount of data on thermal effluents under a variety of flow and meteorological conditions. This data base allows model results to be readily compared with measured data for the same river flow and meteorological conditions, thereby enabling the development of models which work for a variety of weather conditions, and reservoir and power plant operational patterns.
Keywords: fossil-fuel power plants; nuclear power plants; thermal effluents; mathematical models.

150022 Develop Economic Projection Modeling Capability Necessary to Drive Modular Energy and Environmental Planning Models at a Multicounty Level. Nakosteen, R.A. (TVA, 270 Liberty Building, Knoxville, TN, 37902). **Project number:** 79 BDV 130063. **Contract:** EPA-IAG-D7-E721. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Environmental Engineering and Technology. **Funding:** EPA-$74,000.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment.

As a part of its ongoing economic research program, TVA is in the process of developing a Regional Economic Simulation Model of the TVA region and its principal subregions. The objectives of the present work are to expand the existing model for use in: (1) assessing an area's sensitivity to various national parameters; (2) evaluating the impact in small areas (economic area or multicounty planning area) on population, labor force, employment, etc. of a major construction activity, e.g., construction of a large nuclear energy plant; and (3) providing the macroeconomic data base at a multicounty level that is necessary for rigorous site specific analyses.
Keywords: tennessee valley authority; regional analysis; socio-economic factors; energy facilities; employment; labor; mathematical models; planning; environmental impacts; economic impact; tennessee valley region.

150023 Isolation and Identification of Water-Borne Pollutants Associated with the Power Industry (Steam-Electric Power Generation). Howe, L.H. III. (TVA, Laboratory Branch, 401 Chestnut Street, Chattanooga, TN, 37401). **Project number:** 80 BDH. **Contract:** D9-E721-DH. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$44,000.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

The purpose of these tasks is to scientifically develop, evaluate, and/or validate the following analytical methods and/or instruments for measuring pollutants with the goal of providing a scientifically valid reference point for pollutants from which future environmental degradation may be measured and the magnitude of specific energy development determined. Major tasks include: (1) evaluation of acrolein by voltammetry at positive potentials; (2) evaluation of total arsenic by voltammetry and comparison to atomic absorption and colorimetry; (3) evaluation of cadmium, lead, copper, and zinc simultaneously by voltammetry; (4) development and evaluation of digestion techniques for suspended and dissolved metals by atomic emission plasma and referenced to atomic absorption; (5) evaluation of chromium (hexavalent and trivalent) simultaneously by voltammetry or ion chromatography; (6) development and evaluation of extractable organic pollutants in sediments; (7) verification of EPA methods for measuring metals in fish tissue; and (8) development and evaluation of ion selective electrode chlorine analyzer.
Keywords: water pollution; monitoring; acrolein; arsenic; cadmium; lead; copper; zinc; chromium; organic compounds; voltametry; absorption spectroscopy; metals; fishes; tissues; water chemistry; fossil-fuel power plants; environmental impacts.

150024 Processing Sludges from Lime/Limestone Wet Scrubbing Processes for Disposal or Recycle for EPA: Revegetation of SO2 Waste Disposal Ponds Task 5. Duggan, J.C. (TVA, 1050 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4007.5. **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$70,000.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

Activities are reported in a program designed to demonstrate an economically and environmentally acceptable alternative to the problem of ultimate disposal by developing management techniques for ponded sludge to produce a medium that will support beneficial vegetation and enhance stabilization of the disposal ponds. Through greenhouse, field, and rhizotron lysimeter studies potential agronomic uses of the sludge and related aspects will be examined. Methods for establishing various types of vegetation for stabilization of ponded scrubber sludge will be demonstrated through field studies. Initial greenhouse studies have been completed and small field plot work is now underway.
Keywords: sludges; economics; waste processing; ponds; stabilization; research programs; scrubbers; flue gas; greenhouses; agriculture; fertilizers; sulfur dioxide; sulfur dioxide; recycling; production.

150025 Characterization of Effluents from Coal-Fired Utility Boilers for EPA. Flora, H.B. II. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA-$604,000; EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

Programs are reported that are designed to characterize and evaluate fossil-fuel plant effluents and develop various mechanisms to treat the effluents to meet promulgated or proposed limitations emphasizing effluent streams from coal-fired power plants. The objective of the project is to characterize effluent streams from coal-fired power plants by performing many days of sampling. Samples will be analyzed both qualitatively and quantitatively. Power plants with different coal sources will be investigated.
Keywords: fossil-fuel power plants; liquid wastes; waste processing; monitoring; sampling; chemical analysis; coal.

150026 Advanced Combustion Technology, General. Mayfield, M.J. (TVA, 1020 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 988-15-990-1035. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

Programs are being conducted to maintain a current, comprehensive knowledge of advanced combustion technology and to identify and explore advanced technology which shows promise. An assessment is to be made of the state of development, technical, economic, and environmental issues, and applicability to TVA power system. Recommendations are to be made concerning TVA participation in research projects to develop especially promising technologies. Planned are staff reviews, assessments (including consulting services), project advancement, and participation in industry and/or government working groups in the area of advanced combustion technology. Review and evaluation of research and develop-

ment related to advanced combustion and assessing the potential for application to the TVA power system are on-going continuous functions of the Energy Demonstrations and Technology Staff. Reviews thus far have led to the identification of atmospheric fluid bed combustion (AFBC) as a very promising near- to mid-term alternative to conventional powerplants with flue gas scrubbing. **Keywords:** fluidized-bed combustion; research programs; technology assessment; combustion; flue gas; scrubbing.

150027 Fluidized Bed Waste Utilization Project. Duggan, J.C. (TVA, 1050 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 988-15-990.1066. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology. **Funding:** TVA-$10,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

A program is reported designed to demonstrate economically and environmentally acceptable alternatives to landfilling FBC waste; to evaluate the effects of land application of FBC waste for reclamation and agricultural crop production; and to test the suitability of using FBC waste as aggregate in the construction industry. Through greenhouse, field, and rhizotron lysimeter studies, potential agricultural uses of FBC waste will be explored. Physical and chemical changes resulting from application of various rates of FBC waste on selected soils and crops will be made. Fate of heavy metals leaching from the soil/FBC substrate and uptake by crops will be investigated. Laboratory studies will be conducted to determine suitability of FBC waste for road base, aggregate, land reclamation. If these tests are successful, then large scale studies will be initiated. Previous small scale studies by TVA have indicated potential benefits of FBC waste as a limiting agent and a source of sulfur for crops. **Keywords:** fluidized-bed combustion; residues; waste product utilization; agriculture; construction industry; metals; leaching; roads; land reclamation.

150028 Thermogravimetry (TG) for Coal Combustion. Badin, E.J. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-620.01. **Contract:** TV-49235A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$19,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are to conduct TGA experiments to determine chemical additives for an SO2-sorbent which will reduce the molar ratio of Ca/S now projected as required for FBC, and to define emissions from the best method found to reduce the CA/S ratio. The approach to be used will be: (1) conduct TGA experiments using limestone/lime and coal; (2) conduct experiments using limestone/lime, coal, and additives; (3) evaluate the data from the experiments to define the best additive for SO2-sorbency; and (4) conduct additional TGA experiments with the best additive to measure and evaluate emissions from the process.
Keywords: sulfur dioxide; adsorption; calcium compounds; sorptive properties; thermal gravimetric analysis; calcium; sulfur; lime-limestone wet scrubbing processes; additives; research programs; calcium sulfates.

150029 Recovery of Nitrogenous Byproducts from Flue Gas. Kee, B.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.07. **Contract:** TV-52401A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Programs are reported that are designed to develop emission control methods or processes for use on full-size electric generating facilities to meet standards and/or regulations. The primary objective of the recovery of nitrogenous byproducts from flue gas project is to evaluate and assess processes which will remove pollutants from flue gas and convert them to useful byproducts. A second objective of this project is to make an effort to conserve the natural gas supply by investigating alternate methods of producing useful nitrogenous products (presently made from natural gas). A technology assessment on converting nitrogen oxides to nitrogenous byproducts will be made with major emphasis on experience with flue gas operation. A conceptaul design and cost estimate on the best system(s) will then be made for a pilot plant at the 1 to 2 Mw size and for a full scale plant of 500 Mw. After the conceptual design and cost estimates are completed, one process will be selected and a pilot plant will be built and operated to prove the process is applicable to power systems.
Keywords: fossil-fuel power plants; pollution control equipment; research programs; flue gas; nitrogen compounds; denitrification; recovery; uses.

150030 Synthetic Fuels--General. Siegel, G.R. (TVA, 1360 Commerce Union Bank Building , Chattanooga, TN, 37401). **Project number:** 942-521.03. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: Coal(30); oil and gas(20); oil shale(20); solar(30) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

A program is reported designed to follow research, development, demonstration, and production programs related to the manufacture of fuels from raw materials available in the TVA region and to assess the potential application of these fuels to the TVA power system and to regional fuel applications. The program includes efforts to evaluate research, development, and production progress related to the above technologies and assess the technical and economic feasibility of utilizing synthetic fuels in the TVA power system and in regional fuel applications. Consultants may be hired to accomplish some specific task assignments. This project includes, but is not restricted to the following synthetic fuels: hydrogen, charcoal, coke, ketones, and the following raw materials: water, wood, and municipal waste.
Keywords: tennessee valley authority; southeast region; research programs; synthetic fuels; raw materials; hydrogen; charcoal; coke; ketones; water; wood; municipal wastes.

150031 Economic Comparison of the DOWA and Thoroughbred 121 SO2 Removal Processes. Wells, W.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 988-15-990.1061. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Both of these processes are double alkali processes that produce gypsum, which is a stable waste product and has the option of being saleable or stockpiled. The economics of the two processes will be compared with the economics previously calculated for other SO2 removal processes. In this way, a more realistic estimate of the relative merits of these double alkali processes can be made. The base for the cost estimates previously performed by TVA will be revised for this cost estimate. The cost estimates can then be compared to determine the most attractive systems. These numbers are not absolute and cannot be used for budgeting purposes but can be used in confidence for cost comparison. The necessary information for the cost estimate of each of these processes has been gathered. An earlier estimate on DOWA was performed using old design premises.
Keywords: pollution control equipment; sulfur dioxide; removal; tennessee valley authority; flue gas; desulfurization; cost; comparative evaluations; scrubbing.

150032 Evaluation of the DOWA SO2 Scrubbing System. Crowe, J.L. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.10. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology. **Funding:** TVA-$150,000; EPRI; UOP/DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

An SOx technology subprogram is reported which has, among others, an objective to develop, through research, emission control methods or processes for use on full-size electric generating facilities to meet standards and/or regulations. The DOWA scrubbing project which is a part of the SOx technology subprogram is designed to evaluate a promising new SO2 removal process at the 10-Mw level which allows adequate confidence in extrapolating to a full-scale size. Another phase of the project is designed to evaluate advantages of the DOWA scrubbing process over conventional lime/limestone processes in areas such as economics, high SO2 removal efficiencies, gypsum production rather than sludge, etc., while conducting the 10-Mw testing. The 10-Mw TCA scrubber train at the Shawnee pilot plant will be modified to accommodate the designed DOWA scrubber and accompanying equipment as part of an EPRI/TVA/DOWA project. Tests will be conducted to evaluate the performance of the DOWA double alkali process with flue gas obtained from coal-fired boilers. The process has operated well on relatively clean gas--oil fired boiler and acid plant offgas. The results from the 10-Mw testing will be used in evaluating the process as an alternative to lime/limestone scrubbing for meeting standards and/or regulations at full-scale electric generating facilities. The DOWA double alkali scrubbing process was developed for SO2 removal from acid plant tail gas. Besides this application, the DOWA process has been applied to a 40-Mw oil-fired boiler for the Naikai Company in Japan. DOWA is currently negotiating with potential U.S. licensees.
Keywords: fossil-fuel power plants; flue gas; sulfur dioxide; removal; desulfurization; tennessee valley authority; pollution control equipment; evaluation; economics; scrubbing.

150033 Beneficial Uses of Waste Heat: Industrial and Residential Uses. Snipes, R.L.; Goss, L.B. (TVA, 1060 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** E236-971-15-130.05. **Contract:** TVA-39614A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$35,000.

Related energy source: Coal(20); oil and gas(10); oil shale(10); nuclear fission(20); nuclear fusion(10); solar(10); geothermal(10); hydroelectric(10) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The Waste Heat Utilization Project is designed to evaluate and develop waste heat utilization technology. The primary objective of this project is to evaluate the potential for industrial and residential uses of power plant waste heat. This project initially involves the review and evaluation of the current technology for utilizing power plant condenser cooling water in industrial and residential processes. Further investigation and assessments will be made on any of these processes that prove to be potential uses of the waste heat. These investigations will include argumentation systems that could upgrade the waste heat into a more readily usable form. **Keywords:** waste heat utilization; technology assessment; residential buildings; industrial plants; thermal power plants; reviews; evaluation; waste heat.

150034 Physical and Chemical Coal Cleaning: General. Smith, S.R.; Thomas, W.A. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-670.08. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$45,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are: (1) to follow research, development, and demonstration programs related to the removal of ash and/or sulfur from coal and the potential subsequent use of the treated coal as boiler fuel; (2) to assess potential application to the TVA power generation system; and (3) to recommend, where appropriate, TVA participation in research and development projects to develop especially promising technologies. Research, development, and demonstration programs related to the above coal cleaning technologies are evaluated, and the technical and economic feasibility of utilizing the cleaned coals in the TVA power system is assessed. Review and evaluation of coal cleaning processes and the potential application of cleaned fuels to the TVA power system are on-going functions of Energy Research. An analysis has been completed on the washability of coals supplied to Paradise Steam Plant. Results indicate these coals can be washed to meet a 5.2 lb SO2/MM Btu emission standard with approximately a 10% Btu loss. Status reports will be prepared as appropriate. An internal TVA report assessing washability of Paradise coals is available from Energy Research upon request.
Keywords: coal; cleaning; deashing; desulfurization; technology assessment; economics; tennessee valley authority; boiler fuel; washing; sulfur; fossil-fuel power plants.

150035 Environmental Studies of Coal Cleaning Processes. Thomas, W.A. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4021. **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; EPA-$79,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives are (1) to explore the potential environmental effects of coal cleaning equipment and processing proposed to prepare coal for TVA's use; (2) to search for methods of improving the effectiveness of the pollution controls proposed for the coal cleaning plants; and (3) to assess alternative waste disposal methods. This will be accomplished through a review of the existing subject literature. The historical projects relating to coal cleaning have addressed ash removal efficiency; however, they have failed to fully explore the impact on the environment of disposing of the cleaning residue or the environmental effects of operating the processing equipment. Milestone reports will be prepared at the completion of each task of the project with status reports prepared as appropriate.
Keywords: coal preparation plants; environmental impacts; pollution control; waste disposal; cleaning; sulfur.

150036 TVA/EPRI/APS Ionizer Project. Frank, R.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.01. **Contract:** TV-50444A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$900,000; EPRI-$50,000.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objectives of this cooperative project are: (1) through pilot testing (a) define the function of the ionizer in real stack gases, (b) determine the efficiency and reliability of the ionizer, and (c) characterize the ionizer-pilot ESP system by parametric testing; (2) perform a conceptual design and cost estimate for applying an ionizer system at one unit of a TVA steam plant; (3) perform a preliminary design and cost estimate for applying ionizer technology to one duct of a unit of a TVA steam plant; (4) design and install an ionizer system on one duct of a unit at Shawnee; and (5) demonstrate by operation of an ionizer system (75-Mw) on one duct of one unit at Shawnee Steam Plant, the technical feasibility and cost-effectiveness of using an ionizer system. Draft report of the John Sevier pilot studies has been submitted by APS to TVA for review. The final report incorporating TVA's comments is under preparation by APS. A paper is also under preparation jointly by Energy Research and EPRI for presentation at the AIChE National meeting next June. **Keywords:** fossil-fuel power plants; flue gas; particles; electrostatic precipitators; performance testing; pilot plants; cost; demonstration programs; technology assessment; cost benefit analysis; fly ash; ionization.

150037 EPRI-AEIC Electric Water Heating Study. Fox, H.B. (TVA, 210 Power Board Building, Chattanooga, TN, 37401). **Contract:** RP-1101-1. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPRI; TVA.
Related energy source: conservation(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The research objectives of this study are threefold: (1) to develop basic climatological water heating data representative of different climates; (2) to develop a simulation model of electric water heater performance that is sufficiently general to be used by any electric utility; and (3) to use the simulation model to investigate the impact on electric utility systems of alternative rates of electric water heating saturation. A total of ten residential customers of the Electric Power Board of Chattanooga, Tennessee, will be selected. The selected customers will meet the following critera: (1) use an uncontrolled quick-recovery 2-element (4.0 kW each or larger) electric water heater of 40 to 120-gallons capacity as the exclusive source of domestic hot water supply; (2) use only one water heater; (3) have an electric dishwasher and automatic clothes washer; and (4) reside within a 25-mile radius of the weather monitoring station. The customers that seem to meet the aforementioned criteria will then be interviewed to collect pertinent information. The Chattanooga Electric Power Board will be responsible for prestudy contacts with potential customers. Once a customer agrees to participate, the Electric Power Board will be responsible for installing two 4-channel magnetic tape recorders provided by EPRI and one 2-channel magnetic tape recorder provided by TVA. The Electric Power Board will be reimbursed by TVA for the installation and removal cost of test equipment to include the weather monitoring station and any maintenance of equipment during the 1-year test. TVA also will provide a cash incentive of $50 at the beginning and end of the study to each customer. Information regarding the factors influencing electric water heater energy use and the potential effects of solar domestic water heating on utility systems will be results of the project.
Keywords: water heaters; hot water; power demand; performance; electric appliances; data acquisition; monitoring; solar water heaters; cost; tennessee valley authority; rate structure; power meters; residential buildings.

150038 Economic Study of NOx Removal Processes. Maxwell, J.S.; Kee, B.F. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 130013. **Contract:** TV-47770A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA; EPRI-$17,000; EPA.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

This preliminary study will develop investment and operating costs for dry NOx removal processes. The processes of concern are the NH3 injection types using both catalytic and non-catalytic approaches. In addition, an estimate of the likely cost of ammonia over the next 15 years will be made. Using information obtained from public sources and utilities, preliminary cost estimates will be made on catalytic and non-catalytic NOx removal processes using NH3 injection. Since ammonia production would need to be increased for the full scale processes, an estimate of the availability and cost of ammonia over the next 15 years will be necessary.
Keywords: fossil-fuel power plants; flue gas; denitrification; nitrogen oxides; removal; ammonia; injection; production; availability; forecasting; cost; catalysis; economics; air pollution control.

150039 TVA/EPRI Cocurrent Scrubber at Shawnee: Operation. Crowe, J.L.; Wells, W.L. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 011-15-4027. **Contract:** TV-46803-A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; EPRI-$40,000; DOE.
Related energy source: Coal(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective of this project is to design and construct a cocurrent scrubbing system at the Shawnee Advanced Scrubbing Test Facility. The cocurrent scrubber will be designed to scrub a flue gas flow equivalent to 10 Mw of coal-fired boiler generating capacity. This scale permits the results to be readily transferred to utility practice. Task 1 of this project covers project coordination to assure that the goals are accomplished on schedule, within budget, and to the satisfaction of TVA. The idle Hydro Filter train at the Shawnee test facility will be modified to accommodate the cocurrent scrubbing system. Design information is based on data received from the Colbert pilot plant tests and the equipment available at Shawnee. Project coordination will involve assistance in the design of the

scrubber and interpretation of results, coordinating the efforts of all parties involved, and insuring that reports are prepared and properly evaluated. Pilot plant tests have indicated good SO2 removals at high gas velocities with minimal operating problems. Design and construction of the prototype scrubber has begun.
Keywords: fossil-fuel power plants; scrubbers; design; flue gas; desulfurization; sulfur dioxide; removal; construction; lime-limestone wet scrubbing processes; sulfur oxides.

150040 Electric Field Data for 500-kV Transmission Lines. Hilson, D.W. (TVA, 1150 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-531.06. **Contract:** 011-15-4040. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$53,000.
Related energy source: Coal(40); nuclear fission(30); hydroelectric(30) **R and D categories:** Pollutant monitoring.

Under an interagency agreement with the Department of Energy, TVA will measure electric field profiles and audible noise under and along the edge of the right-of-way of the 500-kV lines over a wide range of geographical and atmospheric conditions. The data will be used in various biological and psychological studies being conducted by DOE. TVA's Division of Energy Demonstration and Technology will provide overall project management. Field measurements were begun in January 1980.
Keywords: ehv ac systems; noise; electric fields; behavior; biology; power transmission lines.

150041 Advanced Regenerable Scrubbing Systems: 1 Mw Colbert Plant. DeGugman, J.S.; Wells, W.L. (TVA, 1040 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.11. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology. **Funding:** TVA-$20,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

Development of an advanced regenerable flue gas desulfurization process may provide a preferable (economical and reliable) system over those currently available. The major advantage of regenerable scrubbing is the production of a saleable product--sulfur or sulfuric acid--rather than a useless sludge waste as in a limestone system. The objective of this project is to evaluate promising systems for prospective funding by outside contractors for small scale demonstrations of these systems. At the request of contractors, Energy Research will aid in the determination of the feasibility of advanced regenerable scrubbing systems and prepare proposals for demonstration of these systems at the pilot and prototype scale. EPRI has recently completed a feasibility study of several systems and subsystems. The systems proposed for study are ready for 1-Mw demonstration.
Keywords: fossil-fuel power plants; flue gas; desulfurization; scrubbers; feasibility studies; demonstration programs; economics; reliability; regeneration; sulfur; sulfuric acid; recovery; coal.

150042 Assessment of Terrestrial Impacts Associated with Power Operations. Brellenthin, J.B. (TVA, 1110 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-650.06. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The Biological Research Program has an Assessment of Biological Impacts and Methods for Alleviation Subprogram which is designed to determine acceptable levels of discharges from power facilities for protection of biota and to develop methods to alleviate adverse biological impacts. This project is designed to assess terrestrial impacts associated with power operations and determine acceptable levels of impacts. A review of studies to determine terrestrial impacts associated with normal operation of power facilities will be conducted. Biological studies associated with new equipment and methodologies such as scrubbers will be developed and coordinated.
Keywords: fossil-fuel power plants; nuclear power plants; environmental impacts; biological effects; gaseous wastes; liquid wastes; solid wastes; radioactive effluents; scrubbers; animals; plants.

150043 Characterization and Treatment of Priority Pollutants from Coal Pile Drainage. Ogle, K.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.15. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Water Research Program has an Effluent Control Subprogram which has, among others, an objective to evaluate the chemical composition of various effluent discharges from a fossil-fired power plant. The primary objective of this project is to obtain data on the organic composition of coal pile drainage in order to improve our knowledge of the potential environmental hazards of these constituents. The scope of the program includes collecting runoff samples from several TVA coal-fired power plants and having the samples analyzed by specified procedures. The specific compounds of interest will be delineated by contacting the EEI-Utility Water Act Group, Priority Pollutants Task Force to determine where the industry stands in their negotiations and cooperative effort with EPA. After the compounds of interest have been specified runoff samples will be collected for analysis. A review has indicated that EPA is examining this effluent stream with the potential of setting standards on particular chemical compounds in this runoff.
Keywords: coal; leaching; organic compounds; water pollution; chemical composition; sampling; fossil-fuel power plants; pollution regulations.

150044 Pilot Testing to Assess Prediction of Scale Formation in Recirculating Evaporative Cooling Systems. Boroughs, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 988-15-990.1058. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$65,000.
Related energy source: nuclear fission(50); nuclear fusion(50) **R and D categories:** Pollutant characterization and analysis.

The Water Research Program has a Thermal Control Subprogram and an Effluent Control Subprogram which include in their objectives the assessment, demonstration, and optimization of technology for control of thermal and non-thermal effluents, respectively. The objective of this project is to provide field data from a pilot cooling tower system in order to augment and strengthen other methods of predicting the precipitation of calcium carbonate scale. These predictions are used to define the upper and lower bounds of makeup and blowdown flows from recirculating cooling tower systems. A pilot cooling tower will be operated under a variety of carefully controlled conditions while the CO2 balance pH changes and other pertinent parameters are carefully observed. These data will be analyzed to determine the relationship between cooling water pH and other parameters. The pilot cooling system may then be moved to several proposed or existing plant sites where variations in pH and CaCO3 precipitation will be observed as a function of concentration factor and other variables which were identified as important during the first (parametric) phase of the study. Quarterly progress reports and milestone reports will be made available. A final report will present field data from the pilot tower and will describe the relationship between cooling water pH and other parameters.
Keywords: cooling systems; technology assessment; thermal effluents; cooling towers; calcium carbonates; pilot plants; scale control; scaling; ph value; thermal power plants; deposition.

150045 Development of Model to Predict Scale Formation in Closed Cycle Water Systems. Boroughs, R.D.; Tielke, R.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 988-15-990.1048. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$20,000.
Related energy source: Coal(40); oil and gas(30); oil shale(30) **R and D categories:** Pollutant characterization and analysis.

The Water Research Program has a Thermal Control Subprogram and an Effluent Control Subprogram which include in their objectives the assessment of technology for control of thermal and nonthermal effluents, respectively. The objective of this project is to provide the necessary chemical equilibrium modeling support for both program areas. This will enable more accurate assessment of the potential for scale formation in recirculating cooling and ash sluice systems. Equilibrium modeling can also improve predictions of unit process performance such as softening, reverse osmosis, etc. The scope of this project will be to review existing computer codes for modeling chemical equilibria and identify areas for improvement. A model will be selected and/or developed, tested, and modified to suit anticipated needs within TVA. The model and technical data will be used as support for other projects, e.g., Fly Ash Characterization and Disposal (task-water reuse) and Prediction of Scale Formation in Recirculating Evaporative Cooling Systems.
Keywords: thermal effluents; cooling systems; thermal power plants; closed-cycle cooling systems; fly ash; scale control; performance; technology assessment; computer codes; scaling; mathematical models.

150046 Study of Methods for Monitoring Chlorinated Discharges. Seaman, C.V. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.12. **Contract:** TV-48227A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: nuclear fission(50); nuclear fusion(50) **R and D categories:** Pollutant monitoring.

The Water Research Program has an Effluent Control Subprogram which has, among others, an objective to test and/or develop, through research, methods of monitoring the magnitude of chlorinated discharges from once-through cooling systems and cooling tower blowdown. The methods of monitoring must be able to consistently and accurately measure low residuals of free and/or total chlorine which is necessary to comply with NPDES chlorinated water effluent guidelines. The scope of this project is to study

different methods for the analysis of free and total residual chlorine. Laboratory and field experiments will be necessary for the study of intermittent measurement techniques. Field experiments will be necessary for on-line continuous monitoring techniques. A study of the mechanisms of the reactions involved in the different methods is also included. Laboratory experiments have been performed. Mechanisms of reactions for the methods used in the laboratory experiments have been studied. A report summarizing the results of experiments with intermittent monitoring, continuous monitoring, and mechanisms of reactions will be published.
Keywords: monitoring; once-through cooling systems; chlorine; cooling towers; blowdown; thermal effluents; thermal power plants; chemical analysis; on-line control systems.

150047 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project. Wells, W.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 988-15-990.1051. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$1,055,000.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The following seven task forces are included in the TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project: (1) Project Management; (2) Report on Scrubber Starting; (3) Process Evaluation; (4) Process Improvement and Optimization; (5) Sludge Treatment Demonstration and Evaluation; (6) E15 Environmental Evaluations; and (7) Chemical Data Gathering and Analysis. Results from the Colbert and Shawnee Sludge disposal test in regard to the Widows Creek project have been reported and are available. There are daily, weekly, and monthly reports available concerning the Chemical Data Gathering and Analysis task force.
Keywords: fossil-fuel power plants; lime-limestone wet scrubbing processes; evaluation; optimization; sludges; waste processing; environmental impacts; scrubbers; flue gas; desulfurization.

150048 Minimization of Impacts Associated with Power Plant Raw Water Usage. Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6031. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$155,000.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); nuclear fusion(25) **R and D categories:** Pollutant monitoring.

The Biological Research Program has an Assessment of Biological Impacts and Methods for Alleviation Subprogram designed to determine acceptable levels of impacts from power facilities for protection of biota and to develop methods to alleviate adverse biological impacts. This project is designed to assess the nature and extent of impacts associated with raw water usage by power plants and to develop technologies for minimizing any adverse impacts associated with this water usage. A state-of-the-art review will be conducted on power plant raw water intake systems. From this review a research effort will be formulated to develop technologies at existing and future TVA generating facilities to minimize any adverse impacts associated with raw water intakes and usage. A preliminary state-of-the-art review has been conducted.
Keywords: thermal power plants; condenser cooling systems; intake structures; water requirements; environmental impacts; aquatic ecosystems; aquatic organisms; impingement; biological effects.

150049 Waste Heat Utilization: Greenhouse Environmental Control. Madewell, C.E. (TVA, Agricultural Resource Development Branch, Muscle Shoals, AL, 35660). **Project number:** 3071, 3236. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The project objectives are to develop, test, and demonstrate systems to use waste heat as an alternate heat energy source for greenhouses and to transfer technology and provide technical assistance to commercial users. Technical and economic feasibilities of heating greenhouses with specially designed heat exchangers and low temperature condenser cooling water will be evaluated. Crop production in waste heat greenhouses will be demonstrated. Technical assistance to commercial users will be provided. An experimental direct contact heat exchange system using 70 degrees F water has been shown to be technically feasible in a pilot-scale greenhouse. A 25,000-sq-ft commercial-scale demonstration greenhouse has been operated at the Browns Ferry Nuclear Plant since January 1979. Two heat exchange systems using waste heat are being tested and compared to a conventional heat exchange system. The systems have performed near design expectations, and crops of tomatoes and cucumbers have been successfully grown. Horticultural engineering and economic evaluations are underway to refine the systems and to establish technical and economic feasibilities.
Keywords: nuclear power plants; condenser cooling systems; thermal effluents; waste heat utilization; greenhouses; heating systems; heat exchangers; feasibility studies; economics; crops; productivity; technology transfer; commercialization.

150050 Waste Heat Utilization: Biological Recycling of Nutrients from Livestock Wastes. Madewell, C.E. (TVA, Agricultural Resource Development Branch, Muscle Shoals, AL, 35660). **Project number:** 3071. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** TVA; EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The project objectives are to develop, test, and demonstrate commercial applications of the use of waste heat in the production of filter-feeding fish, waterchestnuts, and methane gas. Livestock manures will be used as the organic substrate-fertilizer in these applications. Specific objectives include: (1) developing the biological and engineering-design criteria to optimize the recovery of waste nutrients and energy; (2) conduct detailed economic feasibility studies; (3) design, construct, and evaluate pilot-scale recycling and associated facilities; and (4) provide technical assistance to commercial waste heat users as well as to nonwaste heat users (farm applications). The potential for using waste heat to enhance production of fish and macrophytes as well as methane gas will be assessed. In addition, an assessment will be made of the potential for using these applications in nonwaste heat situations (onfarm applications). These biological systems will be evaluated for their potential impact on traditional agricultural production and for their application as alternatives to conventional waste treatment systems. Assessments indicate that fingerling production, food fish production, and production of aquatic macrophytes have considerable potential for beneficially utilizing waste heat.
Keywords: waste heat utilization; agriculture; aquaculture; domestic animals; manures; methane; nutrients; feasibility studies; technology transfer; commercialization; economics.

150051 Waste Heat Utilization: Crop Drying. Madewell, C.E. (TVA, Agricultural Resource Development Branch, Muscle Shoals, AL, 35660). **Project number:** 3071. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The project objectives are to develop, test, and demonstrate commercial application of the use of waste heat for crop drying. Specific objectives include: (1) establish the potential for using waste heat for agricultural crop drying; (2) develop heat exchange and drying systems capable of using waste heat; (3) construct and evaluate a pilot-scale crop drying system using waste heat; and (4) provide technical assistance to potential users. The potential for using waste heat for drying agricultural crops within the TVA region will be assessed. The extent and geographic concentration of conventional drying systems will be determined, as will temperature requirements, heat quantities, and seasonality of drying for major crops that require drying. Heat exchange systems will be selected and evaluated for technical and economical feasibility. A pilot-scale grain drying facility will be constructed and evaluated at an operating power plant. A preliminary assessment has been conducted to establish the extent of crop drying within the TVA region and the type of drying systems offering the greatest potential for waste heat utilization.
Keywords: thermal power plants; condenser cooling systems; thermal effluents; waste heat utilization; agriculture; dryers; crops; drying; feasibility studies; economics; technology transfer; commercialization; heat exchangers; demonstration plants.

150052 Waste Heat Utilization: Environmental Control for Livestock Facilities. Madewell, C.E. (TVA, Agricultural Resource Development Branch, Muscle Shoals, AL, 35660). **Project number:** 3071. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The project objectives are to develop, test, and demonstrate commercial application of the use of waste heat for environmental control in livestock housing. Specific objectives include: (1) develop and evaluate heat exchange systems that are capable of utilizing waste heat in livestock facility heating; (2) conduct detailed economic, engineering, and cultural assessments; and (3) design, construct, and evaluate a pilot-scale livestock facility using waste heat. The potential for using waste heat to provide supplemental heat for livestock facilities in the TVA region will be assessed. This will include determining current usage of conventional heating systems in existing production facilities. Specific temperatures, total heat requirements, and other heating criteria will be determined for different livestock production enterprises. Assessments have indicated that poultry brooding and swine farrowing facilities offer greatest potential for heating with waste heat. Conventional and solar energy use system appears to offer possibilities for using waste heat with minor alterations.
Keywords: thermal power plants; condenser cooling systems; thermal effluents; waste heat utilization; heating systems; animal shelters; heat exchangers; feasibility studies; economics; technology transfer; commercialization.

150053 Waste Heat Utilization: Soil Heating to Extend Crop Growing Season. Mays, D.A. (TVA, Soils and Fertilizer Research Branch, TVA F137 National Fertilizer Development Center, Muscle Shoals, AL, 35660). **Project number:** 3071. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** TVA; EPA.
Related energy source: conservation(100) **R and D categories:** Pollutant monitoring.

The project objectives are to investigate soil heating as a crop production resource and to assess the feasibility of using the waste heat in power plant condenser cooling water for soil heating. Open-field and greenhouse soil heating experiments will be performed to evaluate the effects of the following variables: distribution line size; lateral spacing and burial depth; temperature of heating water; and species and cultivars of crop plants. Research conducted thus far has shown that crop yields can be increased somewhat by soil heating and that maturity is hastened. However, installation costs appear to be in excess of 5000 dollars per acre and it appears unlikely that crop yield increases will be sufficient to recover that investment. Open-field soil heating will be concluded during FY 1980.
Keywords: thermal power plants; condenser cooling systems; thermal effluents; waste heat utilization; agriculture; soils; heating; bench-scale experiments; greenhouses; field tests; crops; productivity; cultivation techniques; feasibility studies; economics.

150054 Integrated Environmental Assessment of Biomass. Bohac, C.E.; Hickey, H.R. (Tennessee Valley Authority, Applied Research Staff, 375 401 Bldg., Chattanooga, TN, 37401). **Project number:** 017-25-2411. **Contract:** TV-50447A-SA-104. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Environmental Engineering and Technology. **Funding:** EPA; TVA.
Related energy source: solar(100) **R and D categories:** Pollutant monitoring.

An integrated environmental assessment of the use of biomass for energy in the Tennessee Valley Region will be conducted in three tasks. Task I is a macro-level planning study of the implications of biomass for energy in the power area. Environmental and biomass resource constraints will be examined on a region-wide basis to identify subregions (hotspots) where potential incompatibilities between environmental, biomass resource, physiographic, and development factors are likely to obtain. Task II will implement field measurements and integrated assessment of biomass for energy in selected subregions - perhaps one or two. It will evaluate the interactions of air, socioeconomic, forest, and water related impacts in relation to a number of energy, policy and regulatory scenarios. Task III will be a detailed and comprehensive integrated assessment of the entire TVA region, using methods and knowledge gained in Task II, and should allow projections of impacts for the eastern U.S. with some confidence.
Keywords: biomass; environmental impacts; technology assessment.

150055 ORNL Support to TVA in Coal Cleaning. Smith, S.R.; Thomas, W.A. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-670.05. **Contract:** TV-48296A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

Oak Ridge National Laboratory will provide analytical and experimental support to TVA in coal cleaning systems. ORNL will support TVA's objective to develop new technology for coal cleaning and to improve existing technology through advancements in reliability and system control. This support will eventually interface with the TVA/DOE program to evaluate the effects of coal quality on boiler performance. ORNL will provide technical services to TVA in work that includes (1) development of a process for magnetic beneficiation of fine coal, (2) conducting coal cleaning tets on specific coals, (3) comparative assessment of the environmental and economic advantages of coal cleaning, (4) potential uses of coal cleaning wastes, (5) improvements in the control and operation of coal cleaning plants, (6) evaluation of components and materials used in state-of-the-art coal cleaning processes, and (7) assessment of potential areas of improvement. ORNL will prepare a task letter proposal for each area of ORNL assistance. TVA will indicate acceptance of each proposal by a letter of task authorization.
Keywords: coal preparation; cleaning; testing; wastes; waste product utilization; evaluation; optimization; technology assessment; equipment.

150056 Coal--Oil Mixture for Boiler Ignition. Smith, S.R. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-670.07. **Contract:** TV-51012A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); oil and gas(50) **R and D categories:** Pollutant monitoring.

The purpose of this project is to evaluate and assess the feasibility of using mixtures of fuel oil and finely ground coal for initial light-off of coal-fired steam-electric generators. The objective of this project is to review the present technology and perform preliminary design and economic assessment of equipment and procedures to use coal--oil slurries for light-off purposes in TVA steam plants as a fuel conservation measure. A technology assessment and literature survey will be performed with major emphasis on the past and present programs to use coal--oil mixtures as a substitute for fuel oil. A conceptual design and cost estimate on the best system will then be made for a pilot scale and a full scale demonstration. The tasks identified for this preliminary evaluation are data compilation, site selection, conceptual design and system costs, economic analysis, and recommendations. Potential fuel oil cost savings and estimated conversion costs will be included in the recommendations. The University of Tennessee at Chattanooga will conduct rheological studies of coal--oil mixtures. TVA will supply 130 tons of pulverized coal to Adelphi University for a two-year DOE-sponsored program to burn the coal--oil mixture.
Keywords: fossil-fuel power plants; coal; petroleum; start-up; technology assessment; cost; pilot plants; data compilation; site selection; design; economic analysis; combustion; feasibility studies.

150057 Chlorine Minimization/Optimization Project. Moss, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.38. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has a Chlorination and Alternative Subprogram which has, among others, an immediate objective to assess the quantities of total residual chlorine and its components (free and combined residual chlorine) being discharged from a chlorinated system and to determine efficacy of present chlorination practices. The main objective is to minimize the use of chlorine without experiencing a loss in condenser efficiency. The long-range objective would be to demonstrate the use of a methodology for chlorine minimization/optimization. The scope of the task consists of monitoring chlorine residuals (free and total) being discharged at the outlet of the condensers at Kingston, Allen, Shawnee, and Paradise Steam Plants. The chlorine concentrations will be measured at the chlorine injection point, the inlet of the condensers, the outlet of the condensers, and the inlet and outlet of cooling towers if applicable. Water quality samples will be taken on each test date so that we may characterize the type of water quality at each plant. Condenser performance, turbine back pressure, and condenser cooling water flow rates will be closely monitored so that the success of the tests may be ascertained.
Keywords: chlorination; chlorine; efficiency; monitoring; fossil-fuel power plants; tennessee valley authority; waste water; water quality.

150058 Technical and Economic Study of Mechanical Alternatives to Chlorination. Moss, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.33. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has a Chlorine and Alternatives Subprogram which has among others an immediate objective to document the economic and technical feasibility of using mechanical methods for condenser cleaning as an alternative to chlorination for biofouling control in cooling water systems. It also has an objective to minimize the use of chlorine by increasing the biocidal efficiency of the chlorine used and to investigate the basic mechanism biocide helpers use to reduce the use of chlorine. Since most biocide helpers are primarily dispersants and surfactants which theoretically prepare the slime formations for chlorine treatment, a more in-depth study is necessary. A midterm objective would be to perform preliminary field studies to determine efficacy of these processes. A long-range objective is to conduct long-term field studies. The scope will include: (1) a systematic study of the economics, technologies, and environmental effects of using mechanical alternatives for biofouling control; and (2) investigation of information on available chemicals determined as biocide helpers and analyzing their effectiveness and environmental impact. A pilot study will be initiated if information indicates a promising return.
Keywords: chlorination; technology assessment; biological fouling; economics; water pollution control; cooling systems; chlorine; biological effects; surfactants; environmental impacts.

150059 State-of-the-Art for Biocides in Cooling Systems. Magliente, S.H. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** 942-15-640.28. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has a Chlorine and Alternatives Subprogram which has among others an immediate objective to identify the economic and technical feasibility of using chemical alternatives to chlorine for biofouling control in cooling systems. The initial objective is to identify the most feasible alternatives to chlorine. The long-range objective is to

demonstrate the use of this alternative as a power plant. The mid-term objective would be to perform specific case technical and economic studies. The scope includes conducting a systematic study of the economic, technologies, and environmental effects of using such alternatives to chlorination as ozone, chlorine dioxide, bromine chloride, and other chemical alternatives. Funds for pilot studies of promising alternatives are included and will be approved through a project authorization.
Keywords: chlorination; water pollution control; biological fouling; chlorine; feasibility studies; environmental impacts; technology assessment; ozone; chlorine oxides; bromine chlorides; cooling systems.

150060 Development of Mass Transport Modeling Capabilities. Magliente, S.H. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.27. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has the objectives: (1) to determine the state of knowledge of the chemistry of soil transfer and exchange; (2) to determine the state-of-the-art, availability, and applicability of mass transport models; and (3) to develop mass transport models that will fulfill TVA needs. The midterm objective is to develop for TVA a state-of-the-art knowledge of mass transport models. The long-range objectives are to verify and further develop models by conducting laboratory and field experiments. A review of the literature on the chemistry of soil transfer and exchange and review of mass transport models will be done. The state of knowledge of the chemistry of soil transfer and exchange, and the state-of-the-art, availability, and applicability of various existing mass transport models will be determined. Chemical soil transfer and exchange information will be developed; and mass transport models will be modified or developed as required. Laboratory and field experiments may be conducted to provide information on the chemistry of soil transfer and exchange. Models will be developed and verified with this field data.
Keywords: soils; mass transfer; environmental transport; mathematical models; reviews; soil chemistry; bench-scale experiments; reviews.

150061 Technology for Scrubber Liquor Effluent Reuse. Magliente, S.H. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.26. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to assist other groups in technical evaluations for the treatment of waste water for reuse and/or discharge. The midterm objective is to document with technical evaluations treatment technology for removal of various chemical species. Special emphasis will be placed on priority pollutants and other species causing problems. The scope of effort will consist of providing technical assistance to other groups in identifying, characterizing, and treating waste streams for reuse and/or discharge.
Keywords: waste product utilization; scrubbers; recycling; evaluation; technology assessment; fossil-fuel power plants; water treatment; waste management.

150062 Economic Comparison of Membrane Technology to Other Treatment Technologies. Boroughs, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.22. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which includes the objective of assessing technologies for effluent control. The objective of this project is to evaluate membrane technologies in comparison to other technologies for treating power plant wastes. The scope of this effort includes conceptually designing systems with membrane technology and comparing the estimated costs to other systems which can be used to treat the same stream.
Keywords: waste water; pollution control; fossil-fuel power plants; filters; cost; evaluation.

150063 Ductwork Replacement and Equipment Modification at the Colbert Wet Scrubber Test. DeBuzman, J.S. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.14. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The primary objective of this project is to replace the ductwork that delivers flue gas from No. 3 and/or No. 4 boilers at the Colbert Steam Plant to the pilot plant. A sulfur dioxide injection system will also be installed in the scrubber facility for the purpose of maintaining the required SO2 concentration level for the tests when the plant starts to use low-sulfur coal about July 1979. This and other associated maintenance activities are vital to the reactivation of the pilot plant facilities for testing advanced regenerable FGD systems. A new ductwork system will be installed to deliver flue gas to the existing scrubber modules at the test facility. The test schedule calls for sequential operation, i.e., testing of the units during alternate periods to utilize best the resources and manpower available for the project. The results of these tests will be used to support the design and selection of a type of advanced regenerable scrubbing system for control of SO2 and particulate emissions at TVA power plants. The operation of a magnesium oxide system at the 1-MW pilot plant would provide valuable experience in preparation for operating a full-scale system at Johnsonville. The pilot testing of the absorption/steam stripping process will provide valuable data for the possible application of this system at Cumberland Steam Plant. Finally, the simultaneous SOx/NOx systems will have possible applications at new power plants as part of TVA's compliance program activity on SOx/NOx emission.
Keywords: ducts; fossil-fuel power plants; flue gas; sulfur dioxide; scrubbers; pilot plants; testing; tennessee valley authority; installation.

150064 Evaluation of Scrubbing Alternatives for Cumberland. Robards, R.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.15. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The preliminary proposal for emission control at the Cumberland Steam Plant contained five alternative scrubbing systems which will be evaluated during the next year at which time one or more will be selected for installation. The objectives of this project, upon having selected a scrubber type, are to demonstrate the system at full-scale and extend development of this system for its economic advantage and future use. Technical support in evaluating five or more scrubbing systems will be given to Engineering Design and Power Resource Planning so that the decision to install one or more of these systems can be made to control SO2 emissions at Cumberland. The five alternative scrubbing systems include the cocurrent scrubber, the DOWA scrubbing system, the Thoroughbred 121 process, the Atomics International's Aqueous Carbonate Process, the Absorption Steam Stripping Process with RESOX SO2 conversion to sulfur, and other promising processes such as spray injection with baghouse.
Keywords: scrubbers; pollution control; fossil-fuel power plants; comparative evaluations; sulfur dioxide.

150065 Ionization Methods. Frank, R.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.07. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are: (1) to summarize and evaluate data on advanced ionization techniques such as electron beam irradiation in enhancing fine particulate removal as well as removal of gaseous pollutants as fine particulates by precipitators; and (2) to develop and demonstrate the ability, mechanical integrity, operational reliability, energy saving, and cost effctiveness of using these technologies to help precipitator control fine particulate and gaseous emissions from conventional and advanced coal-based power plants. The approaches are: (1) to keep abreast of new developments by maintaining close contact with the inventor(s), manufacturers, and other researchers; (2) to conduct inhouse, indepth evaluation of data obtained; (3) to conduct pilot studies first at existing TVA plants and then at the proposed pilot fluidized-bed combustion plant to demonstrate the general technical feasibility and provide scale-up information; and (4) to conduct full-scale studies to demonstrate the commercial feasibility of these technologies for such applications.
Keywords: ionization; electrostatic precipitators; electron beam ion sources; particles; gaseous wastes; pollution control; cost; efficiency; fossil-fuel power plants; tennessee valley authority; feasibility studies; commercialization.

150066 Sludge Disposal from Sulfur Dioxide and Particulate Removal Processes. Crowe, J.L.; Runyan, R.A. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.03. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective of the program is to evaluate data which are available on sludge disposal methods and on the properties of both treated and untreated sludges so as to maintain TVA's knowledge of the state of the art in disposal technology. The approach is to summarize and evaluate existing data pertaining to sludge disposal,

investigate the potential methods for improving the disposal characteristics of sludge, and recommend future testing required. The scope of the program is to summarize and evaluate all available data concerning disposal methods so as to determine problem areas and to collect, summarize, and evaluate data from sludge disposal test facilities so as to determine the feasibility for their application. Funds are not provided for an extensive experimental program.
Keywords: sludges; waste disposal; tennessee valley authority; fossil-fuel power plants; waste management; desulfurization; scrubbers.

150067 Costs for Treatment of Ash Pond Water for Reuse. Zielke, R.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.37. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an objective to study the methods in which ash pond water can be treated for reuse within areas of the plant and to determine a cost effective approach to this problem. The scope of this effort includes: (1) summarizing the treatment required for ash pond water reuse in various areas of the plant; (2) establishing a relationship between chemicals in ash pond water as a result of contact with fly ash; (3) relating this information to current TVA operating plants; (4) establishing minimal water quality limits for chemicals in the ash pond water that is returned for reuse; and (5) establishing techniques to bring returned water within these limits on a cost effective basis.
Keywords: cost; ashes; ponds; waste water; water treatment; recycling; standards; fossil-fuel power plants; tennessee valley authority; waste product utilization.

150068 Assessment of Methods for Priority Pollutant Removal. Magliente, S.H. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.45. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); hydroelectric(50) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others immediate objectives to evaluate the chemical composition of various effluent discharges from TVA's power plants and to identify potential removal techniques. The primary objective of this project is to summarize and evaluate data pertaining to concentrations of priority pollutants in TVA's power plant waste streams. The mid-term objective is to assess methods by which these pollutants can be removed and the long-range objective is to develop the technical data base sufficiently to recommend for demonstration removal technologies for various waste streams. The scope of the program is a review of TVA's power plant waste streams, identifying the priority pollutant in the stream, and assessing the methods by which these pollutants can be removed. Tests on actual waters may be performed to verify calculations and assumptions; however, an extensive experimental program is provided under another project.
Keywords: waste water; pollution control; fossil-fuel power plants; liquid wastes; tennessee valley authority; chemical composition.

150069 Advanced NOx Control. Kee, B.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.16. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

This study has an objective to develop emission control methods for use on full size cyclone-fired boiler to meet anticipated standards and/or regulations by the use of advanced NOx control techniques. TVA will provide the equipment and personnel to study the effects of noncatalytic NOx reduction with ammonia addition using the Exxon Thermal DeNOx process. Downstream effects on the air preheaters and precipitators will be closely scrutinized. In addition, combustion modification (C-M) techniques will be developed to reduce NOx emissions. The effects of C-M on corrosion, flame stability, slag tapping, and general boiler performance will be assessed.
Keywords: nitrogen dioxide; air pollution control; standards; compliance; ammonia; denitrification; combustion properties; coal; boilers; performance; evaluation.

150070 Control of Fine Particulate by Ionization Methods: Pilot Study of Advanced Technology. Huang, C.M. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.11. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are to verify the applicability of an ionization technology of advanced design for improving both overall and fine particulate removing abilities of a conventional electrostatic precipitator when treating flue gases generated from burning a wide variety of coals and to obtain design parameters for scaling up to a commercial size operation. Emphasis will be on the fine particulate removal capability and energy and capital saving compared to existing technologies. The approach is to first conduct a comprehensive review and evaluation of advanced ionization techniques currently under development, select the technique that has shown the greatest promise at the laboratory scale, and construct a pilot unit on a slipstream from a TVA boiler. A one-year study will follow. Total and fractional collection efficiencies of the ionization device-precipitation will be measured with the ionization device energized and deenergized to quantify the incremental improvement of particulate collection due to this device.
Keywords: ionization; particles; electrostatic precipitators; flue gas; cost; pilot plants; optimization; fossil-fuel power plants; tennessee valley authority.

150071 Advanced Waste Heat Control: Development of Techniques to Determine Fishery Population Impacts Associated with Power Plant Raw Water Usage. Brellenthin, J.B. (TVA, 1110 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4010.4. **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Biological Research Program has an Assessment of Biological Impacts and Methods for Alleviation Subprogram designed to determine acceptable levels of impacts from power facilities for protection of biota and to develop methods to alleviate adverse biological impacts. This project is designed to utilize an extensive fisheries data base developed by TVA for development and validation of a model to determine the fisheries population impact associated with power plant raw water usage. A key fish species (gizzard shad) for which a thorough data base of population estimates exists will be used to develop a population model which will assess the overall long-term effect of power plant raw water usage.
Keywords: waste heat; water pollution control; fishes; thermal effluents; thermal pollution; biological stress; population dynamics; power plants; environmental impacts; open-cycle systems.

150072 Advanced Waste Heat Control for EPA-Membrane Technology Task. Boroughs, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 017-15-4010.3. **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram and a Thermal Control Subprogram which includes the assessment of technology for control of nonthermal and thermal effluents. The objectives of this task are to evaluate the use of membrane processes for refurbishing power plant discharge waters to make them acceptable for reuse and to determine the role that membrane technology will have in the treatment of influent and effluent streams around a steam-electric power plant. A further objective is to develop the knowledge necessary to appropriately apply membrane technology within the power industry. The scope of this task consists of purchasing prototype reverse osmosis and ultrafiltration equipment so that different ultrafiltration equipment and reverse osmosis membranes can be impartially evaluated on various power plant streams. An analysis will then be made of the applicability of membrane technology to each waste stream. Electrodialysis will be considered in the analysis as well as reverse osmosis and ultrafiltration.
Keywords: power plants; thermal effluents; chemical effluents; water pollution; waste heat; membranes; water pollution control; thermal pollution; recycling; osmosis; ultrafiltration; filters.

150073 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project: Project Management. (TVA, Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.08.1. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are to oversee the various tasks included in this new research and development project associated with the Widows Creek Unit 8 wet scrubber and to coordinate the efforts of the various organizations assigned responsibility hereunder. Project management will include visits to the site during various tests, assistance in design of experiments and interpretation of results, coordinating efforts of various groups participating in the project, and ensuring that the numerous reports are prepared and properly evaluated.
Keywords: lime-limestone wet scrubbing processes; management; coordinated research programs; fossil-fuel power plants; tennessee valley authority.

150074 TVA Widows Creek Unit 8 Wet Limestone Scrubber Project: Report on Scrubber Startup. Munson, G.T. (TVA, 1120 Chestnut

Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.08.2. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to prepare a report, in writing, on all research and development projects associated with the scrubber prior to operational status. The report summarizes the following specific activities: scrubber startup, startup support, site sampling and analysis, Widows Creek fauna/water monitoring, and limestone purchase.
Keywords: lime-limestone wet scrubbing processes; start-up; sampling; water quality; monitoring; fossil-fuel power plants; evaluation; tennessee valley authority.

150075 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project; Process Evaluation (Task No. 3). Robards, R.F.; Runyan, R.A. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.08.3. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to evaluate the Widows Creek Unit 8 scrubber process, including both short- and long-term observation on the system behavior. Subtask 3.1 will involve comparison of the actual system performance with the design performance in both SO2 and particulate removal areas and subtask 3.2 will report on the findings. Subtask 3.3 is a long-term evaluation (2 years) including assessment of performance of construction materials, process equipment components, and recommendations for future scrubber systems. Subtask 3.4 is a report, preliminary in nature, to assist in awarding of a scrubber contract for Widows Creek Unit 7 scrubber. Subtask 3.5 will be a report on the activities of the entire Task 3.
Keywords: lime-limestone wet scrubbing processes; evaluation; sulfur dioxide; particles; air pollution control; performance; fossil-fuel power plants; tennessee valley authority.

150076 Monitoring of Turbine Rotor Cracks by Acoustic Emissions. Kelley, P.G. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-690.04. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: hydroelectric(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to assess the feasibility of monitoring mechanical damage to turbine rotors by detecting acoustic emissions transmitted through the bearings. The background noise spectrum of a selected turbine will be determined and a working frequency chosen which avoids excessive interference. Narrow band sensors will be installed to detect and analyze acoustic emissions. Signals will be processed to give peak and total energy of emissions and source location. TVA personnel will be trained to utilize AE monitoring equipment to record emission information.
Keywords: damage; bearings; hydroelectric power plants; turbogenerators; rotors; acoustic emission testing; monitoring; feasibility studies.

150077 Cycling of Steam Power Plants 0with Drum Boilers. Kelley, P.G. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-690.03. **Contract:** TV-48324A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; EPRI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to recommend startup procedures and establish guidelines for safe and economical startup and cycling routines for units with drum-type boilers. Test work will be carried out on Widows Creek Unit 7. Boiler and turbine parts liable to damage by cycling operation will be identified and modeled to predict the effects of different startup routines. The unit will be fitted with thermocouples and measurement points so that observations can be made during controlled cycling operation to verify predictions and develop improved predictive techniques. These will be used to recommend specific cycling routines for Widows Creek Unit 7 and to provide generally applicable guidelines.
Keywords: fossil-fuel power plants; boilers; start-up; safety; steam turbines; operation; damage.

150078 Calculation of Chemical Composition of Liquor Streams Using the Fractional Conversion Model (Computer). Robards, R.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.05. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to determine saturation levels of various liquor loops by use of the Fractional Conversion Model developed by Radian Corporation for TVA. The scope of the project consists of using the chemical composition of various liquor streams as inputs to the model so that saturation levels for these streams may be calculated by a computer. Liquor streams which will be considered are liquor loops of SO2 scrubbers, ash pond loop, cooling tower water loops, coal pile drainage, etc.
Keywords: liquid wastes; scrubbers; chemical composition; mathematical models; cooling systems.

150079 Characterization of TVA Coal Supplies. Smith, S.R.; Thomas, W.A. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-670.02. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to define the relationships between coal characteristics and power plant performance, especially the impact of available coals on the performance of power plants of the TVA system. Data on the characteristics and coals fired by the TVA units over the last 18 years on the performance of TVA units over the same period were assembled. The two data files will be correlated to determine which coal characteristics impacted various areas of plant operation.
Keywords: coal; fossil-fuel power plants; performance; tennessee valley authority; data acquisition; boiler fuel; physical properties.

150080 1-MW Magnesium Oxide Scrubber Project: Colbert. Marcus, E.G. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.09. **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The primary objectives of the pilot plant program are as follows: (1) develop valuable in-house experience with the MgO process; (2) anticipate potential problems with the Johnsonville MgO process chemistry or equipment failures during startup, shakedown, and long-term operation; and (3) evaluate the long-term effects of contaminants such as fly ash, chlorides, and trace elements which evolve from the burning of coal. TVA's 1-MW lime/limestone pilot plant at the Colbert Steam Plant will be modified to operate in the magnesium oxide scrubbing-regenerable mode. The performance of such process equipment as driers and calciners will be tested and evaluated as an integral part of the scrubbing and regenerative process. Certain process parameters such as dust loading and crystallization of magnesium sulfite will also be evaluated.
Keywords: magnesium slurry scrubbing process; pilot plants; fly ash; chlorides; elements; trace amounts; tennessee valley authority; fossil-fuel power plants; evaluation; retrofitting.

150081 Flue Gas Conditioning. Reed, M.W. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.06. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to summarize and evaluate data on the use of flue gas conditioning agents in improving overall and fine particulate collection efficiencies of electrostatic precipitators; (2) to review, investigate, and develop processes for additive injection to remove SO2 and/or NOx along with particulate in baghouses or precipitators; and (3) to provide guidelines for using chemical additives by conducting comprehensive parametric field tests. The approaches are (1) to maintain current awareness of developments in this technology; (2) to conduct in-house theoretical studies; (3) to conduct basic experimental work either in-house or through contractual arrangements; (4) to conduct comprehensive parametric testing and endurance experiments to determine the ability, operational reliability, energy saving, and cost effectiveness of flue gas conditioning technology when applied to improving overall and fine particulate collection by precipitators; and (5) to establish definitive guidelines for choosing the conditioning agents by developing a model which will correlate precipitator performance with relevant properties of coal, fly ash, flue gas, and precipitator parameters.
Keywords: flue gas; electrostatic precipitators; sulfur dioxide; nitrogen dioxide; particles; pollution control; baghouses; field tests; cost; coal; fly ash; optimization.

150082 Filtration Technology. Kushman, K.L. (TVA, Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.05. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The project objectives are: (1) to summarize and evaluate data on the performance of filtration equipment in removing fine particulate from fossil-fired power plants; (2) to review advanced concepts in filtration technology for fine particulate control; (3) to develop, conduct, and coordinate research to provide information to assist the Shawnee baghouse operation; and (4) to develop and demonstrate advanced filtration technology for fine particulate control in conventional and advanced coal-based power plants. The

approaches are (1) to keep abreast of current developments in filtration technology as applied to the control of fine particulate emission from fossil-fired power plants; (2) to conduct theoretical investigations; (3) to conduct basic experimental work through contractual arrangements; and (4) to conduct pilot studies at TVA plants to demonstrate advanced concepts.
Keywords: filtration; particles; pollution control; fossil-fuel power plants; performance; baghouses; pilot plants.

150083 Pulsed Energization for Precipitators. Kushman, K.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.04. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to summarize and evaluate data on this technology; and (2) to develop and demonstrate the ability, technical integrity, reliability, energy saving, and cost effectiveness of using this technology for improving precipitator collection efficiencies for overall and fine particulates in low-sulfur coal applications. The approaches are: (1) to keep abreast of new developments by maintaining contact with the companies, users, and other researchers and by reviewing literature; (2) to evaluate the available systems and select the most promising option; and (3) to test and demonstrate the technical and economic feasibility of this option for improving existing precipitator collection efficiency and/or for reducing the size of new precipitators.
Keywords: electrostatic precipitators; pulse generators; optimization; cost; efficiency; fossil-fuel power plants; coal; sulfur.

150084 Sonic Dust Removal. Huang, C.M. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.03. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are (1) to summarize and evaluate data on acoustic devices for dislodging ash, soot, and dust from boiler tubes and other enclosed surfaces such as precipitator collector plates and discharge electrodes; and (2) to test and demonstrate the energy saving ease of operation and maintenance, reliability, and cost effectiveness of such a system as an aid or an alternative to existing precipitator collector plate and discharge wire rappers. The approaches are: (1) to maintain current awareness of developments in this technology by conducting literature survey and maintaining contact with developers, users, and other researchers; and (2) to test and demonstrate the commercial feasibility of this technology for enhancing precipitator performance.
Keywords: electrostatic precipitators; tubes; boilers; cleaning; acoustics; ashes; soot; dusts.

150085 Rapid Sulfur Meter. Smith, S.R. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.10. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to develop a continuous on-line nuclear analyzer for monitoring the quality of coals delivered to TVA plants and of coals at coal bunkers or any other locations. The immediate objective is to develop an analyzer system for use at Kingston Steam Plant to monitor the coals delivered by trucks to ensure compliance with the emission regulations set forth in the proposed consent decree. Initially, a rapid sulfur meter (RSM) will be quickly developed, with minimum mdifications to the existing sampling facility, to allow on-the-spot screening of coals delivered by trucks. A new sampling station will be built later which will incorporate the capability of extensive and statistically meaningful sampling of coals from each truck and detailed elemental analysis to give ash and moisture content and calorific values as well as elemental composition of the coal by a hybrid high-resolution germanium sodium iodide detector.
Keywords: on-line measurement systems; monitoring; coal; standards; compliance; tennessee valley authority; sulfur; design; fossil-fuel power plants.

150086 Electrotube. Frank, R.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.08. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objectives are: (1) to summarize and evaluate available data on the application of this technology to remove particulate matter from fossil-fuel combustion product streams; and (2) to develop and demonstrate the ability, technical integrity, operational reliability, energy saving, and cost effectiveness of using this technology to control overall and fine particulate emissions from conventional and advanced coal-based power plants. The approaches are: (1) to keep abreast of new developments, (2) to perform in-house theoretical investigation, (3) to conduct pilot studies at existing TVA plants and proposed pilot fluidized bed combustion plant, and (4) to conduct full-scale studies to demonstrate the commercial feasibility of this technology in such applications.
Keywords: feasibility studies; pollution control equipment; fossil-fuel power plants; cost; efficiency; pilot plants; technology assessment; electrostatic precipitators.

150087 Study of Methods, Controls, and Costs Associated with Dechlorination. Seaman, C.V. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.35. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others the immediate objective to examine the various technologies for removal of total residual chlorine and economic feasibility and adaptability to power plant operational practices. The midterm objective is to document technical problems associated with implementing and controlling this type of dechlorination process. The long-range objective is to demonstrate the use of such a technology under plant operating conditions. A review of current research and demonstration projects related to removal of total residual chlorine will be performed. The adaptability of available systems to TVA plants and economic feasibility of dechlorination for TVA facilities will be determined.
Keywords: dechlorination; cost; fossil-fuel power plants; tennessee valley authority; feasibility studies; technology assessment.

150088 Model Prediction for Chlorinated Effluents. Zielke, R.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-640.36. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has a Chlorine and Alternatives Subprogram which has among others an objective to develop a model to predict the concentration of a biocide in a once-through and a closed-cycle cooling system. The scope of this effort is to improve the model's ability to predict free and total residual chlorine using field data from several plants and to further develop tuning techniques and reliable methods to simulate chlorine demand.
Keywords: mathematical models; chlorine; dechlorination; waste water; cooling systems; forecasting; monitoring.

150089 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project: Process Improvement and Optimization (Task No. 4). Runyan, R.A. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.08.4. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to provide sufficient operating data to allow process improvement and/or optimization of different variables that affect SO2 and particulate removal by the scrubber trains. The approach will involve the determination of maximum SO2 and particulate removal (in both the open grid tower and TCA modes) as a function of L/G, venturi, delta-P, pH, and stoichiometry.
Keywords: lime-limestone wet scrubbing processes; optimization; fossil-fuel power plants; sulfur dioxide; particles; tennessee valley authority.

150090 Empirical Linear Free-Energy Relationships (LFER's) for Coal and Its Combustion Chemistry. Badin, E.J. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-620.03. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

Empirical LFER's are determined by systematically utilizing existing analyses for metals and semimetals in coal and ash byproducts from coal combustion. The LFER's regarding chemistry and environmental concerns of value to TVA coal-energy goals of energy demonstrations and technology are interpreted and evaluated. Whether and how other organizations should cooperate is recommended and implemented where feasible. Midterm objectives are to evaluate results and determine which avenues should be introduced and implement those avenues for which answers are required. Long-range objectives are to endeavor to predict long-range requirements for TVA energy from coal and to obtain required LFER's for these needs. The approach taken was: (1) systematically obtain LFER's for differing ranks of coal from various sources, particle-size ranges of particulates from coal combustors, and related aspects pertinent to TVA coal-fired utilities;' (2) implement methods to obtain analyses from other organizations for comparison purposes;

and (3) interpret and evaluate the LFER's utilizing slopes of LFER's as a basis.
Keywords: free energy; coal; combustion properties; coal; fossil-fuel power plants; tennessee valley authority; combustion.

150091 Combustion Chemistry Projects for Coal-Energy Demonstrations and Technologies. Badin, E.J. (TVA, 1145 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-620.02. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The objective is to complete the ongoing project on Chemistry Evaluation for Effects of Bases or Alkaline Compounds on Coal Combustion toward the TVA pilot and demonstration of FBC. Midterm objectives are to carefully evaluate the results in the light of TVA coal-energy problems and implement further projects with additional objectives. Long-range objectives are to reevaluate in terms of TVA future increases in coal-energy processes and implement projects toward TVA new objectives. The approach is to (1) carry out an updated critical literature survey in order to organize pertinent information; (2) systematically evaluate the information in order to increase the chemical understanding and introduce avenues or conclusions to aid TVA coal-energy processes; and (3) achieve recommendations to aid specific parts of the TVA processes such as more complete combustion in AFBC.
Keywords: coal; combustion; combustion properties; bases; tennessee valley authority; technology assessment; data analysis; fossil-fuel power plants.

150092 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project: EIS Environmental Evaluations. Robards, R.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.08.6. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Determinations will be made of the actual scrubber operation on ambient air quality, particularly considering effects of plume rise varying with temperature. Sulfuric acid aerosol formation will be investigated; H2SO4 aerosol formation and its impact on vegetation will also be considered. Water quality studies will include mixing characteristics of waste and discharge into the Tennessee River, and the chemical biological effects of constituents added to water systems surrounding the power plants. Samples are collected at discharges of the ash pond, mist eliminator and scrubber pond, and from wells to sample ground water.
Keywords: lime-limestone wet scrubbing processes; environmental impacts; air quality; temperature effects; sulfuric acid; aerosols; plants; water quality; sampling; ground water; scrubbers; ponds; wells; tennessee river; biological effects.

150093 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project: Sludge Treatment Demonstration and Evaluation (Task 5). Runyan, R.A.; Crowe, J.L. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.08.5. **Contract:** 78P38-151759. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The project objectives are to demonstrate and evaluate on a prototype scale level the most effective scheme determined during ongoing testing at the Colbert/Shawnee plants for decreasing the effective area required for sludge disposal at the Widows Creek facility and that will produce a stable disposal product. The overall scope of the work should lead to the engineering, design, and installation of a commercial scale waste sludge treatment facility at Widows Creek. Plans are underway to demonstrate and evaluate on a prototype scale forced oxidation method of sludge disposal from a coal-fired boiler, and to demonstrate and evaluate forced oxidized sludge landfill at Widows Creek. An economic evaluation of sludge disposal methods for application to Widows Creek is also planned. The approach of study and work to be performed under Task 5 will involve a detailed evaluation of the six methods of sludge treatment currently being demonstrated at the Shawnee scrubber test facility and an evaluation of the sludge-fly ash blending and layering tests made at the Colbert pilot plant.
Keywords: widows creek steam plant; sludges; waste processing; waste disposal; sanitary landfills; pilot plants; waste processing plants; lime-limestone wet scrubbing processes; fly ash; fossil-fuel power plants.

150094 Development of Biological Criteria for Load Management and Siting Practices. Brellenthin, J.B. (TVA, 1110 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-650.10. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); hydroelectric(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

ECT's biology program has a land management and siting project designed to develop biological criteria for siting power facilities and managing power lands and to insure that Power's biological concerns are factored into the site selection process. This project provides for active participation in the Office of Power siting and land management programs. A review of the biological criteria involved in land management and siting will be conducted and new or additional criteria will be developed as warranted.
Keywords: power plants; site selection; environmental impacts; land use; management; biological effects.

150095 Comparative Economics of Advanced Processes. Robards, R.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-630.17. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The primary objective of this project is to update or perform new cost estimates for FGD processes so that comparative economics can be used for decision making. In previous years, cost estimates have been performed by ECDP on several FGD systems. These processes include lime, limestone, magnesium oxide, Wellman--Lord, catalytic oxidation, copper oxide, citrate, Dowa, Chiyoda Thoroughbred 121, Atomics International, FMC, consol, CEA-ADL, and generic double alkalis. The economics of these processes are frequently updated as new developments take place. In addition, cost estimates for NOx removal and simultaneous SOx--NOx removal will be performed.
Keywords: economic analysis; comparative evaluations; nitrogen oxides; sulfur oxides; removal; forecasting; air pollution; flue gas; desulfurization; limestone; calcium oxides; magnesium oxides; catalysis; copper oxides; citrates.

150096 Horizontal Travelling Screen. Johnson, J.T. (TVA, 1110 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** S015-174. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(25); nuclear fission(25); hydroelectric(50) **R and D categories:** Ecological effects of pollutants or physical disturbances.

ECT's biology program has an intake program plan with a horizontal travelling screen project which has the objective of analyzing the feasibility of this concept as an intake design alternative. Should the feasibility of this concept prove feasible, construction and operation of a prototype facility will be pursued. It appears that with proper design and the use of current technology, it should be possible to design a reliable horizontal travelling screen. TVA will analyze feasibility of the concept and provide a report assessing the horizontal travelling screen. Should the system prove feasible, construction and operation of a prototype facility will be pursued. No funds are included for this possible follow-on activity.
Keywords: feasibility studies; intake structures; power plants; environmental impacts; biological effects; screens; design; transport; performance testing.

150097 Biomonitoring. Brellenthin, J.B. (TVA, 1110 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-650.04. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: general science(100) **R and D categories:** Environmental effects assessment..

ECT's biology program has a terrestrial program plan containing six subprogram areas. The biomonitoring subprogram is designed to keep abreast of results of biological monitoring studies for power facilities to assure minimal adverse impacts from power operations. This project will provide for detailed reviews of Power-funded biological monitoring programs and identification of research needs. Continuing detailed reviews will be conducted on results of biological monitoring studies. Results will be used to determine research needs associated with minimizing any adverse impacts associated with power operations. Assessments will be made on the adequacy of these studies.
Keywords: power plants; environmental impacts; biological effects; terrestrial ecosystems; monitoring.

150098 Intake Avoidance Concept. Johnson, J.T. (TVA, 1110 Chestnut St. Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-650.03. **Contract:** SO15-176. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); hydroelectric(25) **R and D categories:** Environmental effects assessment.

The ECT Biology Program has an Intake Program Plan with an Intake Avoidance project. The objective of this project is to determine the acceptability of the small opening, fixed screen concept as an intake alternative for the TVA region. A facility to

simulate this screening concept under field conditions will be designed and workplans for its operation will be prepared. If this phase of the project is successful, further development and funding will be pursued. No funds are included for this possible subsequent activity. **Keywords:** tennessee valley authority; nuclear power plants; intake structures; performance; design; environmental impacts; aquatic ecosystems; screens.

150099 Baghouse Test Support. Kushman, K.L. (TVA, 1170 Chestnut St. Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.18. **Contract:** TV-48192A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objective is to provide technical support to the TVA pilot baghouse and selected projects in the areas of baglife estimation, operating and maintenance cost analyses, and collection efficiency and pressure drop assessment. The approach is to establish personal services contracts to identify and recommend appropriate test and engineering analysis techniques and to perform engineering analyses of experimental data.
Keywords: baghouses; fabric filters; operation; maintenance; efficiency; pressure drop; performance testing; economic analysis; service life; thermal power plants.

150100 Novel Filtration Concepts Evaluation. Kushman, K.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.17. **Contract:** TV-49295A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are (1) to identify and evaluate advances in baghouse technology and hardware that can potentially reduce operating and maintenance costs and/or increase particulate collection efficiency, and (2) to define or improve candidate pilot-scale fabric filtration test facility configuration. The approach is to review existing theory and data and identify fundamental factors affecting collection efficiency and operating and maintenance costs; to survey baghouse vendors, the Environmental Protection Agency, and various research institutions, and evaluate recent developments in fabric filtration systems that can potentially improve baghouse performance and reduce costs; and to define pilot-scale baghouse test facilities based on this information.
Keywords: filtration; baghouses; technology assessment; efficiency; optimization; pilot plants; planning.

150101 Novel Filtration Concepts Optimization. Kushman, K.L. (TVA, 1170 Chestnut Street Tower II, Chattanooga, TN, 37401). **Project number:** 942-15-660.16. **Contract:** TV-49235A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: Coal(100) **R and D categories:** Environmental effects assessment.

The objectives are to: (1) identify developing filtration technology concepts that, at the laboratory scale, have demonstrated significant potential to reduce baghouse operating, maintenance, or capital costs or to increase particulate collection efficiency; and (2) assess the maximum impact such concepts may have on full-scale baghouse performance and costs. The approach is to review developments in filtration technology and to conceive and implement theoretical and/or laboratory-scale experimental programs to optimize selected concepts. Results from these programs will be used to estimate full-scale baghouse cost and performance impacts. This effort will be accomplished through personal services contracts. Favorable developments will be incorporated into our inhouse pilot-scale baghouse facilities for further test and development.
Keywords: filtration; bench-scale experiments; baghouses; optimization; efficiency; cost; fossil-fuel power plants.

150102 Advanced Waste Heat Control for EPA: Intake Structure Task. Brellenthin, J.B. (TVA, 1110 Chestnut St. Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(25); oil and gas(25); nuclear fission(25); hydroelectric(25) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The Biological Research Program has an Assessment of Biological Impacts and Methods for Alleviation Subprogram which has among others an objective to develop, through research, control methods to reduce impingment and entrainment of aquatic organisms. The primary objectives of this task are to evaluate intake systems for screening aquatic organisms and to obtain biological and engineering information to evaluate such systems. The scope of this task will consist of summarizing and evaluating available data concerned with intake structures and identifying impingement and entrainment problems for electric generating stations. Also, fine mesh and wedge-wire screening systems will be tested in a laboratory prototype. Testing will consist of gathering data on biological and engineering data regarding the ability of such a system to operate functionally without problems and to reduce entrainment of organisms with increased survival of some organism.
Keywords: thermal power plants; intake structures; cooling systems; impingement; entrainment; aquatic organisms; performance testing; biological effects; design; waste heat.

150103 Development of Flue Gas Desulfurization Technology: Shawnee Lime/Limestone Scrubbing Program. Crowe, J.L. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA; DOE.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this advanced program is to further the development of nonregenerable lime and limestone flue gas desulfurization processes by testing and demonstrating advanced concepts at the Shawnee test facility for improving the reliability, efficiencies, and economics of the processes. The approach is to operate the TCA, venturi-spray tower and cocurrent scrubbers at the Shawnee test facility so as to test the effect of all or part of the following variables on SO2 removals: process reliability, performance of equipment, materials of construction, MgO addition single and two-stage forced-oxidation with and without MgO addition, limestone type and grind, and organic acid addition with and without oxidation. Other efforts include field testing of sludge disposal techniques, expansion of computer program for projecting the design and economics of full-scale lime and limstone FGD system.
Keywords: lime-limestone wet scrubbing processes; flue gas; desulfurization; optimization; sulfur dioxide; magnesium oxides; consol fgd process; fossil-fuel power plants.

150104 Processing Sludge from Lime/Limestone Wet Scrubbing Processes for Disposal or Recycle for EPA: Revegetation of SO2 Waste Disposal Ponds Task. Crowe, J.L. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to demonstrate an economically and environmentally acceptable alternative to the problem of ultimate disposal by using management techniques for ponded sludge to produce a material that will support vegetation and stabilize the disposal areas. Through greenhouse, field, and prototype studies, possible agronomic uses of the sludge will be identified. Methods for vegetation and stabilization of ponded scrubber sludge will also be demonstrated through field studies.
Keywords: lime-limestone wet scrubbing processes; sludges; waste processing; waste disposal; recycling; revegetation; ponds; waste management; desulfurization; fossil-fuel power plants.

150105 Absorption Steam Stripping Pilot Plant (Advanced Regenerable Systems): 1-MW Colbert Plant. DeGuzman, J.S. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-49019A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPRI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

Development of an advanced regenerable flue gas desulfurization (FGD) process may provide a preferable (economical and reliable) system over those currently available. The major advantage of regenerable scrubbing is the production of a saleable product (sulfur or sulfuric acid) rather than a useless sludge waste as in a limestone system. The objective of this project is to evaluate absorption/steam stripping as one of the new generation of advanced regenerable FGD systems. At the request of contractors (EPRI), ED and T will aid in the determination of the feasibility of advanced regenerable scrubbing systems and prepare proposals for demonstration of these systems at the pilot and prototype scale. ED and T will also be involved in the construction and operation of the 1-MW pilot plant. Process data collected in the system's testing will be evaluated and a final report prepared for publication by the contractors.
Keywords: absorption; flue gas; desulfurization; scrubbers; waste product utilization; materials recovery; steam; feasibility studies; pilot plants; consol fgd process; fossil-fuel power plants.

150106 TVA Economic Evaluation of the Rockwell Spray Dry Throwaway Process. Robards, R.F. (TVA, 1120 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-49050A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPRI.
Related energy source: Coal(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this project is to develop and present an economic evaluation of Rockwell International's (RI) open-loop Aqueous Carbonate Process (ACP) on a comparative basis with the TVA evaluation of the limestone slurry Flue Gas Desulfurization (FGD) process. A Phase II follow-on effort is being performed to compare contractor cost basis with the EPRI cost basis. Phase I of

the economic evaluation will include two cases - one using soda ash as sorbent, the second using lime as sorbent. Based on the general premises and assumptions included in this schedule, TVA will request that RI supply a process description and RI material balance, and the description, size, and 1978 cost of major equipment pieces associated with the process. TVA will generate a flow diagram, a material balance in TVA format, overall plant layout, an itemized equipment list with material costs displayed in 1979 dollars, and revenue requirements in 1980 dollars for each case. Sixty days prior to the conclusion of Phase I, a proposal for Phase II efforts is planned for work to compare TVA economic evaluation premises (TVA basis) with the EPRI economic premises (EPRI basis).
Keywords: flue gas; desulfurization; ai aqueous carbonate process; economic analysis; calcium carbonates; sodium carbonates; comparative evaluations; spray drying; consol fgd process; fossil-fuel power plants.

150107 Characterization of Effluents from Coal-Fired Utility Boilers for EPA: Effects of Coal-Ash Leachate on Ground Water Quality Task. Ogle, K.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to characterize the chemical composition of effluent streams from coal-fired power plants. The primary objective of this task is to characterize the leachate from ash ponds and the resulting chemical change in the leachate after percolation through subsoil. Special emphasis will be placed on trace elements. The scope of this task will involve the installation of test wells around ash ponds at two TVA coal-fired power plants. Soil core samples will be analyzed as a function of depth to determine the level of penetration by the leachate. Laboratory work will include column elution tests to characterize leachable material from coal ashes and their respective subsoils. Ground water as well as water leachate from installed wells will be used to perform laboratory studies on the extent of penetration and contamination. Factors within the subsoil that affect leachate will be delineated and an evaluation of present and long-range effects will be performed.
Keywords: fossil-fuel power plants; leaching; ponds; waste water; trace amounts; elements; chromatography; soils; ground water; environmental impacts; diffusion.

150108 Characterization of Effluents from Coal-Fired Utility Boilers for EPA: Chlorinated Once-Through Condenser Cooling Water Study Task. Seaman, C.V. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others the immediate objective to examine the magnitude of chlorinated organics produced in a once-through cooling system, to assess the quantities of total residual chlorine and its components (free and combined residual chlorine), and to determine efficacy of present chlorination practices. The mid-term objective is to develop a methodology for chlorine minimization/optimization studies. The long-range objective is to demonstrate such a methodology. The scope of the task consists of field sampling and laboratory analysis of chlorinated organics included on the priority pollutant list. Also, identification of organic precursors and amino acid concentrations in raw river water samples will be performed. This work will be performed on samples from four TVA steam plants. An outside laboratory will perform some of the necessary analytical work. Chlorine residuals (free and total) being discharged are measured at the outlet of a condenser. Chlorination cycles will be set at different rates, frequencies, and lengths of feed. The effluents and the condenser performance will be monitored to qualify and quantify the efficacy of the different chlorination cycles and rates.
Keywords: chlorine; chlorinated aliphatic hydrocarbons; cooling systems; fossil-fuel power plants; efficiency; sampling; chemical analysis; amino acids; rivers; tennessee valley authority; chlorination.

150109 Characterization of Effluents from Coal-Fired Utility Boilers for EPA: Design of Monitoring Program for Ash Pond Effluents Task. Ogle, K.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to characterize the composition of effluent streams from coal-fired power plants and to determine if methods of control are necessary. The primary objective of this task is to establish sound monitoring frequencies necessary to yield an adequate degree of confidence in representing ash pond discharge characteristics and to determine if the power plant is a net discharger. Special emphasis will be placed on trace elements. The scope of this task is to sample ash pond effluents at Colbert and Kingston Steam Plants with a frequency that is based on a statistical evaluation of past effluent data. Based on this program, TVA will be able to determine the sampling frequency to yield data representative of ash pond discharges.
Keywords: monitoring; ashes; ponds; waste water; sampling; fossil-fuel power plants.

150110 Characterization of Effluents from Coal-Fired Utility Boilers for EPA: Effects of pH Adjustment and Suspended Solids Removal on Trace Metals in Power Plant Ash Pond. Ogle, K.L. (TVA, 1140 Chestnut Street Tower II, Chattanooa, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to characterize the chemical composition of effluent streams from coal-fired power plants and to determine if methods of control are necessary. The primary objective of this task is to perform laboratory studies on the settling characteristics of bottom and fly ash in order to determine the settling time needed to meet (BATEA) total suspended solids standards and to determine if there is adsorption of trace elements on the suspended solids after pH adjustment to meet standards. The scope of this task will involve obtaining fly and bottom ash from Kingston and Colbert Steam Plants and to determine the settling time required to meet effluent guidelines. At the settling time required to meet effluent standards, the samples will be pH adjusted to meet effluent standards and various water quality parameters will be measured (especially trace elements) to see the net effect on the water quality of pH adjustment.
Keywords: waste water; fossil-fuel power plants; fly ash; ashes; sedimentation; trace amounts; elements; suspensions; standards; water quality; ph value.

150111 Characterization of Effluents from Coal-Fired Utility Boiler for EPA: Characterization of Coal Pile Drainage Task. Ogle, K.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to characterize the chemical composition of effluent streams from coal-fired power plants and to determine methods of treatment and/or control. The primary objective of this task is to characterize the drainage from coal piles as a function of rainfall. Special emphasis will be given to trace elements and priority pollutants. The scope of this task will involve monitoring the coal pile drainage from two TVA coal-fired plants. Samples will be taken by an automatic sampler, composited and sent to the Laboratory Branch of Environmental Planning. The samples will be analyzed for 17 trace elements, total suspended solids, total dissolved solids, alkalinity, hardness, and pH. Laboratory column elution tests will be conducted on coal samples to attempt to predict runoff characteristics. Rain samples will also be taken for analysis. Methods of treatment for this effluent stream will also be examined.
Keywords: chemical composition; waste water; fossil-fuel power plants; pollution control; trace amounts; elements; monitoring; coal; tennessee valley authority; rain; quantitative chemical analysis; water treatment.

150112 Characterization of Effluents from Coal-Fired Utility Boilers for EPA: Model Prediction of Scale Formation in Recirculating Evaporative Cooling Systems Task. Boroughs, R.D. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has a Thermal Control Subprogram and an Effluent Control Subprogram which include in their objectives the assessment, demonstration, and optimization of technology for controlling thermal and nonthermal effluents, respectively. The objective of this project is to provide a verified process model of $CaCO_3$ scale formation in cooling systems which can then be used to define the constraints of cooling tower operation in modeling various reuse/recycle options. A pilot cooling system will be used to study the effects of various parameters of $CaCO_3$ scale formation. A computer model of the relevant processes will then be constructed, calibrated, and verified on the basis of this data. The verified process model will then be of value nationwide in the prediction and control of $CaCO_3$ scale.

Keywords: thermal effluents; calcium carbonates; cooling systems; pilot plants; scale control; recycling; scaling.

150113 Characterization of Effluents from Coal-Fired Utility Boilers for EPA: Treatment of Chemical Waste Waters from Coal-Fired Power Plants With Special Emphasis on Trace Contaminant Task Removal. Magliente, S.H. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant monitoring.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to evaluate the ability of activated carbon and macroreticular resins to remove chlorinated organics. The primary objective will be to evaluate the removal of chloroform, bromodichloromethane, and dibromochloromethane from chlorinated condenser cooling water. The midterm objective would be to demonstrate through laboratory tests on river water the usefulness of this technology for such an application. The long-range objective would be to demonstrate such a treatment system on a power plant waste water. The study will evaluate the ability of activated carbon and macrorecticular resins to remove chloroform, bromodichloromethane, and dibromochloromethane by conducting adsorption isotherms, and column adsorption studies.
Keywords: activated carbon; waste management; chloroform; brominated aliphatic hydrocarbons; chlorinated aliphatic hydrocarbons; resins; pollution control; adsorption; sorptive properties.

150114 Fly Ash Characterization and Disposal for EPA: Characterization of Cool and Ash Task. Zielke, R.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an objective to investigate ashes and their effluents. The objective of this project is to characterize ashes and their waste effluents. The scope of this project is to provide information concerning the trace elements in coal and ashes, characterize ashes and waste effluents of two TVA plants, and provide a mass balance for trace elements for these plants.
Keywords: fly ash; ashes; chemical composition; trace amounts; elements; coal; fossil-fuel power plants; tennessee valley authority; waste management.

150115 Fly Ash Characterization and Disposal for EPA: Fly Ash Handling Systems Task. Ogle, K.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Research Program has an Effluent Control Subprogram which has among others an immediate objective to determine methods of effective fly ash handling. The objective of this task of the program is to examine fly ash handling systems and the problems associated with ash handling. The scope of the project includes a literature survey and summary of available information on wet and dry fly ash handling systems. The approach also includes small-scale studies of dry handling systems and wet handling systems, cost estimates for some ash handling systems, and recommendations of promising systems.
Keywords: fly ash; waste disposal; materials handling; cost; waste management.

150116 Fly Ash Characterization and Disposal for EPA: Disposal and Utilization of Fly Ash Task. Zielke, R.L. (TVA, 1140 Chestnut Street Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(100) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Program has an Effluent Control Subprogram which has among others an objective to investigate ashes and their effluents. The objective of this project is to provide a literature survey on the current state-of-the-art techniques concerning fly ash disposal and utilization. National and international literature on bottom ash and fly ash disposal, handling, utilization, reuse, and recycle will be reviewed. This includes discussion in the National Ash Association, Edison Electric Institute, Electric Power Research Institute, AEP, and others. Through telephone and field trips, present and projected methods of ash disposal and utilization will be identified with the TVA system of 12 steam plants.
Keywords: fly ash; waste disposal; uses; materials handling; recycling; waste product utilization; tennessee valley authority; fossil-fuel power plants; waste management.

150117 Advanced Waste Heat Control for EPA: Demonstration of Wet/Dry Cooling Tower. Boroughs, R.D. (TVA, 1140 Chestnut St. Tower II, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: Coal(50); nuclear fission(25); hydroelectric(25) **R and D categories:** Pollutant characterization and analysis.

The Waste Water and Solid Waste Control Research Program has a Thermal Control Subprogram which has among others an objective to evaluate cooling technology. The primary objective of this task is to evaluate the engineering and environmental aspects of wet/dry cooling towers. Additionally, a system optimization model will be developed to identify the optimum turbine, condenser, and cooling system configuration. The scope of this task consists of purchasing a demonstration wet/dry tower and then testing the tower to verify models of performance, reduction in water usage, and plume dispersion. An evaluation of the engineering and environmental effects of wet/dry cooling will be conducted. A Westinghouse Electric Corporation (WEC) system optimization model will be purchashed and developed to identify the optimum turbine, condenser, and cooling system configuration.
Keywords: demonstration programs; cooling systems; optimization; cooling towers; performance testing; plumes; water requirements; environmental effects; thermal power plants; technology assessment.

NUCLEAR REGULATORY COMMISSION

160000 Develop Striped Bass Young-of-the-Year Model on Hudson River. Barnthouse, L.W. (Oak Ridge National Laboratory, P.O. Box X, Building 1505, Oak Ridge, TN, 37830). **Project number:** B-0165. **Contract:** B-0165. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$92,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The purpose of the project is to develop and apply computer simulation models and other methods of quantitative analysis in assessing effects of power plant entrainment and impingement on striped bass populations in the Hudson River. The key objectives are: (1) develop and apply empirical entrainment and impingement methodologies to estimate entrainment and impingement impacts of Hudson River power plants; (2) develop and apply a methodology to examine and correct for biases inherent in present formulae used to calculate probability of mortality for live organisms entrained by power plants; (3) develop and apply a stock-recruitment model and methodology for testing validity of certain types of fits of stock-recruitment curves; (4) perform independent analysis of the Texas Instruments 1974-1975 data sets relating to relative contribution of Hudson River striped bass population to Atlantic Coastal fishery; (5) develop and apply methodologies to estimate ratio of density of striped bass ichthyoplankton entering power plant intake to cross-sectional average density in river in vicinity of power plants; and (6) develop and apply quantitative methods of analysis for California and Maryland striped bass stocks. Models and other methods of analysis developed to date have figured prominently in environmental impact assessments and hearings on Hudson River power plants.
Keywords: thermal power plants; new york; new jersey; hudson river; condenser cooling systems; intake structures; environmental effects; striped bass; impingement; entrainment; biological effects; mortality; population dynamics; ichthyoplankton; mathematical models; simulation.

160001 Impacts on Hudson River White Perch. Barnthouse, L.W. (Oak Ridge National Laboratory, P.O. Box X, Building 1505, Oak Ridge, TN, 37830). **Project number:** B-0423. **Contract:** B-0423. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The project objectives are: (1) to collect, compile, and analyze data and other information on white perch impingement losses at power plants on the Hudson River; (2) to estimate the exploitation rate and condition mortality rate due to impingement; and (3) to document in a final report the results of the imminent analysis and to make a determination whether the impingement losses are having a potentially adverse impact on the white perch population in the Hudson River.
Keywords: hudson river; fishes; environmental impacts; data acquisition; data analysis; impingement; power plants; mortality; population dynamics.

160002 Containment Analysis Development. Wells, R.A. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A-6042. **Contract:** A-6042. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$510,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective is the development of multidimensional transient compressible flow program, BEACON, to perform best estimate calculations of containment pressure and temperature response. Work has progressed through the development of BEACON/MOD3 and a comprehensive code assessment program is being undertaken.
Keywords: bwr type reactors; pwr type reactors; containment systems; mathematical models; computer codes; k codes; compressible flow.

160003 PBF Experimental Engineering. MacDonald, P.E. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A-6041. **Contract:** A-6041. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$6,888,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The Power Burst Facility (PBF) is a testing tool to obtain data on the performances of fuel rod clusters under abnormal power flow and energy density conditions. The data obtained will be used to develop or confirm analytical capability which can be used to predict fuel response in power reactors during off-normal operating conditions. Nuclear irradiation tests will be performed on single fuel rods or clusters of fuel rods under abnormal conditions. Tests will be performed to characterize the behavior of a single rod and a nine-rod bundle of unirradiated PWR fuel rods at power densities from the normal operating range through the range where departure from nuclear boiling (DNB) is exceeded. These tests determine the modes, mechanisms and consequences of fuel cladding failure under various overpower and/or undercooling conditions. The PCM tests to be performed in FY 1980 are PCM-7 (9-rod). The PBF LOCA test series is being performed to determine the behavior of PWR-type fuels under LOCA conditions, including ballooning that could occur in prepressurized rods. The 4-rod blowdown LOCA tests LOC-6 and LOC-7 are planned for FY 1980. The RIA tests will determine test fuel rod behavior and fuel failure thresholds that might result from a reactivity initiated accident. RIA1-4, a 9-rod test with preirradiated rods is scheduled for FY 1980. A rewet, stored energy test, PR-1, is also scheduled for FY 1980. Three RIA tests, RIA1-3, RIA1-6, and RIA1-7, and three abnormal operational transient tests, OPT1-1, OPT1-2, and OPT1-3, are scheduled for FY 1981, together with preparation for the first severe damage small break LOCA test in late FY 1980 or early FY 1981.
Keywords: pbf reactor; reactor operation; pwr type reactors; fuel elements; fuel element clusters; reactor accidents; reactor safety; fuel element failure; loss of coolant.

160004 Fission Product Transport Analysis. Gieseke, J.A. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** A4078. **Contract:** A-4078. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$362,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide methodology for analyzing transport and deposition of fission products during a range of accident conditions in LWRs and spent fuel transportation casks. Initial emphasis was on behavior in the primary system of LWRs during controlled-LOCA and in the spent fuel cask during LOCA. The work has been extended to address fission product behavior during hypothetical meltdown accidents in LWRs. The results of the analyses can be used to help evaluate the degree of conservatism in current accident analysis assumptions, assist in the design of experiments for verification of the models developed, and form the basis for more detailed model development should the need arise. The technical approach being followed superimposes analytical models of the transport and deposition properties of the various chemical and physical forms of fission products in a steam environment on state-of-the-art calculations of thermal hydraulic conditions during design basis LOCA or on estimates of thermal hydraulic conditions during assumed meltdown situations.
Keywords: bwr type reactors; pwr type reactors; loss of coolant; spent fuel casks; primary coolant circuits; fission products; deposition; radioactive aerosols; radioactivity transport; calculation methods.

160005 Natural Convection in Molten Pools. Kulacki, F.A. (Ohio State University, Department of Mechanical Engineering, Columbus, OH, 43201). **Project number:** A4061. **Contract:** A-4061. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$45,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The project objective is to develop correlations for determining heat transfer rates by natural convection from enclosed fluid volumes having internal heat generation. This is an important safety consideration in the evaluation of the postaccident heat removal capabilities for both thermal and fast reactors under postulated core melt conditions. Heat transfer experiments will be performed examining effects of geometry and multiple layers and analytical representations of the results will be derived.
Keywords: power reactors; reactor cores; meltdown; liquid metals; heat transfer; natural convection; after-heat removal.

160006 Fission Product Release from LWR Fuel. Malinauskas, A.P. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0127. **Contract:** B-0127. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$340,000.
Related energy source: nuclear fusion(100) **R and D categories:** Pollutant characterization and analysis.

Initially this program was developed primarily with the aim toward supplanting existing information which is incomplete or inconsistent as regards fission product behavior during release from Light Water Reactor (LWR) fuels as might occur in controlled loss of coolant accidents (LOCA) or spent fuel transportation accidents (SFTA). Currently the objective is to extend the studies to include conditions approaching core meltdown. Emphasis is placed on defining the chemical and physical forms most likely to result from interactions between fuel, fission products, cladding, and coolant, and on improving the precision attending predictions of gap release fraction.
Keywords: bwr type reactors; pwr type reactors; loss of coolant; fuel elements; spent fuel elements; accidents; transport; fission product release.

160007 Fuel Behavior Verification. Hobbins, R.R.; Bohn, M.; Dearien, J.A. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A 6046. **Contract:** A-6046. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,825,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

This project encompasses: (1) assistance to the Division of Reactor Safety Research in the development and coordination of a comprehensive program for determining the behavior of reactor fuels under abnormal and accident conditions; (2) the development of detailed analytical and experimental project descriptions; (3) the evaluation of experimental data and the development and verification of LWR fuel and cladding material property correlations, including properties for plutonium recycle fuel; (4) the verification of analytical fuel behavior models by comparison of calculations with appropriate experimental data; (5) the fabrication and irradiation of certain instrumented test assemblies in the Halden Reactor; and (6) the development and execution of a program for postirradiation examination of typical power reactor fuel. Pertinent experimental data will be obtained and codes will be checked against these dates.
Keywords: bwr type reactors; pwr type reactors; fuel elements; fuel element failure; performance; transients; reactor accidents; performance testing; data compilation.

160008 Fuel Behavior Model Development. Bohn, M. (Eg and G Idaho Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6050. **Contract:** A-6050. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$538,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to provide computer codes to predict the behavior of fuel rods in light water nuclear reactors during normal and transient conditions. The plastic deformation and creep effects incorporated into FRACAS-II Subcode is being slipped to August 31, 1978. This delay will have no impact on subsequent milestones further downstream. The advanced version of GRASS was linked to FRAP-T. The COBRA IV, multi channel thermohydraulic code was linked with FRAP-T and a report describing the linkup was issued (CDAP-TR-017). A preliminary draft of the automated statistical analysis to be added to FRAP-T has been completed and remaining work is proceeding on schedule. The initial programming of FRAPCON-1 is complete and the developmental verification and documentation underway. FRAP-T5 development is continuing. The preliminary Rod Bowing Effect Model for the FRAP-T Code was issued.
Keywords: bwr type reactors; pwr type reactors; fuel elements; transients; mathematical models; p codes; computer codes.

160009 Creare Downcomer Effects Program. Rothe, P.; Crowley, C.J. (Creare, Inc., Hanover, NH, 03755). **Project number:** A4070. **Contract:** A-4070. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$607,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The FY 1978 objectives are as follows: (a) develop phenomena-based best-estimate semi-empirical models to predict transient plenum refill rates and phenomena affecting system behavior during the ECC injection phase and (b) develop preliminary scaling hypotheses relating to transient plenum refill and phenomena affecting system behavior during the ECC injection phase. The approach is a combination of experimental and model development activities. Experiments on the 1/15 scale can be conducted at Creare, and use is made of 2/15 scale experimental data from Battelle-Columbus, Dartmouth experiments, Semiscale and LOFT results. The desired result is an experimentally derived semi-empirical model which can predict transient lower plenum refilling.
Keywords: pwr type reactors; reactor safety; loss of coolant; eccs; performance; hydraulics; liquid flow; mockup; testing.

160010 Steam-Water Mixing and System Hydrodynamics Program. Collier, R. (Battelle Columbus Labs., 505 King Street, Columbus, OH, 43201). **Project number:** A4048. **Contract:** A-4048. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$850,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective is to conduct experimental studies which investigate the steamwater interactions including ECC penetration and sweepout in 1/15 and 2/15 scale models of PWR's. The data and results of these studies will be used to develop empirical models for use in best estimate analysis of loss-of-coolant accidents. FY-79 activities are directed at identifying and establishing the physical basis for scaling relationships pertinent to ECC bypass phenomena and at determining the validity of using steady-state results for predicting transient behavior. Experimental studies will be conducted in a 2/15 PWR vessel model to evaluate ECC penetration and refill processes, and correlations for prediction of the transient refill process will be developed.
Keywords: pwr type reactors; eccs; performance; reactor safety; configuration; hydraulics; two-phase flow; mockup; entrainment; functional models.

160011 PWR Blowdown Heat Transfer Separate Effects Program. White, T.D. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0125. **Contract:** B-0125. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$4,750,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The PWR-BDHT program is a separate effects program designed to investigate transient heat transfer phenomena within an electrically powered fuel pin array. In addition to LOCA transients, high pressure (600 to 1000 psi) bundle uncovery experiments will be conducted. Specific data to be obtained include: (1) time-to-CHF under rapid depressurization; (2) bundle film boiling and transition boiling effects; (3) bundle uncovery/recovery heat transfer effects; and (4) comparisons of transient and steady-state derived heat transfer correlations.
Keywords: pwr type reactors; reactor safety; loss of coolant; blowdown; heat transfer; fuel assemblies.

160012 Inspection of Nuclear Reactor Welding by Acoustic Emission. Prine, D.W. (General American Research Division, 7449 Natchez Avenue, Niles, IL, 60648). **Project number:** A4052. **Contract:** A-4052. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

Project objectives are: (1) to develop the techniques for continuous monitoring of welding of nuclear components, such as pressure vessels and piping by acoustic emission; (2) to prove the feasibility of the technique under shop conditions and validate the acoustic emission findings by currently accepted NDE techniques; (3) to provide data for ASME code acceptance of the inspection practice; (4) to develop, build and validate prototype monitors for "no-hands" service in shops for nuclear pipe and pressure vessel welding; and (5) to verify the capability of advanced AE monitors to detect and discriminate different flaw types and sizes. Flaw detection has been demonstrated by acoustic emission during welding a variety of piping and in pressure vessel steel in commercial welding shops. AE discrimination signatures have been developed for slag inclusion and for cracking and AE sizing for welding flaws.
Keywords: bwr type reactors; pwr type reactors; reactor components; reactor cooling systems; welded joints; acoustic emission testing; inspection.

160013 Design Criteria for Piping and Nozzles. Moore, S.E. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0123. **Contract:** B-0123. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$400,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The Design Criteria for Piping and Nozzles Program is generating data for use in satisfying structural safety criteria in the design of nuclear plant pressure boundary components, and for use in assessing the adequacy of current structural analysis methods and design qualification rules. The program is organized into eight major tasks including administration, PVRC and ASME Code efforts and NRC Licensing support, and six tasks identified with specific components. Extensive studies are being conducted on the structural behavior of piping system components such as straight pipe, elbows, tees, reducers, etc., welded and flanged joints in pipe, and reinforced openings, i.e., isolated and closely-spaced nozzles, in cylindrical pressure vessels over dimensional ranges and loading conditions that are typical for light-water reactor plant design.
Keywords: pwr type reactors; bwr type reactors; pressure vessels; pipes; nozzles; stress analysis; stresses; configuration.

160014 Crack Arrest Study. Rosenfield, A.R. (Battelle Memorial Institute, 505 King Avenue, Columbus, OH, 43201). **Project number:** A4046. **Contract:** A-4046. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$512,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The project objective is to establish a crack arrest methodology for heavy-walled pressure vessels fabricated from nuclear grades of steel.
Keywords: bwr type reactors; pwr type reactors; pressure vessels; cracks; testing; two-dimensional calculations.

160015 Structural Integrity of Water Reactor Pressure Boundary Components. Loss, F.J. (Naval Research Laboratory, Code 6390, Washington, DC, 20375). **Project number:** B5528. **Contract:** B-5528. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$775,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The project has the following objectives: (1) assess materials behavior in relation to structural safety and reliability for pressure boundary components of light water reactors; (2) develop an understanding of fast fracture and low cycle fatigue phenomena in terms of continuum mechanics and metallurgical factors; (3) identify metallurgical factors and evolve guidelines for radiation resistant steels; (4) investigate procedures for periodic reduction of radiation induced property changes; and (5) evolve engineering criteria for reliable strucural performance and long term operation.
Keywords: materials testing; physical radiation effects; steels; fatigue; fractures; pressure vessels; performance testing; reactor materials; pwr type reactors; bwr type reactors; reactor safety; reliability.

160016 Source Term Measurements. Mandler, J.W. (EG and G Idaho, Inc., Idaho National Engineering Laboratory, Idaho Falls, ID, 83415). **Project number:** A6075. **Contract:** EY-76-C-07-1570. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$699,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objectives of the program are to provide verified empirical source term data for PWRs; to provide performance data on reactor plant process equipment; to develop analytical capability to adequately collect and measure radioiodines, particulates, C-14 and tritium species at levels appropriate for verifying compliance with ALARA limits; and to measure radiation fields in selected plant operating areas for evaluation of dose rate source terms and dose rate models.
Keywords: pwr type reactors; radioactive effluents; reactor operation; activity levels; fission product release; gamma radiation.

160017 Heavy-Section Steel Technology Program. Whitman, G.D. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0119. **Contract:** B-0119. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,990,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The Heavy-Section Steel Technology Program is providing data which is used in the prediction of thick-section vessel fracture characteristics to include a realistic evaluation of the fracture potential and the development of fracture prevention criteria. Flaw growth mechanisms, crack propagation and arrest including the effects of irradiation in both design and accident loading conditions are being considered. The significance of cracks residing in weld

repair regions and in low shelf toughness material are being quantified. The program includes tests on pressure vessels and specimens up to 6 inches thick. Results from these efforts contribute to the needs of regulatory and safety bodies, code writing bodies, and the nuclear power industry.
Keywords: pwr type reactors; bwr type reactors; pressure vessels; fractures; steels; fracture properties; performance testing; mockup; reactor materials; stresses; defects.

160018 Improved Ultrasonic Non-Destructive Testing of Pressure Vessels. Ganapathy, S. (University of Michigan, Department of Electrical and Computer Engineering, Ann Arbor, MI, 48109). **Project number:** A4047. **Contract:** A-4047. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$130,000.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

A system is to be developed for reliably determining the size of flaw indications to within the limits set by the new ASME Boiler and Pressure Vessel Code requirements as published in the Summer 1973 Addenda. This is to be done by computer-processing of ultrasonic pulse-echo data from a phase-sensitive synthetic array of transducers. Feasibility of this concept is expected to be demonstrated within the first six months of the contract period using test specimens having machined discontinuities, which have been made from materials used in reactor pressure vessels. To be demonstrated is that the phase-sensitive array is superior to the conventional pulse-echo systems in determining the size, shape, and orientation of a discontinuity.
Keywords: bwr type reactors; pwr type reactors; pressure vessels; testing; defects; nondestructive testing; cracks; ultrasonic testing.

160019 Research Program--Uranium Mill Tailings. Kisieleski, W.E.; Momeni, M.H. (Argonne National Laboratory, 9700 S. Cass Avenue (EIS-10), Argonne, IL, 60439). **Project number:** A2046. **Contract:** A-2046. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$269,000.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

The purpose of this study is to obtain experimental data for the prediction of impacts of uranium milling operations on public health and the environment. The data will provide the Nuclear Regulatory Commission (NRC) with a base for the development of a methodology to establish compliance with environmental standards, and a generic evaluation of the impacts of uranium milling operations. The objectives of this field study program at operating uranium mills are as follows: (1) to provide measurements which can be used as a basis for estimating and characterizing the airborne effluent release rates (source terms) for uranium milling activities [This would include release rates of radioactive particulates (specific nuclides) and radon-222 from (a) mill stacks and vents, (b) ore piles, and (c) tailings piles.]; (2) to provide data which can be used to confirm predicted offsite environmental concentrations (based on source terms and dispersion calculations); or which can form the data base for revising estimates of release rates (particularly for releases from area sources such as tailings piles and ore pads); (3) to evaluate the potential radiological significance of food ingestion pathways resulting from airborne effluent releases from uranium mills. Primarily focus is on ingestion exposures associated with grazing animals and locally raised food crops or garden produce; and (4) to test, demonstrate, and evaluate environmental monitoring methods and techniques in order to provide information for developing regulatory guidance for these monitoring programs. The program is achieving its initial goal of providing input data from milling operations for the generic statement.
Keywords: feed materials plants; environmental impacts; radiation hazards; radon 222; radioactive effluents; radiation monitoring; radioecological concentration; mill tailings; particles; radioisotopes.

160020 Threadfin Shad Impingement: Population Response. McLean, R.B. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** B0406. **Contract:** B-0406. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$191,000.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Health effects assessments.

The impact of cooling water systems on fisheries is assessed in NRC's environmental impact statements. Threadfin Shad Impingement: Population Response is a study of the mechanisms influencing fish kills at nuclear power plants designed: (1) to develop the causal link (if any) between intake structures and mortality of threadfin shad collected on intake screens; (2) to assess the effect of cold water temperatures on the susceptibility of threadfin shad (dorosoma petenense) to impingement on intake screens and to predation by game fish (i.e., sauger); (3) to assess the effects of sauger on threadfin shad as prey; (4) to determine the possibility of using blood chemistry (serum electrolytes) as a method to quantify lethal and sublethal stress in threadfin shad; and (5) to determine mechanisms used by threadfin shad to rebound from population crashes. Results to date have allowed a judgement to be made concerning both the cause of impingement of threadfin shad and the resulting effects on community functions in Watts Bar Reservoir. The results also allow conclusions to be drawn concerning the probable cause of impingement of threadfin in other systems that have similar environmental characteristics and intake structures. Rebounding mechanisms include increased egg hatching success as egg density decreases and y-o-y spawning.
Keywords: nuclear power plants; condenser cooling systems; intake structures; environmental effects; fishes; impingement; biological effects; mortality; population dynamics; temperature effects; aquatic ecosystems; ecology; biological stress; behavior.

160021 Analysis of the Effects of Natural Phenomena upon Existing Plutonium Fabrication Facilities. Carson, J.E. (Argonne National Laboratory, Division of Environmental Impact Studies, Argonne, IL, 60439). **Project number:** A2150. **Contract:** A-2150. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$200,000.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

The objectives are: (1) to determine the ability of existing structures containing plutonium to resist severe wind storms including tornadoes; (2) to establish the diffusion and deposition of special nuclear materials by severe storms; and (3) to determine the radiological effects of such an event. Seven teams of specialists from around the country are studying six existing mixed oxide fuel fabrication and/or research facilities. A meteorologist from the Univ. of Chicago calculated the probability of winds equaling or exceeding a given wind speed for each site and also developed a descriptive model of the tornado vortex. A scientist from the Savannah River Lab in SC developed a mathematical model of dispersion of particulates plus rainout/washout by tornadic clouds. The strength of the buildings containing plutonium and their probable mode of failure during tornadoes and strong straight line winds were determined by an engineering team from Texas Tech. The amount of materials released as a function of storm intensity were determined by scientists from Battelle PNL for input into SRL dispersion model. Demographers from Argonne determined the population statistics for the area within 80 km of each facility. Meteorologists from ANL have provided data on the climatology of each site and estimates of dispersion during normal and straight-line strong wind events. A team of radiologists from Battelle PNL calculated the radiological impact of severe storms. The severe storms analysis is one part of NRC's analysis of the safety and environmental impact of severe natural phenomena on facilities containing Pu. The other two events are floods and earthquakes. The methods, models and procedures can be used to determine the potential safety hazards of a damaging natural phenomenon on any structure containing hazardous materials and to assess the risks associated with non-NRC licensed facilities containing special nuclear materials.
Keywords: fuel fabrication plants; plutonium oxides; tornadoes; storms; safety engineering; seismic effects; floods; earthquakes; radionuclide migration.

160022 GEIS on Handling and Storage of Spent Light Water Power Reactor Spent Fuel. Novick, M. (Argonne National Lab., 9700 S. Cass Avenue (EIS-11A), Argonne, IL, 60439). **Project number:** A-2142. **Contract:** A2142. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$60,000.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

The objective of the project is the preparation of a generic environmental impact statement (GEIS) on the handling and storage of commercial LWR spent fuel through the year 2000 in the absence of spent fuel reprocessing. The GEIS will address (1) the relationship between expected spent fuel generation and the capacity of storage facilities to accommodate it, (2) the alternatives available or possible for spent fuel storage and the alternatives to the continued generation of spent fuel, (3) a cost-benefit analysis of the environmental, social and economic factors; the commitment of resources for spent fuel storage; the relationship between short-term uses of the environment and its long term productivity for the various alternatives considered, (4) the implication of transportation requirements, (5) the implications that may affect licensing requirements, and (6) possible amendments that will be needed to the regulations that govern the handling and storage of spent fuels. Final GEIS on handling and storage of spent light water power fuel will be published as NUREG-0575.
Keywords: bwr type reactors; pwr type reactors; spent fuel storage; environmental impact statements; forecasting; research programs; planning.

160023 Licensing Program Support--Environmental Assistance for the Office of Nuclear Materials Safety and Safeguards. Gustafson, P.F. (Argonne National Laboratory, 9700 South Cass Ave. (EIS-10),

Argonne, IL, 60439). **Project number:** A2153. **Contract:** A-2153. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$55,000.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

The objective is to prepare environmental assessments and environmental impact statements for nuclear fuel reprocessing, storage, and recycling facilities. An independent assessment of the potential environmental impacts due to construction and/or operation of a specific nuclear fuel reprocessing, storage or recycle facility is developed by a team of engineers and scientists.
Keywords: environmental impact statements; environmental impacts; fuel reprocessing plants; fuel fabrication plants; spent fuel storage; storage facilities; construction; operation.

160024 Generic Environmental Impact Statement on Uranium Milling Operations. Montet, G.L. (Argonne National Laboratory, 9700 S. Cass Avenue (EIS Building 10), Argonne, IL, 60439). **Project number:** A2143. **Contract:** A-2143. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$391,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the project are: (1) to provide a statement of the environmental impacts of uranium milling in the United States, including an evaluation of the local, regional, and national impacts on both short- and long-term bases; (2) to provide information on which to determine the need for additional regulatory requirements for uranium mills, with emphasis on the waste management of mill tailings; and (3) to support any rule makings and/or requests for modifications of statutory authorities that may be determined to be desirable. A team of personnel knowledgeable in the required areas was assembled to obtain and evaluate data and to prepare the generic statement. A preliminary version of the draft generic statement has been completed, the draft is in preparation, and the final statement will be prepared after public comments have been received.
Keywords: feed materials plants; environmental impacts; mill tailings; uranium ores; ore processing; radon; radioactive effluents; radioactive waste management.

160025 Licensing Program Support--Environmental Review Support for the Office of Nuclear Material Safety and Safeguards. Gustafson, P.F. (Argonne National Laboratory, 9700 South Cass Ave. (EIS-10), Argonne, IL, 60439). **Project number:** A2010. **Contract:** A-2010. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$613,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to prepare environmental impact statements for uranium milling facilities. An independent assessment of the potential environmental impacts of specific uranium mills is developed by a team of engineers and scientists.
Keywords: feed materials plants; environmental impacts; environmental impact statements; risk assessment.

160026 Dynamic Studies of Liquid Metal Fast Breeder Reactors and Nuclear Power Plants. Hetrick, D.L. (Univ. of Arizona, Dept. of Nuclear Engineering, Tucson, AZ, 85721). **Project number:** A4065. **Contract:** A-4065. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of this project is to develop analytical methods and computer programs to study the safety and stability of LMFBR systems. The first task is a continuation of development plant system simulation codes and the application of these codes to accident analysis and risk assessment. A second task will provide an improved treatment of equation-of-state data in the evaporation-condensation modeling of accident analysis codes. The third task will be an evaluation of the use of homogeneous solution reactors as drivers for safety test facilities.
Keywords: lmfbr type reactors; reactor safety; reactor kinetics; reactor stability; reactor operation.

160027 Approximate Treatment of the Third Dimension in Numerical Transport Calculations. Lewis, E.E. (Northwestern University, Technology Institute, Dept. of Engineering Sciences and Applied Mathematics, Evanston, IL, 60201). **Project number:** A4079. **Contract:** A-4079. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$40,000.
Related energy source: nuclear fusion(100) **R and D categories:** Environmental effects assessment.

The project will develop approximate methods of treating the third dimension in neutron transport calculations and incorporate them into an existing two-dimensional neutron transport code. Present methods of solving the neutron transport equations in higher order approximations than diffusion theory are restricted to two dimensions. Although a three dimensional transport code has been developed at the Los Alamos Scientific Laboratory (LASL), it is a very expensive code to use, requiring large amounts of computer time. The approximate methods developed in this program should make solution of practical problems on present day computers feasible. The method would be used to solve problems such as: (1) general neutronics of gas cooled fast breeder reactors (GCFBR); (2) effect of sodium voiding in LMFBRs; and (3) power distributions in the blankets of LMFBRs.
Keywords: lmfbr type reactors; gcfr type reactors; reactor kinetics; three-dimensional calculations; neutron diffusion equation; numerical solution.

160028 3D Technical Support and Instrumentation. Rice, R.E. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6100. **Contract:** A-6100. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$3,340,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to provide technical support and instrumentation for the 3-D experimental program. Regarding the instrumentation task, the contractor is to provide the following instruments: (1) twenty-five gamma densitometers; (2) thirty-four liquid level detectors; (3) one hundred and five turbine flowmeters; (4) six drag rakes and seven drag discs; (5) fourteen spool pieces; and (6) six fluid distribution grids. To date, the contractor supplied twenty liquid level detectors, four drag discs, and eight spool pieces.
Keywords: reactor safety; test facilities; reactor instrumentation; design.

160029 Primary Coolant Rupture Study. Danko, J.C. (General Electric, 175 Curtner Ave. Code 581, San Jose, CA, 95114). **Project number:** B3012. **Contract:** B-3012. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$193,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the project are (1) to develop electrochemical potentiokinetic reactivation (EPR) test techniques that can be used in both service and construction phases for evaluating the susceptibility to intergranular stress corrosion cracking (IGSCC) of BWR stainless steel components, and (2) to broaden the EPR data base for failed field components and for the effects of metallurgy and surface treatments so that the EPR techniques and evaluations can be applied to welded components with a high level of confidence.
Keywords: bwr type reactors; reactor cooling systems; reactor materials; stress corrosion; cracks; stainless steels.

160030 Alternate ECC Concepts. Chapin, D. (MPR Associates, Inc., 1140 Connecticut Avenue NW, Washington, DC, 20036). **Project number:** B5537. **Contract:** B-5537. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$415,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The project has the following objectives: (1) extend the two-phase pump calculational model to allow prediction of torque; (2) assist NRC in reviewing the EPRI and NSSS vendor two-phase pump test programs; (3) assist NRC in implementing the pump data base; (4) provide technical support on the 3D Refill-Reflood Research program; and (5) provide technical assistance in the review of reports and programs as requested by NRC-RSR.
Keywords: bwr type reactors; pwr type reactors; eccs; performance; fluid flow; loss of coolant; design.

160031 LWR Pressure Vessel Irradiation Surveillance Dosimetry. McElroy, W.N. (Hanford Engineering and Development Lab., P.O. Box 1970, Richland, WA, 99352). **Project number:** B5988. **Contract:** B-5988. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$750,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of the project are to: (1) make measurements in standard reference and controlled LWR-pressure vessel benchmark fields using available multiple foil techniques, quartz sensors, and SSTR's; (2) prepare updated and improved ASTM recommended practices for the routine application of validated LWR-dosimetry and surveillance procedures.
Keywords: bwr type reactors; pwr type reactors; pressure vessels; neutron dosimetry; radiation monitoring.

160032 Study of Chemical Toxicity of Low Level Wastes. Stalb, R.A. (General Research Corp., 5383 Hollister Avenue, P.O. Box 3587, Santa Barbara, CA, 93111). **Project number:** B6127. **Contract:** NRC-02-77-183. **Supported by:** Nuclear Regulatory Commission,

Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$63,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

In order to determine the toxicity of low level wastes, the Nuclear Regulatory Commission contracted this work to define parameters to be evaluated (e.g., chemicals associated with the wastes, chemical and radiological toxicity changes with time and environmental interactions). The approach to evaluate chemical toxicity and assessment of secondary hazards related to disposing of the chemical in low level waste disposal sites will also be determined.
Keywords: low-level radioactive wastes; toxicity; radioactive waste disposal; risk assessment.

160033 Study to Determine the Country's Waste Disposal Needs Through the Year 2000. (Teknekron, Inc., Washington, DC, 20016). **Project number:** B6131. **Contract:** NRC-02-77-160. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of this contract are to develop a model or refine an existing model for periodic independent projections of volumes, radioactivity and actinide mass of all nuclear wastes generated on a regional basis through the year 2000 and to develop a method for periodically estimating the costs of waste storage and/or disposal per unit volume of each type of waste defined in the projections model. The contractor was responsible for furnishing the necessary qualified personnel, facilities, and materials to fulfill these objectives.
Keywords: radioactive waste storage; forecasting; cost; mathematical models; volume; radioactivity; actinides; radioactive waste disposal.

160034 Modeling of Pool Swell Hydrodynamics. Sonin, A.A. (Massachusetts Institute of Technology, Cambridge, MA, 02139). **Project number:** B6167. **Contract:** B-6167. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$114,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to develop a basis for small scale modeling of LOCA induced flows in BWR pressure suppression containments by performing experimental and theoretical studies on fluid-structure interactions and their effect on scaling considerations in simulated containment system flows.
Keywords: bwr type reactors; loss of coolant; hydrodynamics; containment systems; dynamic loads; stresses; pressure suppression; condensation chambers; mathematical models; simulation; fluid flow.

160035 Thermal Phenomena of Reactor Accidents. Kazimi, M.S. (Massachusetts Inst. of Technology, Nuclear Engineering Dept., 77 Massachusetts Ave., Cambridge, MA, 02139). **Project number:** B6213. **Contract:** B-6213. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$70,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of this program of experimental and analytical development in LMFBR safety research is to provide additional data and anaytical correlations which will be needed to improve the thermal transfer functions input to the SIMMER code. SIMMER is being developed for NRC at the Los Alamos Scientific Laboratory to evaluate hypothetical core disruptive accidents. Experiments will be performed using simulate materials to study the phenomena involved in thermal exchange between hot and cold fluids when one or both of the fluids is in a liquid-vapor two-phase state. The rate of heat exchange and resulting vaporization or condensation will be determined. Analytical models will be developed to correlate the experimental data with the objective of being able to extrapolate from the simulate data to the material of interest in reactor cores; i.e., fuel (UO/sub 2/), steel and sodium.
Keywords: lmfbr type reactors; reactor core disruption; thermodynamics; heat transfer; mathematical models.

160036 Dosimetry Measurement Reference Data Base for LWR Pressure Vessel Irradiation Surveillance. Grundl, J.A. (National Bureau of Standards, Gaithersburg, MD, 20760). **Project number:** B6224. **Contract:** B-6224. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$83,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The project has the following objectives: (1) provide benchmark neutron field irradiations, a compendium of recommended neutron spectra, and associated reference data for benchmark testing of multiple foil and other detectors employed in LWR pressure vessel dosimetry; (2) perform NBS fission chamber measurements in LWR-PV dosimetry benchmark fields; (3) participate in preparation of recommended practices for routine LWR-PV dosimetry and surveillance which will include detector reference procedures and interpretation; and (4) provide QA checked neutron fluence counting standards for round-robin testing of ASTM recommended practices.
Keywords: bwr type reactors; pwr type reactors; pressure vessels; neutron dosimetry; irradiation; data compilation; monitoring.

160037 LOFT Advanced Fuel Rod Instrumentation Development. Sheen, E.; Yatabe, J. (Hanford Engineering Laboratory, P.O. Box 1970, Richland, WA, 99352). **Project number:** B6228. **Contract:** B-6228. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$350,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to develop advanced LOFT fuel element instrumentation with improved accuracy, lifetime and ease of use.
Keywords: loft reactor; reactor instrumentation; in core instruments; fuel elements; temperature measurement; pressure gages.

160038 Advanced Fracture Mechanics Methodology. Paris, P.C. (Washington University, Box 1087, St. Louis, MO, 63130). **Project number:** B6288. **Contract:** B-6288. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$128,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The program is directed toward developing the methodology required to perform safety analyses under conditions in which stable crack growth occurs. Specifically involved is the determination of fracture toughness from single irradiated small specimens, the analysis methods to be applied, and the development of the tearing instability concept. This program will complement existing NRC programs, and close coordination with HSST, NRL, and NSRDC is required. This work should be applicable to general EPFM analysis methodology.
Keywords: power reactors; reactor materials; fracture properties; calculation methods.

160039 J-R Curve Methodology Development--Computer Interactive. Gudas, J.P. (David W. Taylor Naval Ship Research & Development Center, Code 2813, Annapolis Laboratory, Annapolis, MD, 20006). **Project number:** B6290. **Contract:** B-6290. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$80,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the project is to develop most conservative J/sub I/ versus crack extension relationship incorporating straight crack from coplanar deformation of reactor pressure vessel steels and to describe effects of specimen geometry changes and degree of crack tunneling on J/sub I/ versus crack extension relationship.
Keywords: power reactors; reactor materials; pressure vessels; steels; fracture properties; calculation methods; reactor components.

160040 Environmental Impact Statement on the Sheffield Low-Level Waste Disposal Site. (NUS Corporation, 4 Research Place, Rockville, MD, 20850). **Project number:** B6382. **Contract:** NRC-02-78-035. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$146,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

In the licensing procedure, the Nuclear Regulatory Commission (NRC) requires each facility to submit an Environmental Impact Statement (EIS). To aid them in developing the scope of the EIS, reviewing existing facility information, preparing a draft EIS, and upon NRC consideration of the draft EIS, preparinq a final EIS for the Sheffield renewal/expansion, the technical assistance of the NUS Corporation was contracted.
Keywords: radioactive waste disposal; environmental impact statements; low-level radioactive wastes; maryland; licensing.

160041 Updating the Environmental Survey of the Uranium Fuel Cycle. Daniels, R.S. (NUS Corporation, 4 Research Place, Rockville, MD, 20850). **Project number:** B-6145. **Contract:** NRC-02-78-044. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$270,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The purpose of this contract is to revise and update the report previously issued as WASH-1248, Environmental Survey of the Uranium Fuel Cycle. The contractor is responsible for the project definition which will encompass the fuel cycle from mining to nuclear waste management associated with providing and disposing nuclear fuel for light water reactors. Research into the environmen-

tal effects from facilities, data on occupation exposure, environmental effects from decommissioning, consequences of accidents and natural catastrophies, dose commitment and health effects are included in this work order. The contractor, upon completing his research, will prepare a draft survey and, after review by NRC, a final report on his findings. The principal investigator may also be called upon to participate in any meetings or hearings requiring the presentation or defense of all work which the contractor completes under this statement of work.
Keywords: fuel cycle; environmental impacts; uranium mines; water cooled reactors; radioactive waste management; health hazards; risk assessment.

160042 Atmospheric Dispersion. Van der Hoven, I. (National Oceanic and Atmospheric Administration, Environmental Research Labs., 8060 13th Street, Silver Spring, MD, 20910). **Project number:** B-5690. **Contract:** B-5690. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$265,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the program is to conduct research in meteorological dispersion in order to obtain diffusion parameters for a variety of sites. Field measurements of downwind tracer gas concentrations and related meteorological parameters over a wide range of distances, terrain, weather conditions and source configurations are to be made.
Keywords: lmfbr type reactors; reactor sites; meteorology; site selection.

160043 Evaluation of Docket Files for Terminated Licenses. Dickson, H.W.; Rohwer, P.S. (Oak Ridge National Laboratory, Bldg. 7710, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** A-9085-7. **Contract:** A-9085-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$200,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The technical objectives of the project are to review terminated licenses in the NRC Docket File System, extract pertinent data, create a computer file of this data, and identify which previously-licensed sites potentially could constitute residual radiological safety hazards. The technical approach for meeting these objectives is to prepare and complete a computer input/data analysis form for each closed docket file. The data will be entered into restricted-access computer files for future reference. A decision regarding the potential for residual health hazards will be made based on the information available in the docket files. The final product will be a report which describes the methodology employed and a listing of docket numbers and site locations which warrant categorization as potential health and/or safety hazards. To date, the Part 40 and Part 70 docket file review has been completed and the Part 30 (byproduct) docket file review has been initiated.
Keywords: nuclear power plants; reactor decommissioning; radiation protection; radiation hazards; data processing; legal aspects; data base management.

160044 Programming and Computer Assistance: Cask Analysis and Review. Whitesides, G.E. (Oak Ridge National Laboratory, Computer Sciences Division, Bldg. 6025, Oak Ridge, TN, 37830). **Project number:** B0009. **Contract:** B-0009. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$242,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives of this program are to provide programming, documentation, and validation of computer programs needed to carry out criticality safety and shielding analyses of spent fuel shipping casks, and to perform any analyses required by the Division of Materials and Fuel Cycle Facility Licensing in the evaluation of licensing proposals.
Keywords: licensing; spent fuel casks; criticality; safety; shielding; spent fuel elements; transport; information.

160045 Safety Review of Nuclear Facilities. Frederick, E.J.; Davis, W. Jr. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0102. **Contract:** B-0102. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$355,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of this program is to provide assistance to the Division of Fuel Cycle and Material Safety for the safety review of applications for construction, major modifications, and operation of nuclear fuel cycle facilities and the preparation of generic reports on the fuel cycle as well as other documents and reports as specified by the division. The safety of nuclear facilities and the general risk to the public as a result of the operation of nuclear facilities will be assessed in terms of the consequences of operations during normal and abnormal conditions and the adequacy of the systems provided for the mitigation of the consequences of accidents. The scope of the review program will include, but will not be limited to, an analysis of the design and performance of the following systems and procedures: (1) ventilation; (2) process off-gas; (3) liquid effluents; (4) liquid waste treatments, storage, and solidification; (5) solid waste handling; (6) fuel receipt and storage; (7) mechanical and chemical processing; (8) solvent cleanup; (9) acid recovery; (10) product handling; (11) radiological safety; and (12) instrumentation and controls.
Keywords: nuclear power plants; fuel reprocessing plants; radiation protection; radiation hazards; environmental impacts; radioactive effluents.

160046 Dosimetry and Biotransport Models to Implement ALARA. Killough, G.G. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** B0188. **Contract:** 60-78-121. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$137,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The purpose of this project is to implement advanced dosimetric and environmental transport models and associated data bases to calculate realistic estimates of radiation doses to man. This effort is specifically tailored to meet particular needs of the NRC as the Commission develops capabilities to implement dose limits which satisfy the requirement as-low-as-reasonably-achievable (ALARA). The list of radionuclides treated in this research includes all of those suggested by experience with radiological safety assessments for LWR fuel cycle facilities. Transfer models will be developed to simulate radionuclide movement through specific environmental pathways. A comprehensive biotransport model development program is not envisioned under this project; rather, the intent is to respond to specific needs, to study individual radionuclides and exposure pathways in detail, and to assist the NRC staff in other ways to integrate state-of-the-art dosimetry and biotransport models for assessment of environmental releases of radionuclides. State-of-the-art dosimetry models have been computerized and documented, and calculation of dose conversion factors for significant internal and external exposure modes (i.e., inhalation, ingestion, submersion in contaminated water, immersion in contaminated air, and exposure to a contaminated surface) has been done. A study of terrestrial food-chain pathways is in progress.
Keywords: radionuclide migration; mathematical models; data base management; dosimetry; radiation doses; human populations; environmental exposure pathway; radioisotopes; biological pathways; biological models; rbe.

160047 Environmental Assessments of Fuel Cycle Facilities. Zittel, H.E.; Kelly, M.J. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0279. **Contract:** B-0279. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$450,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of this project is to provide technical assistance to the NRC in the preparation of detailed assessments of the environmental impacts associated with or potentially associated with existing and/or proposed fuel cycle facilities. Included in such facilities may be fuel fabrication facilities, in situ uranium solution mines, uranium mills, ore buying stations, and above ground uranium leaching operations. Assistance will consist of the preparation of draft assessments and/or environmental statements and the development of testimony or other required supportive data as may be required by the environmental impact review process. Such assistance will be provided by a multidisciplinary national laboratory group versed in the assessment of environmental impacts and all other technical aspects of the review process.
Keywords: fuel fabrication plants; feed materials plants; ore processing; solution mining; uranium mines; environmental impacts; uranium ores; leaching.

160048 Advanced Two-Phase Flow Instrumentation. Turnage, K.G. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0401. **Contract:** B-0401. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$120,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the Advanced Two-Phase Instrumentation Program is the application of advanced instrument science to improve accuracy and precision of transient two-phase flow measurements required in reactor safety research. The program is pursuing two general tasks: hardware development and the application of instrument signal correlation and noise analysis to two-phase flow measurements. Hardware development includes the design, farica-

tion, and testing of improved instrumented spool pieces for transient, two-phase flow measurements in primary piping. In addition, in-bundle devices being developed for PWR reflood studies will be applied to non-reflood conditions such as blowdown. In addition, this program develops in-vessel liquid level detector for pressurized water reactors applications.
Keywords: pwr type reactors; reactor safety; loss of coolant; hydraulics; two-phase flow; test facilities; flowmeters; boiling detection.

160049 NRC Measured Data Repository (MDR). Maskewitz, B.F. (Oak Ridge National Laboratory, Building 6025, Oak Ridge, TN, 37830). **Project number:** B0402. **Contract:** B-0402. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The Measured Data Repository (MDR) will serve NRC programs by providing an archival repository of measured, validated, experimental data for future use, and for dissemination. MDR will receive all available measured data and project computed data, generated each year during NRC-contractor and other tests, as it is released following refiling and reformatting by the Data Bank Processing System at INEL. Initially the data will include results from all current LOCA tests as well as selected data from tests already completed. The Repository will provide a common source of raw data for the NRC regulatory and safety research efforts and for the nuclear power industry.
Keywords: reactor safety; reactor accidents; research programs; data acquisition systems; data compilation; information retrieval; information systems.

160050 PWR 3-D Program: Advanced Instrumentation for Reflood Studies Program. Eads, B.G. (Oak Ridge National Laboratory, Building 9201-3, Oak Ridge, TN, 37830). **Project number:** B0413. **Contract:** B-0413. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$2,220,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The Advanced Instrumentation for Reflood Studies (AIRS) Program is a part of the PWR 3-D Program of the USNRC. The goal of the AIRS Program is to develop and supply instrumentation systems for measurement of deentrainment and liquid fallback in LOCA reflood test facilities. Two basic types of instrumentation are being developed. One type, referred to as film probe, is to measure the thickness and velocity of liquid films on the internals of the reflood facilities. The other type, generally referred to as impedance probe, is to measure the velocity and void fraction of the two-phase fluid in the core and upper plenum of the test facilities. The instrumentation systems are to be provided to German and Japanese test facilities on a loan basis from the United States. The development includes both hardware for measurement and software for processing and analyzing the results.
Keywords: pwr type reactors; loss of coolant; reactor safety; hydraulics; two-phase flow; flowmeters; test facilities.

160051 Light Water Reactor (LWR) Pressure Vessel Irradiation Program. Kam, F.B. (Oak Ridge National Laboratory, Building 3047, Oak Ridge, TN, 37830). **Project number:** B0415. **Contract:** B-0415. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$250,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

One of the major problems in the LWR PVS program is the extrapolation of measured data from positions exterior to the pressure vessel to obtain inferred damage rates and flux and spectral information within the vessel. ORNL's program is divided into three major tasks. The first task is the design, construction, and operation of simulated PV wall benchmark facilities. This task includes the fabrication of the instrumented irradiation capsules which are continuously monitored by a process control system capable of maintaining a temperature gradient of 550 degrees F + 20 degrees F on the metallurgical matrices. The second major task is the calculations program which involves the application of current state-of-the-art techniques in the areas of: (1) dosimetry; (2) transport methods, sensitivity analysis, and channel theory; and (3) damage analysis, in particular the proportion of damage caused by neutrons below 1 MeV. The third task is to do the postirradiation testing of the metallurgical specimens beginning in FY-80 The program also includes the preparation of recommended practices for the NRC PVS program.
Keywords: pwr type reactors; bwr type reactors; pressure vessels; steels; reactor materials; physical radiation effects; damage; tensile properties; performance testing.

160052 Eddy-Current In-Service Inspection for Steam Generators. Dodd, C.V. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0417. **Contract:** B-0417. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$105,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Eddy-current examination techniques for steam generators will be developed. These techniques will separate the effects of diameter variations (e.g., denting), probe wobble, tube supports, and conductivity variations from defect size, depth, and wall thickness variations. The state-of-the-art commercial eddy-current tests attempt to separate these six variations with a single frequency, which is not possible if more than two occur at a time. However, these effects can be separated if there are more unique instrument readings than there are test property variations. These unique readings can usually be obtained from multiple-frequency or pulsed eddy-current tests.
Keywords: power reactors; steam generators; eddy current testing; in-service inspection.

160053 Safeguards Analysis for Byproduct Materials and Small Quantities of Special Nuclear Materials (SNM). Chester, R.O.; Randolph, M.L. (Oak Ridge National Laboraory, P.O. Box X, Building 7509, Oak Ridge, TN, 37830). **Project number:** B6108. **Contract:** B-6108. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$50,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The purpose of this study is to examine the question of whether the risk and consequences of theft or sabotage of facilities or vehicles containing small quantities of special nuclear materials (SNM) and byproduct materials are such that licensees should be required to adopt further measures to safeguard them. Phase one of this study was an initial screening of these materials. From this screening candidates for further consideration were identified. In the course of phase two, a detailed examination will be made of the conditions of possession, use, and shipment of the materials identified in phase one. The characterization of the conditions of possession, use, or shipment will identify any current conditions of the referenced materials that contribute significantly to either the protection from or vulnerability to potential attempts at theft, diverson, or sabotage.
Keywords: safeguards; theft; sabotage; by-products; nuclear materials management; radioactive materials; nuclear materials diversion.

160054 Assessment of Respiratory Protection Systems. Hack, A.L. (Los Alamos Scientific Laboratory, Los Alamos, NM, 87545). **Project number:** A7039. **Contract:** 60-78-027. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$132,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to test and evaluate respiratory protection devices and systems that may be used by NRC licensees in order to assess the degree of protection provided in radioactive aerosol environments. NRC licensees utilize materials considered extremely toxic when compared with general industry, so it is necessary that the efficiency and reliability of their health protection measures be quantitated. A main objective of this program is to test and evaluate respiratory protection devices and systems that may be used by NRC licensees under simulated working (stress) conditions in order to assess the degree of protection provided in radioactive aerosol environments. Evaluation of the PF's for the closed-circuit SCBA devices will be continued using the modified activity test procedures and the simulated work stress test protocol. Testing will begin with simple air-purifying devices and progres to the more complex supplied air and self-contained equipment. The test results should assist in the design of a standard series of test exercises that can be performed by any organization that wants to more realistically quantitatively test the fit of respirators on its employees. PF determination of all closed-circuit SCBA units under modified activity test procedures will be completed to permit NRC to define the level of protection provided and identify work situations where these units can be used.
Keywords: respirators; radiation protection; respiratory system; testing; us nrc; radioactive aerosols; health hazards.

160055 Criteria and Test Methods for Certifying Air-Purifying Respirators Against Radioiodine. Wood, G.O. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** A7041. **Contract:** A-7041. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$102,000.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to develop regulatory guidance for acceptance criteria for an air-purifying respirator to protect against elemental, organic vapor and acid gas forms of radioiodine. Such guidance has required experimental studies to determine how and with what efficiencies the sorbents in respirator canisters and cartridges remove

airborne vapors of radioiodine. Testing equipment and procedures are constantly being developed and improved. The goal is a test system of minimum complexity and maximum usefulness in determining the suitability of a given respirator canister or cartridge. Another goal has been to determine whether a nonradiometric test using vapors containing the I-127 isotope could be used to determine sorbent removal of vapors containing I-131. Experimental data accumulated during FY-79 has demonstrated that this is likely. A nonradiometric test would be safer and more acceptable to manufacturers and government agencies. The final acceptance tests, apparatus, and criteria will be recommended to the NRC for approval of air-purifying respirator canisters and cartridges. Results will be published and the test procedures and techniques that have been developed will be transferred to the Testing and Certification Branch of the National Institute for Occupational Safety and Health. They will establish an approval schedule and testing program.
Keywords: iodine isotopes; air pollution; respirators; testing; health hazards.

160056 Radon from Open-Pit Uranium Mining. Kislieski, W.E. (Argonne National Laboratory, Argonne, IL). **Project number:** A-2209. **Contract:** A-2209. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to provide a basis for properly assessing the environmental significance of effluents released to the atmosphere by open-pit uranium mining.
Keywords: uranium mines; environmental impacts; radon; air pollution; particles; radiation hazards; radiation monitoring.

160057 Characterization, Resuspension and Transport of Radioactive Particles from Energy Fuels Extraction and Processing Plants. Schwendiman, L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2095. **Contract:** B-2095. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$332,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The short range objective is to determine the distribution of radionuclides in surface and airborne particles resulting from uranium milling. Longer range objectives include better definition of the sources of airborne waste, the relationship of airborne waste to surface contamination during seasonal changes, and application of transport models to assess the radiological consequences to people in the vicinity.
Keywords: feed materials plants; aerosols; particles; seasonal variations; particle resuspension; air pollution; radioisotopes; distribution; radiation hazards; mill tailings; radiation monitoring.

160058 Radon Exhalation from Uranium Mill Tailings Piles. Perkins, R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2269. **Contract:** B-2269. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$77,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is the development of a new absolute method for the measurement of radon exhalation from a ground surface, and the application of the method to a uranium mill tailings pile.
Keywords: mill tailings; radon; radon 222; radiation hazards; radioactive waste disposal; radiation monitoring.

160059 Radon and Aerosol Release from Open-Pit Uranium Mining. Perkins, R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2279. **Contract:** B-2279. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$274,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide basic information for properly assessing the environmental significance of effluents released to the atmosphere by open-pit uranium mining.
Keywords: uranium mines; radioactive aerosols; radon; environmental impacts; radiation hazards; air pollution; radiation monitoring.

160060 Bulk Properties of Radwaste Glass. Litovitz, T. (Catholic University, Washington, DC). **Project number:** B6330. **Contract:** NRC-04-78-250. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$95,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The goals of the project are: (1) the development of a quantitative relationship between the bulk properties of a glass or ceramic material and its long-term structural stability; and (2) the development of tests for chemical durability of glasses and ceramics that are generally applicable for predicting radwaste container longevity.
Keywords: radioactive waste disposal; glass; ceramics; stability; solidification; radioactive waste management; materials.

160061 Durability of Crystalline Nuclear Waste Forms and Their Natural Analogs at Geologic Storage Conditions. Phillips, M. (Toledo University, Toledo, OH, 43606). **Project number:** B-6624. **Contract:** NRC-04-78-267. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$109,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of the project is to evaluate the durability of crystalline nuclear waste-forms and their natural analogs at geologic storage conditions. The scope of the work consists of three tasks. Task 1 includes an examination of the mineral associations, paragenesis, compositional limits, and frequencies of occurrence of natural analogs of the nuclear waste-form crystal types. A compilation from the GEOREF data base of the geologic occurrence of the natural analogs will be made, then analyzed by multiple regression and analysis of variance methods to determine those analogs that are most persistent in a variety of geologic environments. Task 2 includes an experimental study of the effects of thermal gradients, and separately, the effects of natural geologic fluid composition on cation transport, element partitioning and phase distribution. This task consists of preparing supercalcine-type simulated crystalline nuclear waste-forms using cold purex process formulation PW-4b, PW-7, and PW-7a with added aluminosilicate components as well as molybdate and titanate forms. Task 3 consists of studies of the factors controlling the containment of volatiles such as cesium and of the effects of the presence of variable oxidation state elements. Quantitative information on element partitioning, mineral alteration and mineral reactions will be acquired for use in interpreting results of Tasks 1 and 2 above.
Keywords: radioactive waste storage; geologic deposits; calcination; radionuclide migration; safety; radioactive wastes; stability; underground storage.

160062 Characterization and Environmental Significance of Gases and Particles in Uranium Mine Exhaust Ventilation Air. Schwendiman, L. (Battelle Pacific Northwest Laboratory, Richland, WA, 99352). **Project number:** B-2270. **Contract:** B-2270. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$271,000.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide basic information for properly assessing the environmental significance of effluents released to the atmosphere by uranium mining operations.
Keywords: uranium mines; environmental impacts; gaseous wastes; air pollution; aerosols; particles; radioactive wastes.

160063 HLW Burial: West Valley. Fakuding, R.H. (State Univ. of New York, Albany, NY). **Project number:** B-6350. **Contract:** B-6350. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The project objectives are to develop and test methodologies for quantifying consequences of the operation of nuclear fuel cycle facilities. Results will be used to develop and support policy actions by NMSS relative to shallow land burial sites under current review. The project scope is to conduct geologic, hydrologic, and radiochemical measurements in the vicinity of the high level waste burial area at West Valley, New York.
Keywords: high-level radioactive wastes; radioactive waste disposal; ground disposal; radioactive waste facilities; new york; environmental impacts; geology; hydrology; radiochemical analysis; soils; water; radionuclide migration.

160064 Maxey Flats: Subsurface Radar. Morey, R.; Santeler, S.S. (Geo-Centers, Inc., Newton Upper Falls, MA). **Project number:** B-6349. **Contract:** B-6349. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide information that can be used to develop remote sensing criteria for closing and monitoring existing shallow land burial sites. The feasibility of using subsurface radar profiling as a nonintrusive method of obtaining hydrological and geological information and as a subsurface mapping technique for nuclear waste disposal sites is tested and evaluated. Phase I includes: (1) formulate plans for subsurface radar profiling survey at Maxey Flats during dry season; (2) conduct field test at Maxey Flats; (3) interpret results; and (4) evaluate effectiveness of radar profiling system and the data analysis and interpretative functions.

Keywords: radioactive waste disposal; ground disposal; decommissioning; radioactive waste facilities; radiation monitoring; remote sensing; feasibility studies; radar; data analysis; abandoned sites.

160065 Inadvertent Repositories. (Stanford Univ., Palo Alto, CA). **Project number:** B-6341. **Contract:** B-6341. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are to evaluate evidence of retention and migration of radioactive materials at existing underground geologic locations and to consolidate data on the chemical and physical properties of materials from these locations. Results will be used to assist in testing of analysis models for radionuclide migration and risk assessment. The proposed study will: (1) consolidate the many available indirect evidences of retention and migration of radioactive materials in natural and inadvertent repositories; (2) evaluate and order the data wth respect to reliability and sufficiency; (3) determine what additional laboratory and experimental field data are needed; (4) undertake laboratory experiments to measure other pertinent material characteristics such as leachability; and (5) evaluate by stochastic methods the pertinence of the natural repository data for design of long-term disposal facilities. Cases studied will include natural uranium ore bodies, natural fission reactors, underground nuclear explosion cavities, and underground engineered storage facilities.
Keywords: radionuclide migration; chemical properties; physical properties; radioactive materials; underground disposal; design; natural nuclear reactors; uranium deposits; cavities; underground space; data compilation.

160066 HLW: Particulate Migration. (Georgia Inst. of Tech., Atlanta, GA, 30332). **Project number:** B-6338. **Contract:** B-6338. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective of the project is to observe migration rates and mobilization processes of selected radioactive and activable ions in a model aquifer of sufficient cross section to minimize wall effects and lateral gradients.
Keywords: high-level radioactive wastes; aquifers; radionuclide migration; radioactive waste disposal; underground disposal.

160067 Evaluate Entrainment Effects. (New York State Energy Research and Development Authority, Albany, NY). **Project number:** B-6298. **Contract:** B-6298. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the program are to use a moveable condenser tube simulator to examine the response of entrainable aquatic organisms to physical, thermal, hydraulic, mechanical, and chemical stresses associated with the pumped entrainment process; to provide statistically reliable estimates of mortalities and sublethal effects resulting from the physical and chemical stresses of the entrainment process; and to provide information and data on the design and operation of cooling systems for the purpose of establishing a basis and rationale for recommending improved design changes.
Keywords: nuclear power plants; auxiliary water systems; intake canals; simulation; environmental impacts; entrainment; impingement; aquatic ecosystems.

160068 Radiation Streaming. Cohen, M.O. (Mathematical Applications Group, Inc., Elmsford, NY). **Project number:** B-6206. **Contract:** B-6206. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide the NRR staff with a validated method for assessment of shield designs and radiation streaming through shielding gaps in reactor applications. This will be accomplished by: (1) obtaining data necessary to model streaming pathways at Milestone Unit No. 2; (2) modeling streaming geometries with SAM-CE code; (3) optimizing importance sampling (history forecasting); (4) performing streaming analysis; (5) performing sensitivity analysis; (6) comparing analysis results with available experimental data; (7) providing NRC with a training session on code use; and (8) delivering a final report of results, users manual, and a tape of the code.
Keywords: shielding; radiation streaming; computer codes; reactors; s codes; research programs; computerized simulation.

160069 Burial Ground Survey: New York. Fakuding, R.H. (State Univ. of New York, Albany, NY). **Project number:** B-6008. **Contract:** B-6008. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to provide periodic information for developing geologic and hydrologic criteria for closing and monitoring existing shallow land burial sites. The project's scope is to investigate the potential for radionuclide migration at the West Valley, New York, burial site by considering surface water effects, determining source terms and evaluating land form modification processes; to assess the onsite movement of dissolved radionuclides and the radionuclides sorbed on sediments to determine their capability of being released to offsite environment; and to determine the general pattern of radionuclide migration of backfill material contributing to sediment load of site drainages.
Keywords: radioactive waste facilities; new york; ground disposal; radioactive waste disposal; decommissioning; radionuclide migration; environmental transport; sorptive properties; soils; sediments; geology; hydrology; environmental impacts; abandoned sites.

160070 Charcoal Filter Performance. (Naval Research Lab., Washington, DC, 20357). **Project number:** B-6003. **Contract:** B-6003. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective of this research is to provide the licensing staff with experimentally validated data for use in licensing reviews of the effects of atmospheric contaminants (NOx, SOx, H2O) on the ability of activated charcoals, used in nuclear plant safety systems, to trap methyl iodine present in gaseous releases. The effects of single and combined contaminants appropriate for charcoal application in nuclear power plants will be determined. Several (7 or more) activated charcoals representative of those used in LWR's will be exposed to airborne contaminants. After exposure, the effects on methyl iodide trapping will be determined, either for the bulk charcoal or for successive layers in the flow direction. Exposure plans are: (1) exposure to flow of outdoor air at NRL and other selected locations in the U.S. for periods of one to twelve months; (2) exposure to alternating one month period of flow and non-flow in outdoor air; (3) examination of properties of charcoal from TMI-2; and (4) laboratory exposure to individual and combined contaminants, with flow or simulated storage, for various total exposure of ozone, SO2, NO2, hydrocarbons, methane, CO, and moisture with RH of 50, 70, and 90%.
Keywords: air filters; activated carbon; nitrogen oxides; sulfur oxides; methyl iodide; performance testing; sorptive properties; adsorption; licensing; contamination.

160071 Radiohydrology Tunnel: Sheffield. (Geological Survey, Reston, VA). **Project number:** B-5760. **Contract:** B-5760. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objective is to collect data on geologic and hydrologic parameters of the Sheffield low-level radioactive waste burial site requisite for the development of comprehensive criteria to be used in the selection of new waste sites and for closing and monitoring existing shallow land burial sites. As a means of gaining access to the soil beneath the Sheffield low-level waste trenches, a 72 inch diameter tunnel will be excavated beneath the trenches. The tunnel will provide access for collection of the data on geologic and hydrologic parameters. The tunnel will be constructed within the unsaturated zone below the trenches and above the water table. Moisture in the unsaturated zone moves through the soil vertically by capillarity from the surface down to the water table. Under these conditions the lined and cement grouted tunnel will act as a barrier to the movement of soil moisture. Moisture will move down to and around the grout, and proceed down to the water table. The tunnel will not provide a pathway that would conduct water laterally to the land surface.
Keywords: site selection; low-level radioactive wastes; decommissioning; radiation monitoring; underground disposal; hydrology; radionuclide migration.

160072 Thorium in Human Tissue. (New York Univ., New York, NY). **Project number:** B5756. **Contract:** B5756. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health effects assessments.

The objectives are to measure and interpret the thorium content of human tissues obtained at autopsy in order to establish the naturally occurring levels of Th-228, Th-230, and Th-232 in persons residing close to uranium mill tailings piles and in other background area. Phase I will be to develop a radiochemical methodology for tissue digestion, thorium separation, and electrodeposition as well as to obtain and calibrate radiation counting instrumentation. In Phase

II we will collect tissues from cadavers in Grand Junction, Colorado, and other background areas; analyze samples of lung, lymph node, liver, spleen, kidney, and bone for content of thorium isotopes; and interpret the isotopic ratios observed in terms of geographic location and occupational exposure history. If necessary, thorium will be measured in samples in soil and air.
Keywords: thorium; man; radionuclide kinetics; body burden; autopsy; radiochemical analysis; bioassay; separation processes.

160073 Assess Nuclear Industry Impacts: Natural Populations. (Univ. of Washington, Seattle, WA). **Project number:** B-5679. **Contract:** B-5679. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives of the program are to assess the importance of synergistic effects of chlorine with temperature and heavy metals in biota; and to conduct state-of-the-art review of chlorine literature with emphasis on synergistic effects of chlorine, temperature, and heavy metals on important species.
Keywords: nuclear industry; environmental impacts; chlorine; aquatic ecosystems.

160074 Influence of Genetic Immune Disorderss. (Univ. of California, Davis, CA). **Project number:** B-3033. **Contract:** B-3033. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The basic objective is to determine if the genetic disorders producing immunological or hematological deficiencies enhance susceptibility to radiation-induced leukemia. OSD will use the results in determining the health effects of exposure to low-level radiation and the necessity for establishing standards for susceptible sub-populations. Normal mice and mice with either genetically based immunological disorders or genetic anemias will be exposed to continuous whole body gamma irradiation at 20 r/day. Unirradiated controls will also be maintained. Exposure will continue until leukemia or other radiation-induced diseases are manifested. Animals will be sacrificed for pathology examination and stem cell evaluation. Mice from all experimental groups will be sacrificed at specific time intervals so that preleukemic changes may be determined.
Keywords: genetic radiation effects; leukemia; radioinduction; immunology; mice; epidemiology.

160075 Biodosimetric Confirmation. (Univ. of Southern California, Los Angeles, CA). **Project number:** B-3029. **Contract:** B-3029. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objectives are: (1) to confirm in a relatively long-lived animal, the beagle dog, the use of hematopoietic end-points as sensitive biodosimeters of radiation dose and as early predictors of the development of relative late effects including leukemia; and (2) to confirm the effect of dose-rate on development of late effects. OSD will use the results for determination of health effects from low-level radiation. Groups of dogs of different ages will be exposed to graduated doses and dose-rates. The effects of continuous whole-body gamma ray irradiation will be determined using the lymphocyte stimulation test and lymphoid colony technique for peripheral blood lymphocytes and using granulocyte-monocyte and lymphoid culture techniques on bone marrow. The changes in these sensitive biodosimeters will be assessed with respect to their ability to predict risk for late effects including leukemia and carcinogenesis. In addition, a separate group of dogs will be removed from the radiation field when lymphocyte function is impaired to evaluate the time necessary for repair.
Keywords: dosemeters; beagles; radiation doses; biological indicators; delayed radiation effects; low dose irradiation; health hazards; gamma radiation.

160076 Transuranium Element Transport-Agricultural Systems. Wallace, A.; Romney, E.; Schutz, R.; Nishita, H. (Univ. of California, Los Angeles, CA). **Project number:** B-27. **Contract:** B-27. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the project are to determine transfer coefficients for uptake of radionuclides by agricultural crops from soils and to provide information on acceptable covers and perimeter crops for closing and monitoring existing shallow land burial sites. Another objective is to develop and improve the basis for safety and environmental standards for siting, operating, and decommissioning low-level waste disposal facilities.
Keywords: radioisotopes; root absorption; soils; radionuclide migration; crops; radionuclide kinetics; low-level radioactive wastes; radioactive waste disposal; nuclear facilities; site selection; operation; decommissioning; radiation monitoring; safety standards; ground disposal; ground cover; biological indicators.

160077 Sediment Transport: Model Run. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2294. **Contract:** B-2294. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Project objectives are: (1) to verify the unsteady, two-dimensional sediment and radionuclide transport model, SERATRA, by application to Cattarangus and Buttermilk creeks near West Valley Radioactive Waste Burial Site in New York; (2) to use the data and information collected in the research program entitled Sediment and Radionuclide Transport in Rivers - Field Sampling Program, Cattarangus and Buttermilk creeks, New York as input to the computer code; and (3) to assess the potential migration of radionuclides from the waste burial site to the mouth of Cattarangus Creek and to Lake Erie.
Keywords: radioactive waste disposal; sediments; surface waters; radionuclide migration; mathematical models; underground disposal; new york.

160078 Mill Tailings Pond Seepage. Walter, R. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2292. **Contract:** B-2292. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project objective is a measuring program to determine the interaction of tailings leachate with clay liner material and subsurface sediments representing the Morton Ranch Site. Numerical models for the description and prediction of subsurface leachate movement in the flow system beneath the tailings pond at the Morton Ranch Site should be implemented using interaction data obtained. Results are to be used in licensing future mills. NRC must assure compliance with EPA regulations for waste water discharges from surface impoundments.
Keywords: feed materials plants; mill tailings; sediments; clays; radionuclide migration; mathematical models; ground water; waste water; radioactive waste management.

160079 Radionuclide Distribution in Kentucky. (Dept. of Energy, Washington, DC). **Project number:** B-2291. **Contract:** B-2291. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

Criteria will be developed for closing and monitoring existing shallow land burial sites. Specific objectives are: determine amounts and chemical species of radionuclides moved by subsurface routes; determine area distribution of specific radionuclides at the waste burial site and adjacent areas; compare the chemical species of radionuclides in burial trenches with those observed in monitoring trenches and wells and in springs or seeps and in surface flow from the site; and coordinate implementation with closely-related programs for Maxey Flats.
Keywords: kentucky; radioactive waste disposal; underground disposal; radionuclide migration; radioecological concentration.

160080 Neutron Dosimetry at Nuclear Sites. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2282. **Contract:** B-2282. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The objective is to determine the effectiveness of personnel neutron dosimetry systems at operating nuclear power plants. NRR will use the results to approve licensee's neutron dosimetry programs.
Keywords: nuclear power plants; personnel; dosemeters; accuracy; neutron dosimetry.

160081 Decontamination Effects on Effluent Control Systems. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2281. **Contract:** B-2281. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$75,000.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The project objective is to develop validated data to support licensing amendments of the costs and impacts of decontamination operations. Through literature review and several site visits, a radwaste system design and operation will be established, composite baseline design for evaluating radwaste capabilities will be formulat-

ed, and utility and AE decontamination-plans for both strong and weak decontamination solutions will be developed. The effects of the candidate decontamination processes on the ability of baseline designs to function effectively will also be evaluated, and if appropriate, conceptual designs for additional radwaste systems will be provided.
Keywords: cost; environmental impacts; decontamination; radioactive wastes; licensing; radioactive waste facilities.

160082 PuO2 Particle Leak Studies. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2093. **Contract:** B-2093. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

The project objective is to establish a method for the licensing staff to correlate measurable gas escape rates with radioactive material powder leakage from shipping packages subjected to specified package performance tests as defined in Regulatory Guide 7.6.
Keywords: plutonium dioxide; casks; leaks; powders; transport; performance testing.

160083 Unified Transport Assessment. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0168. **Contract:** B-0168. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Physical/chemical mechanisms of pollutant interactions.

At present there are no acceptable, tested models for assessing the dynamic behavior and physico-chemical interactions and transport of radionuclides in the aquatic environment, especially as related to the math models which characterize thermal plumes. The objectives are to: (1) provide a reliable model for predicting radionuclide concentration in nuclear stations discharges in rivers, estuaries, ponds, lakes, and coastal waters; (2) provide models for predicting radionuclide concentrations in sediments and transport of sediments in receiving water bodies; and (3) provide the same mathematical and computational procedures which are to be used for radioisotopic, thermal chemical, and zone matching analyses.
Keywords: radionuclide migration; mathematical models; plumes; aquatic ecosystems; thermal effluents; sediments; nuclear power plants.

160084 Waste Transport in Soils. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** A-7040. **Contract:** A-7040. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The project objectives are to investigate the degree of movement and retention of radionuclide of nuclear origin in or by selected soil types; evaluate the degree of correlation between the soil physical, chemical, mineralogical, and microfloral properties and the degree of movement and retention of waste radionuclides; investigate the applicability of laboratory tests of the potential for radionuclide migration in selected soils to site evaluations by comparing the results of laboratory and field experiments; and investigate the pathways of water entry into the waste burial trenches at Maxey Flats.
Keywords: soils; radionuclide migration; radioactive waste disposal; low-level radioactive wastes; underground disposal; safety.

160085 Ventilation System Performance. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** A-7029. **Contract:** A-7029. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives of the program are to determine the structural integrity of HEPA filters; to determine ventilation system response to tornados, specifically to the effectiveness of the air cleaning components under high flow rate conditions; and to quantitatively determine the amount of particulate release during tornado conditions.
Keywords: nuclear power plants; air filters; performance testing; containment systems; ventilation systems; tornadoes; air cleaning systems.

160086 Iodine Pathway Study. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A-6288. **Contract:** A-6288. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to interpret data and information on iodine-131 behavior in the environment following routine release from nuclear facilities. The iodine pathway analysis will include, but not be limited to, an analysis of the following stations and field measurements: (1) 131-I released from the Quad Cities facility; (2) 131-I concentrations in the air and in the environment; (3) 131-I measurements in precipitation (rain), grass, and milk; and (4) meteorological data as obtained from the station's meteorological tower.
Keywords: iodine 131; radionuclide migration; nuclear power plants; radioactive effluents; radioecological concentration.

160087 Source Terms of Radiosotopes. (Brookhaven National Lab., Upton, NY). **Project number:** A-3042. **Contract:** A-3042. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Project objectives are to define source terms of radionuclides and solutes in trench waters from licensed disposal sites in cooperation with USGS; and to describe physical, chemical and biological properties controlling migration of radionuclides and associated materials. Results will be used to develop criteria for closing and monitoring existing shallow land burial sites. These meet ZBB objectives to develop and improve methods for predicting the impacts of low-level waste disposal facilities and to improve the data base on low-level waste characteristics.
Keywords: radioactive waste disposal; waste water; radionuclide migration; physical properties; chemical properties; radiation monitoring; low-level radioactive wastes; environmental impacts.

160088 Properties of Radiation Wastes. (Brookhaven National Lab., Upton, NY). **Project number:** A-3027. **Contract:** A-3027. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

Project objectives are to: (1) develop information on the physical and chemical characteristics of solidified low level wastes which can be used to assess the safety of land burial operations, interim storage and transportation of low level wastes; and (2) provide data which will support standards for quality control in solidification of liquid radwastes at commercial nuclear reactors. This project includes summarizing existing information and determining through actual measurement the physical and chemical characteristics of solidified low-level waste products as a function of time, storage environment, and other factors. Emphasis has been on reactor generated wastes. The program will be expanded to include wastes generated in non-reactor portion of fuel cycle.
Keywords: low-level radioactive wastes; chemical properties; physical properties; solid wastes; transport; radioactive waste disposal; radioactive waste storage; underground disposal.

160089 Health Effects Assessment: Exposure to Radiation and Non-Radiation Pollutants. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** A-2059. **Contract:** A-2059. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Health effects assessments.

The objective is to assess the potential health effects and life-shortening resulting from exposure to effluents from the uranium and coal fuel cycles. NRR will use the DEMPAK code to calculate deaths and illness resulting from exposure to radioactive and nonradioactive pollutants.
Keywords: chemical effluents; health hazards; radioactive effluents; fuel cycle; nuclear fuels; coal; uranium; diseases; epidemiology; mortality.

160090 Coastal Zone Predictive Modeling at Power Plant Sites. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** A-2055. **Contract:** A-2055. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The objectives are: (1) to test a state-of-the-art numerical model to simulate nearshore circulation, sediment movements, and bathmetric changes in the surfzone of a coastal reach; (2) to predict shoreline changes on coastal environments (lakes, estuaries, oceans) where nuclear power stations may be sited; (3) to predict littoral process and responses in the vicinity of nuclear power stations; and (4) to provide information on the potential for radionuclide transport in surface waters by considering the effect of sediment transport, deposition, and resuspension. This will be used for RG 4.2, NRR and HMB staff position, and environmental impact statements for station sited on lakes and coasts.
Keywords: power plants; site selection; coastal regions; land use; aquatic ecosystems; baseline ecology.

160091 Chemical Effluents from Nuclear Power Stations: Copper. Harrison, F.L. (Lawrence Livermore Lab., 7000 East Ave., P.O. Box 5507, Livermore, CA, 94550). **Project number:** A-0119. **Contract:** A-0119. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC--$0,128,000; DOE.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

Use of surface waters in the operation of nuclear power stations may degrade the quality of the ambient water. The objectives of this research project are: (1) to obtain data on the behavior of potentially toxic substances introduced into surface waters by nuclear power stations or produced by chemical reactions of substances released from nuclear power stations in the receiving water; and (2) to determine the magnitude of the effects of these substances on representative, economically important aquatic species. Of special interest are corrosion products of copper because of their adverse effects on aquatic organisms.
Keywords: nuclear power plants; environmental impacts; chemical effluents; surface waters; aquatic ecosystems; copper; toxicity.

160092 Utilization of Atmospheric Release Advisory Capability (ARAC). Rosen. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** A-0220. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the program is to assess the technical requirements for and cost-benefit of adopting existing ARAC techniques to licensed nuclear power plants.
Keywords: pwr type reactors; bwr type reactors; nuclear power plants; environmental impacts; radioactive effluents; radiation monitoring; cost.

160093 Atmospheric Release Advisory Capability (ARAC) Experience at Three Mile Island-2. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** A-0235. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the program is to produce a comprehensive description and analysis of ARAC operations and performance during and following the TMI-2 emergency for general use in reactor operations.
Keywords: three mile island-2 reactor; reactor accidents; reactor safety; radioactive effluents; environmental impacts; radiation monitoring.

160094 TMI Followup. Tokarz, F. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** A-0236. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the program is to support the Division of Operating Reactors in the review and implementation of required improvements to reactor safety derived from TMI experience.
Keywords: three mile island-2 reactor; reactor accidents; reactor safety; legal aspects; regulations.

160095 Study of Foreign Reactor Accidents and Incidents. (Lawrence Livermore Lab., P.O. Box 5507, Livermore, CA, 94550). **Project number:** A-0237. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective of the program is to support the Division of Operating Reactors in the review of existing literature, papers, and reports of foreign reactor accident experience. Each event will be identified and described in sufficient detail to determine its applicability to U.S. reactor designs. Visits to foreign sites to obtain necessary details of events will be conducted if necessary. A report will be prepared.
Keywords: power reactors; reactor accidents; reactor safety.

160096 Supplemental Meteorological Instrumentation for Incident Response. Michael, P. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** A-3317. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to evaluate types of supplemental meteorological instrumentation needed for incident response at nuclear power plant sites. An evaluation of off-the-shelf meteorological instrumentation (including both direct and remote sensors) and data acquisition systems (including the capabilities of other Federal agencies) to supplement the onsite meteorological program and other locally available systems will be performed. Instrumentation should be portable, capable of being deployed in minimal time frame, and provide useful information for emergency planning and evacuation.
Keywords: nuclear power plants; reactor sites; environmental impacts; reactor accidents; radiation monitors; performance testing; radiation monitoring; radiation protection.

160097 BWR Off-Gas System Experience. (EG and G, Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83404). **Project number:** A-6261. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The contractor will assist DOR to review the 26 responses to I and E bulletin on off-gas explosions to determine if licensee's actions adequately reduce probability of such explosions. Findings will be available to DSE for consideration of changes to licensing requirements and review process.
Keywords: bwr type reactors; off-gas systems; explosions.

160098 Review of Nuclear Power Plant Emergency Planning. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** A-7114. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

LASL has previously provided assistance to NRR/DOR in the review of nuclear power physical security. A logical extension of this effort is the review of these same nuclear power plant emergency plans. In particular, the present increment of funds is to provide for the review of emergency plans by those LASL individuals who performed the physical security reviews. The level of effort is estimated to be between seven and nine professional man-years per year and will include extensive onsite review.
Keywords: nuclear power plants; reactor safety; emergency plans.

160099 Fission Product Release. Malinauskas, T. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0243. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objective is to re-evaluate the source terms of fission products released in the course of design basis accidents for possible modification of staff standard review plan.
Keywords: nuclear power plants; design basis accidents; fission product release; reactor safety.

160100 Extension of SKYSHINE-II. Wells, M. (Radiation Research Associates, Inc., Fort Worth, TX). **Project number:** B-1199. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The objectives are to develop: (1) reflection data for steel/concrete for neutron and gamma-ray; (2) shield transmission data for steel/concrete for gamma ray; and (3) appropriate computational scheme for SKYSHINE-II procedure in NUREG/CR-0781 for calculation of offsite dose rates including the contribution from the uncollided component.
Keywords: neutrons; gamma radiation; steels; absorption; concretes; neutron transport; photon transport; scattering; reflection.

160101 Modeling of Environmental Radiological Exposure Pathways and Consequences from Reactor Accidents. Watson, E.C. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2158. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

This project is designed in three phases. The objective of Phase I of this project was to investigate and report on methods for modeling of environmental radiological exposure pathways and consequences in reactor accident situations. In Phase II, models will be selected for a comprehensive computer code to calculate site-specific radiation doses and consequences for accidents of Class 3 through 8. Detailed documentation of the code will be provided. Phase III will include use of the code to perform site-specific consequence calculations and sensitivity analyses, and recommendations to NRC of codes and parameters to be used for NEPA evaluations. Standard assumptions will be developed for NEPA evaluations of Class 3 through 8 accidents. A computer program will be written to implement the consequence model developed or selected from existing models with appropriate modifications for calculation of site specific doses and consequences from Class 3 to 8 accidents. Analyses will be made to determine range of risks (e.g., health effects, economic

losses) resulting from variations in site characteristics and variations in accident probabilities due to differences in individual plant design. **Keywords:** biological pathways; radionuclide migration; reactor accidents; environmental impacts; mathematical models; radiation doses; risk assessment; biological effects; human populations.

160102 Application of Fisheries Management Techniques for Assessing Impacts. McKenzie. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2160. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

The purpose of this task is to develop guidelines for the design and implementation of a fisheries monitoring program for nuclear power stations judged to have a low potential for environmental impact. This task continues the effort, started in FY 78, to develop standardized far field fisheries monitoring program utilizing established fisheries management techniques. Phase one, the compilation and review of established fisheries management techniques, has been completed. Phase two, scheduled for completion in FY 80, would result in the development of guidelines for designing and implementing a monitoring program. These guidelines would be formulated from the results of Phase one and examine the data from a minimum of four nuclear power plant sites.
Keywords: fishing industry; nuclear power plants; environmental impacts; fishes; monitoring; standards.

160103 Review of In-Plant Monitor Capability. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA,, 99352). **Project number:** B-2174. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

A state-of-the-art review of in-plant area radiation monitors and airborne radioactivity monitors should be performed to determine capability to respond at accident dose levels. Recommendations are desired as to number and locations of such instruments in-plant, and range of dose rates and airborne concentrations which can be reliably determined under accident conditions.
Keywords: nuclear power plants; radiation monitors; reactor instrumentation; radiation protection; performance testing.

160104 I-131 Pathway Behavior Under Stored Feed Conditions. Watson, E.C. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2175. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

A study is underway to determine pathways by which radioiodine in reactor effluents can transfer to cow or goat milk even though the animals are not on pasture but are on stored feed. The contractor will explore existence of possible pathways of transfer of radio-iodine in reactor effluents to cow's and goat's milk other than the ones that are well-known such as those considered in R.G. 1.109. The contractor will develop mathematical model(s) to calculate iodine concentration in milk by the new transfer pathways. The contractor will use the model to verify the iodine concentrations detected in cow and goat milk consequent to the Three Mile Island Unit 2 accident in March 1979.
Keywords: biological pathways; iodine isotopes; radionuclide migration; milk; food chains; mathematical models; cows; goats; radiation monitoring; three mile island-2 reactor.

160105 *Whole Body Counting Program for the Public Around* Three Mile Island. (Helgeson Nuclear Services, Inc., Pleasonton, CA). **Project number:** B-6820. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

This is a program to determine if members of the public nearest TMI-2 had measurable levels of internally deposited radioactivity originating from the accident, and if so, what their lifetime dose commitments and risks might be. The contractor will perform whole body counting services for each person selected by NRC from the general public living within approximately 3 miles of the Three Mile Island Nuclear Power Station. The counting will be a NaI(Tl) detector system with sensitivity of a few nCi for most gamma emitting nuclides (with energy greater than about 200 keV) for a scanning time of 10 minutes or less.
Keywords: whole-body counting; three mile island-2 reactor; radiation doses; lifetime; human populations; nai detectors; gamma spectroscopy; reactor accidents; environmental impacts.

160106 Advanced Reactor Accident Delineation and Assessment. Kastenberg. (Univ. of California, Los Angeles, CA). **Project number:** B-3004. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The objective of this project is to provide input to the ARB to aid in the Branch's assessment of advanced reactor licensing and safety issues. Specifically this input will consist of independent analysis, evaluation of DOE and applicant submittals, and assessment drawing on UCLA experience and expertise.
Keywords: lmfbr type reactors; htgr type reactors; heavy water moderated reactors; risk assessment; reactor safety; reactor licensing.

160107 Effects of Explosions. Proctor. (Naval Surface Weapons Center, Silver Spring, MD). **Project number:** B-6812. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC.
Related energy source: Coal(50); nuclear fission(50) **R and D categories:** Epidemiological studies.

The objective is to provide technical assistance in the analysis of shock wave effects on nuclear power plant safety related structures, and technical assistance on the capabilities of various chemical compounds, including flammable liquified and/or compressed gases to generate explosive shock waves for specific plant reviews.
Keywords: nuclear power plants; seismic effects; reactor components; containment buildings; shock waves; explosions.

160108 Technical Support in the Development of Nuclear Waste Management. Heckman, R.A. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** A-0277. **Contract:** A-0277. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

Lawrence Livermore Laboratory (LLL) has provided, and will continue to provide, technical assistance to the NRC in developing a technical information base and, in some cases, analytical models in the following areas: (1) waste form performance criteria - commercial high level waste, spent fuel (commercial reactors), transuranic waste, and military high level waste; (2) repository site suitability - bedded salt and shale layered basalt, plutons, and domed salt (scoping study); (3) radiological performance objectives; (4) geoscience parameter data base handbook; and (5) technical assistance (short-term as needed) - thermal/radiological transport modeling assistance for development of repository design/performance standards, and general short-term assistance as needed (special projects, short-term scoping studies, etc.).
Keywords: radioactive waste management; spent fuels; high-level radioactive wastes; radioactive waste facilities; site selection; shales; salt deposits; salt caverns; basalt; information systems; design; performance.

160109 Structural Case Reviews for Fuel Reprocessing and Fuel Fabrication Facilities. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** A-0285. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The performing organization will: (1) provide estimates of the probability of a seismic event by acceleration level (response spectra) including site-specific response spectra characterization for the facilities under evaluation; (2) examine the critical structures as designated by the NMSS PM and components at each site to determine their resistance to a seismic event; and (3) assess four plutonium fuel fabrication plants (Exxon, Richland, WA; Atomic Internationl, Chatsworth, GA; Battelle Memorial Inst., Columbus, OH; and General Electric, Vallecitos, CA).
Keywords: fuel reprocessing plants; fuel fabrication plants; seismic effects; evaluation; plutonium oxides.

160110 Atmospheric Release Advisory Capability. (Lawrence Livermore Lab., Livermore, CA). **Project number:** A-0351. **Contract:** 80-79-005. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

NRC is interested in an assessment of the potential of the Atmospheric Release Advisory Capability (ARAC) System for contributing to the overall response capability for emergency situations involving atmospheric releases at nuclear facilities it licenses.
Keywords: nuclear power plants; emergency plans; radioactive effluents; radioactive aerosols.

160111 Molten Fuel Interactions. Muir, J.F. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1019. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.

Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The physical and chemical processes involving molten fuel during hypothetical meltdown accidents in LWRs are studied. This program concentrates on identifying and understanding the response of concrete contacted with molten LWR core materials in order to evaluate: (1) the generation rate of water vapor, inert non-condensable gases, and flammable gases; (2) the effects of gas generation on fission product and aerosol release; (3) the chemical reactions occurring in the complex system; and (4) the rate of concrete erosion.
Keywords: bwr type reactors; pwr type reactors; reactor safety; meltdown; concretes; reactor materials; corium; chemical reactions; radioactive aerosols.

160112 Steam Explosion Phenomena. Corradini, M.L. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1030. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The objectives of the program are to identify and characterize the physical conditions which must be met in order for a steam explosion to occur when molten LWR core materials contact water; and to provide a firm technical basis for estimation of the probability of containment breaching by steam explosions following postulated fuel melt accidents.
Keywords: pwr type reactors; bwr type reactors; reactor safety; meltdown; fuel-coolant interactions; steam; corium; explosions; containment systems; performance; failures.

160113 Radiation Dose Estimates and Hazard Evaluations for Inhaled Airborne Radionuclides. Mewhinney, J.A. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** A-1031. **Contract:** A-1031. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this project is to identify the most important aerosol characteristics that modify the patterns of radiation dose and the predicted health consequences of airborne radioactivity that may be released from operations with nuclear fuel materials. Physical, chemical, and biological characterizations of aerosols actually present in nuclear fuel operations are being studied. Industrial aerosol samples are reaerosolized in our laboratory for animal inhalation exposures to determine the patterns of deposition, retention, and translocation as a function of time.
Keywords: aerosols; radioactive materials; radionuclide kinetics; radiation doses; nuclear facilities; inhalation; rats; dogs; monkeys; chemical properties; physical properties; radiation hazards.

160114 Reference Critical Experiments. McCarthy, J.D. (Rockwell Inst., Box 464, Golden, CO, 80401). **Project number:** 939728. **Contract:** A-1036. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this program is to provide critical experimental data to be used for benchmarking computer calculations. This data will be utilized in the design of processing, storing and shipping fissile material. The originally scheduled program involving cylinders (single and arrays) of highly enriched uranyl nitrate has been completed. The arrays of low enriched uranium oxide (U3O8) at H/U = 0.75 have been completed.
Keywords: uranyl nitrates; uranium oxides; criticality; benchmarks; computer calculations; containers.

160115 Generic Environmental Assessment on Transportation of Radioactive Material Near and Through a Large and Densely Populated Area. Finley, N.N. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1077. **Contract:** A-1077. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The general objective is the preparation of a generic environmental impact assessment resulting from the transport of radioactive materials into, out of, through, and near a large densely populated area. Analysis, heavily integrated with the development and exercise of computer models, is used to estimate impacts due to incident-free transport and transport involving vehicular accidents, human error, and malevolent attack. Subcontractual efforts were used to evaluate societal impacts. Earlier in the study an Ad Hoc Task Group comprised of individuals from government, industry, and environmental organizations was used to advise on scope, methods, and data. Results to date include publication of three interim reports (SAND-77-1927, NUREG/CR-0334, one unnumbered), five conference papers, and two subcontractors reports (SAND-78-7017 and SAND-79-7032). These preliminary results were a partial basis for the imposition of interim protective measures for spent fuel (44FR34466). A draft environmental assessment is expected to be issued in the first half of 1980 along with reports on social impacts; these will comprise the primary technical basis for the NRC's Draft Environmental Impact Statement to be issued concurrently.
Keywords: urban areas; radioactive materials; transport; accidents; spent fuels; social impact; environmental impact statements; mathematical models; risk assessment.

160116 Upgrading and Updating WASH-1238. Luna, R.E.; Finley, N.C. (Sandia Labs., Albuquerque, NM, 87115). **Project number:** A-1087. **Contract:** A-1087. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The purpose is to upgrade and update WASH-1238, Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, 1972. The work shall include current shipment data, changes caused by no reprocessing, higher burnup and enrichments, special routing considerations, and intermediate storage requirements. The transport of material associated with decommissioning is also to be considered as well as problems associated with waste. Analysis of accident data is to include health effects and risk analysis as given in NUREG-0170. Final document is to provide the technical basis for an EIS on the subject.
Keywords: radioactive materials; transport; storage; radioactive wastes; decommissioning; radiation hazards; risk assessment; nuclear power plants.

160117 Evaluation of Tritium Processors for NRC. Lamberger, P.H.; Rhinehammer, T.B. (Mound Facility, P.O. Box 32, Miamisburg, OH, 45342). **Project number:** A-1157. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to provide expert technical assistance to the Office of Nuclear Material Safety and Safeguards (NMSS), Division of Fuel Cycle and Material Safety, in the evaluation of licensee's proposals for improving tritium containment. These evaluations will cover processes, operating procedures, equipment and capture systems relating to manufacturing, scrap recovery, storage, and packaging for transfer and disposal. The adequacy of licensee proposals to protect the public health and safety and the environment will be evaluated, noting deficiencies in proposals where they exist, estimating the degree of containment which might be expected from proposed improvements and noting whether or not the best available technology is being used. When conclusions are reached about adequacy, a brief statement will set forth the bases for such conclusions. Site visits may be necessary to perform the analyses. On occasion expert testimony will be provided in specific areas of technical competence to support findings.
Keywords: tritium; radioactive waste management; equipment; radioactive waste storage; packaging; radioactive waste disposal.

160118 Reference Repository Definition and Technology Transfer. Campbell, J.E.; Cranwell, R.M. (Sandia Labs., Albuquerque, NM, 87115). **Project number:** A-1158. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This program will be closely coordinated with two other NRC-funded programs at Sandia. These other programs involve the development of a methodology for evaluating the long-term risk from radioactive waste disposal. The first objective of the program is to assure timely, thorough and efficient transfer of the analysis techniques and tools developed in the methodology program. The second objective is to develop reference repositories in media other than bedded salt (e.g., basalt, granite, and domed salt).
Keywords: radioactive waste disposal; risk assessment; geologic deposits; salt caverns; basalt; granites.

160119 Methodology Development for Risk Assessment of Waste Isolation. Campbell, J.E. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1192. **Contract:** A-1192. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is development of methodology for assessing risks from nuclear waste isolation. The approach is to develop consequence and probabilistic models to simulate waste depository/geologic media interactions, transport processes, and expected and unlikely events impacting on isolation effects of geologic and engineered barriers. Reference repository defined as basis for analysis. First phase is bedded salt. Results to date are identification of system properties important to long-term safety and identification of data

deficiencies and computer models with user manuals. Significance of these results is to allow staff to concentrate in regulatory development on processes and elements important to risk. Models with user manuals and risk assessment procedures will be used to train staff in safety assessment of waste repositories and methodology application guides research program development to important areas.
Keywords: radioactive waste disposal; risk assessment; geologic deposits; salt deposits; computerized simulation; environmental impacts.

160120 Effect of Liquid Pathways in Consequence Calculations. Niemczyk, S.J. (Sandia Labs, Div. 4413, Albuquerque, NM, 87115). **Project number:** A-1200. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the project is to establish the degree of potential radiation exposure to the population from hypothetical accident sequences involving a core melt-down accident due to radionuclides reaching the public via liquid pathways, by: (1) estimating the magnitude and likelihood of such releases; (2) characterizing the range of possible hydrogeologic conditions and estimating their significance relative to time dependent nuclide outflow characteristics; (3) modeling surface water dispersion and trophic level transport; (4) estimating consequences; and (5) discussing possible mitigating actions.
Keywords: radiation accidents; risk assessment; simulation; radionuclide migration; water pollution; radiation protection.

160121 Biological Characterization of Radiation Exposure and Dose Estimates for Inhaled Uranium Milling Effluents. Eidson, A.F. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** A-1222. **Contract:** A-1222. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

Specialized characterizations of refined uranium ore, yellowcake, produced by uranium mills are needed by the Nuclear Regulatory Commission to evaluate the adequacy of current radiation protection practices and regulatory guides. The chemical characteristics of yellowcake aerosols collected from mills are determined. The biological clearance of inhaled yellowcake is being studied in beagle dogs and Fischer-344 rats exposed to aerosols generated from yellowcake powders. Exposures are controlled to levels below those that cause biological effects. Animals are sacrificed over a two-year period. Comparisons of the chemical characteristics of yellowcake samples with their biological behaviors are made to identify important aerosol properties that influence the organ distributions. Results indicate that solubility is the most important property of yellowcake determining its biological behavior if inhaled.
Keywords: uranium oxides u3o8; feed materials plants; chemical properties; dogs; rats; aerosols; inhalation; radionuclide kinetics.

160122 Spent Fuel Isolation Alternatives. Pepping, R.E. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1225. **Contract:** A-1225. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is the development of methodology for assessing risks from spent fuel isolation. The approach is to modify as necessary the probabilistic and consequence models developed for high-level waste risk methodology project, by using the same reference facility and same geologic setting. A similar systems analysis approach will be used to modify the risk assessment methodology for high-level waste. The first phase involves bedded salt and later phases include domed salt, granite, basalt, shale, and clay. Chemical and physical characteristics different from high-level waste have been identified. The significance of these results is to identify model changes needed and data needed for input to the models. The expected products are documented procedures, models, user manuals, and sample problems and demonstration of methodology for use in repository safety assessment and licensing development.
Keywords: risk assessment; radioactive waste disposal; high-level radioactive wastes; spent fuels; mathematical models; environmental impacts; geologic deposits; basalt; clays; shales; granites; salt deposits.

160123 Separate Effects Tests for TRAP Code Development. Sallach, R.A. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1227. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary purpose of this study is to provide experimental data to aid and develop the TRAP code models of fission product chemistry in the primary system of a light water reactor during a fuel melt accident. The study is concerned in particular with laboratory scale experiments to investigate vapor pressures of fission product species at elevated temperatures; and chemical compound formation and reaction rates for multiple fission product species in high-temperature steam environments. Analytical studies will also be performed to assist the development of the TRAP code and to provide models of fission product releases occurring during core-concrete interactions and as a result of vapor explosions.
Keywords: pwr type reactors; bwr type reactors; reactor safety; meltdown; fission products; fission product release; t codes; computer codes; vapor pressure.

160124 Radiological Emergency Planning and Response Evaluation. Ortiz, N. (Sandia Labs., Albuquerque, NM, 87185). **Project number:** A-1271. **Contract:** 80-79-007. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to prepare a comprehensive scenario of a nuclear power reactor accident resulting in an airborne off-site radiological release. The scenario is to be studied for testing state and local government radiological emergency response plans submitted for NRC concurrence. We will support the interagency Regional Advisory Committees (RAC) in observing and evaluating state and local government radiological emergency response exercises; assist NRC in the review of state and local government radiological emergency response plans for compliance with federal guidelines; and provide technical assistance to improve NRC's radiological emergency response planning program with state and local governments.
Keywords: nuclear power plants; radiation accidents; radioactive effluents; radionuclide migration; emergency plans; government policies; state government; local government.

160125 Assessment of Leachate Movement from Ponded Uranium Mill Tailings. Gee, G. (Battelle Pacific Northwest Labs., Battelle Blvd., Richland, WA, 99352). **Project number:** A-2046. **Contract:** A-2046. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Ecological effects of pollutants or physical disturbances.

One objective is to determine the interaction of mill tailings leachate with clay liner material and subsurface sediments at the Morton Ranch Site. This work will result in development of distribution coefficients (Kd's) and a technology that may be extended for general use and application to uranium mill waste disposal problems. Another objective is to implement numerical models for description and prediction of subsurface leachate movement in soils beneath the Morton Ranch Mill.
Keywords: mill tailings; leaching; ground water; radionuclide migration; clays; sediments; feed materials plants; radioactive waste disposal; distribution.

160126 Health Effects of Industrial Exposure to Thorium. Stehney, A.F. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** A-2050. **Contract:** A-2050. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The objective is to determine the amounts, distributions, and health effects of internally deposited thorium and thorium daughter products from industrial exposure. The approach consists of a laboratory and epidemiological study of former thorium workers. Medical and dosimetric data are obtained by study of living persons and autopsy material and by study of questionnaires and medical records. The principal end-points are mortality by cause and diseases of the respiratory system. Whole body counting (in vivo), radiochemistry, and microscopic techniques are employed. Health risks in thorium processing operations and determination of relationship to internally deposited thorium, especially particulate thorium deposited in the respiratory system will be evaluated. The results are needed for assessment of risk in the industrial processing of thorium for use in nuclear reactors.
Keywords: thorium; health hazards; radionuclide kinetics; epidemiology; occupational diseases; radiochemistry; respiratory system; nuclear power plants.

160127 Reanalysis of the tri-State Leukemia Survey Data. Ginevan, M.E. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** A-2067. **Contract:** A-2067. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The objective is to perform a re-analysis of the adult portion of the tri-state data, accomplishing the following specific tasks: (1)

calculate age-standardized relative risks of adult leukemia for non-overlapping x-ray exposure categories and develop absolute risk estimates which can be related to existing absolute risk estimates for low-level low-LET radiation leukemogenesis; (2) investigate possible relationships between radiation exposure, disease, and leukemogenesis in adults and discuss these findings in the context of susceptible subgroups for radiation leukemogenesis; (3) investigate the possible influence of other variables, e.g., temporal aspects of exposure, ethnic, socioeconomic on the relationship between diagnostic x-ray exposure and leukemogenesis; and (4) develop explanatory models and generate testable hypotheses to account for the tri-state data.
Keywords: leukemia; epidemiology; risk assessment; radioinduction; biological radiation effects; nuclear medicine; diagnosis; radiotherapy; human populations.

160128 Radiological Evaluation of Former Licensed Sites. Roberts, C.J.; Gustafson, P.F. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL, 60439). **Project number:** A-2156. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

The performing organization will furnish the necessary qualified personnel, facilities, materials, and services to perform an environmetal assessment of remedial actions at one NRC site. Surveys of additional sites, if required, will be specified through revision of this statement of work. The assessment will include determination of: (1) the radionuclides present, including radon and progeny as appropriate; (2) the spatial distribution of the radionuclides above background,; and (3) the external gamma radiation at one meter above surface.
Keywords: radiochemical analysis; radiation monitoring; contamination; abandoned sites; nuclear industry; decontamination; land reclamation.

160129 Development of Nuclear Waste Form Criteria. Schweitzer, D.G. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** A-3158. **Contract:** EY-76-C-02-0016. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental effects assessment.

This program is directed to technical support in the areas of radioactive waste management, high level waste storage and disposal, low level and transuranic waste, long term storage of irradiated fuel, and research conducted in all areas of waste management. The objective of the technical support program in waste management is to assist the NRC in technical needs which must be met to regulate high level and transuranic wastes. These are, in order of priority: (1) the information needed to develop regulations, criteria, and other guidance; (2) identification of the research needed to reduce significant uncertainties and execution of that research; and (3) development of the capability to process a license application. BNL will provide a thorough review of the subject of waste form including the identification of potential regulatory criteria and needed research. BNL will draw upon in-house or subcontracted skill and will take advantage of current or previous efforts at NRC, DOE and elsewhere, as appropriate.
Keywords: radioactive waste disposal; low-level radioactive wastes; high-level radioactive wastes; radioactive waste management; technology transfer.

160130 Study of UF6/UO2F2 in Experimental Animals. Morrow, P.E. (Univ. of Rochester, Rochester, NY, 14642). **Project number:** A-4083. **Contract:** AC02-76EV03490. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objectives are to: (1) determine renal and skeletal retention functions for uranium following single UO2F2 administration; (2) determine effects of known renal burdens of uranium on renal function, morphology, and uranium excretion; (3) evaluate biochemical indices of renal function; (4) compare effects of UO2F2 and HF alone and together; and (5) explore methods of uranium assay. Rats or dogs will be exposed by inhalation, intratracheal instillation, or intravenous injection to single administrations of UO2F2 at several dose levels.
Keywords: uranyl fluorides; biological effects; radionuclide kinetics; kidneys; retention functions; skeleton; rats; dogs; inhalation; hydrofluoric acid; renal clearance; synergism.

160131 Radiation Exposure of Transportation Worker Handling Large Numbers of Radioactive Material Packages. Smith, B.P. (Reynolds Electrical and Engineering Co., Inc., P.O. Box 14400, Las Vegas, NV, 89114). **Project number:** A-6137. **Contract:** A-6137. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objectives of this program are to: (1) identify transportation carriers where employees may receive doses in excess of 500 millirems per year; (2) determine the actual exposure received by these employees; (3) observe handling procedures; and (4) identify relationship between quantities of radioactive materials handled and anticipated exposure. Five to ten carrier facilities will be visited by the contractor's personnel. Radiation measurements will be made by using direct-reading instruments and personnel dosimeters.
Keywords: transportation systems; personnel; nuclear trade; materials handling; radiation doses.

160132 Fluid Distribution and Liquid Level Detector System. Rice, R.E. (EG and G Idaho Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A-6282. **Contract:** A-6282. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objective of the program is to provide the following instruments: (1) four fluid distribution grid systems for Japanese Loss-of-Coolant-Accident (LOCA) Refill and Reflood Test Facilities; and (2) two fluid distribution grid systems and ten liquid level detectors for Federal Republic of Germany (FRG) Loss-of-Coolant-Accident (LOCA) Refill and Reflood Test Facility. The above instruments are supplied to help understand how water penetrates the downcomer of the pressurized-water-reactor (PWR) and how the fluid behaves in the upper plenum.
Keywords: pwr type reactors; loss of coolant; reactor safety; test facilities; level indicators; specifications; hydraulics.

160133 Respirator Studies for NRC. Skaggs, B.; Hack, A. (Los Alamos Scientific Lab., P.O. Box 1663, MS 986, Los Alamos, NM, 87545). **Project number:** A-7005. **Contract:** A-7005. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The purpose of this project is to provide the NRC with information necessary to supplement NRC Regulatory Guides covering the use of respirators for protection against inhalation of airborne radioactive materials. Technical competence and laboratory support in respiratory protection are made available for guidance necessary for standards development, compliance costs, NRC licensee respirator program reviews, or other actions within the responsibility of the NRC. Assistance in assuring prompt application of new developments in respiratory protection is provided. Consultations and technical assistance are provided on numerous respirator problems including the clean-up operations at Three Mile Island (TMI). At the request of NRC, two visits were made to TMI to assist NRC staff in evaluating the existing respirator program, developing criteria for up-grading this program, and providing guidance to the organizations involved in the clean-up operations.
Keywords: respirators; inhalation; radioactive materials; compliance; regulatory guides; technology assessment.

160134 Investigation Related to Alternative Waste Forms for Liquid Scintillation Waste. (Idaho Operations Office, Idaho Falls, ID, 83401). **Project number:** A-6184. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The objective is to provide assistance to NMSS in sampling and analyzing the off-gassing products of incinerated liquid scintillation wastes. The specific task objective is to identify the off-gassing contaminants, their concentrations, and the percent of activity escaping in these contaminants during incineration. Specific tasks are: (1) collect samples with guidance of NRC of off-gassing products of incinerated liquid scintillation wastes; and (2) analyze the samples to identify the off-gassing contaminants, the activites/concentration of the off-gassing contaminants, and the percent of the activity (i.e., if 2 curies of liquid were incinerated during a test and .2 curies were released as part of the off-gassing contaminant, 10% is released).
Keywords: low-level radioactive wastes; incinerators; off-gas systems; gaseous wastes; leaks; sampling; air pollution; chemical analysis; radioactive waste processing; radioactive waste management; air; air quality.

160135 Fuel Cycle Facility Technical Review. (Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** A-7010. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant monitoring.

The scope of this work is to provide technical assistance to NRC in preparation of its safety evaluations and environmental impact assessments for selected fuel cycle facilities. When required,

the environmental assessment will be supplemented by a negative declaration or environmental impact statement.
Keywords: safety; environmental impacts; fuel cycle; feed materials plants; fuel reprocessing plants; evaluation.

160136 Investigations Related to the Migration of Raffinates from the Existing Cotter Tailings Impoundments. (Los Alamos Scientific Lab., Los Alamos, NM, 87945). **Project number:** A-7144. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC. **Related energy source:** nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objective is to provide assistance to NMSS in sampling and analysis of environmental media near the Cotter Corporation Uranium Mill at Canon City, Colorado. The specific task objective is to better define the extent of contamination of groundwater as well as to determine whether these contaminants are accumulating in soils and vegetation, which are irrigated with this groundwater. Previous monitoring studies carried out by Cotter Corporation and the CODH have found elevated concentrations of uranium, molybdenum, total dissolved solids, sulfate and selenium in shallow groundwater. The hydrologically downgradient problem will be to verify environmental contamination resulting from release of trace elements via seepage from the mill's tailings ponds. Specific tasks are: (1) collect environmental samples with guidance of NRC and assistance of CODH, and (2) analyze the samples for molybdenum, selenium, uranium, chlorine, sulfate and radium.
Keywords: feed materials plants; mill tailings; ground water; soils; plants; uranium; molybdenum; sulfates; selenium; chlorine; radium; sampling; leaching; contamination.

160137 Confirmatory Survey of US Nuclear Facilities at Oak Ridge. Auxier, J.A. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** A-9087. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The contractor will furnish the necessary qualified personnel, equipment, materials, and services to perform a radiological survey of the USN facilities. The survey will be performed in accordance with the following general outline: (1) survey and sampling methods: (a) direct alpha measurements, (b) beta-gamma count rate measurements, (c) removable radioactive surveys, (d) radiation level surveys, (e) soil and sediment samples, (f) water samples, (g) paint samples, (h) scale samples, (i) ceiling samples, (j) US ceramics facility, and (k) state licensing materials; (2) effectiveness of decontamination and survey results comparision; and (3) location of water and soil samples.
Keywords: radiation monitoring; personnel dosimetry; radiation doses; radioactivity; water; paints; sampling; licensing; soils.

160138 Regulatory Differences Between Thorium and Current Uranium Fuel Cycles. McBride, J.P.; Frederick, E.J. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** A-9088. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective of this program is to study the health, safety, and environmental consideration of potential thorium fuel cycles as compared to the current uranium fuel cycles and how any differences could impact on the regulatory process. The study will focus on three specific tasks: thorium cycle impacts assessment; comparison of uranium and thorium cycles; and regulatory requirements.
Keywords: pwr type reactors; bwr type reactors; thorium cycle; environmental impacts; legal aspects.

160139 LOCA Simulations in NRU. Mohr, C.L. (Battelle Pacific Northwest Labs., Battelle Blvd., Richland, WA, 99352). **Project number:** B-2277. **Contract:** B-2277. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.
Keywords: reactor safety; loss of coolant; simulation; fuel element failure; fuel elements.

160140 Steam Generator Tube Rupture Iodine Transport Mechanisms. Denning, R.S. (Battelle Columbus Labs., 505 King Ave., Columbus, OH, 43201). **Project number:** B-6706. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The purpose of this program is to investigate the physical mechanisms of radioiodine transport under PWR steam generator tube rupture conditions. This program consists of two tasks. Under task 1 the potential for optimization of the primary system coolant as it leaks from the primary system into the steam generator secondary side will be experimentally determined. Under task 2 models will be developed to predict the transport of iodine within the steam generator and the secondary system.
Keywords: pwr type reactors; steam generators; tubes; failures; leaks; fission product release; radioactivity transport; iodine.

160141 Licensing Assistance/Tailings Management Program Technical Evaluation. (Geotechnical Engineers, Inc., 1017 Main Street, Winchester, MA, 01890). **Project number:** B-6446. **Contract:** NRC-02-79-031-01. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will perform evaluations of tailings management alternatives for existing or proposed uranium milling projects. For each project the contractor will supply the necessary facilities, material services, and personnel to accomplish the following tasks: (1) review the applicants' evaluation of tailings management alternatives, and identify any requirements for additionl information (the evaluation will consist of an examination of the factors that may affect the long-term stability characteristics of the tailings management alternatives as they relate to four radiation pathways and one nonradiological pathway); (2) document the examination of the long-term stability characteristics of each alternative in an evaluation report; and (3) respond to public comments or other agency (state and federal) comments on the contractor's evaluations if requested by the NMSS project officer.
Keywords: mill tailings; radioactive waste management; licensing; evaluation; environmental impacts; feed materials plants.

160142 Pioneer Uravan Mill Tailings Evaluation. Delaney, B.T. (Fred C. Hart Associates, New York, NY, 10022). **Project number:** B-6923. **Contract:** NRC-02-79-051. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will evaluate tailings management alternatives for the proposed new Pioneer Uravan Uranium Mill to be located near Uravan, Colorado. In addition, the contractor will submit a report to the project officer documenting the contractor's site visit and stating if other locations in the mill vicinity offer probable major improvement in long-term stability over the applicant's proposed location. The contractor will also submit to the project office a file containing one copy of each document referenced and/or developed in connection with site evaluation.
Keywords: mill tailings; radioactive waste management; feed materials plants; colorado; site selection; evaluation.

160143 TVA Edgemont Mill Tailings Evaluation. Castro, G. (Geotechnical Engineers, Inc., 1017 Main Street, Winchester, MA, 01890). **Project number:** B-6924. **Contract:** NRC-02-79-052. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will evaluate tailings management alternatives for the TVA Edgemont decommissioning plan. In addition, the contractor will submit a report to the project officer documenting the contractor's site visit and stating if other locations in the mill vicinity offer probable major improvements in long-term stability over the applicant's proposed location(s). The contractor will also submit to the project office a file containing one copy of each document referenced and/or developed in connection with this site evaluation.
Keywords: decommissioning; nuclear facilities; mill tailings; radioactive waste management; evaluation; abandoned sites; feed materials plants; tennessee valley authority.

160144 Union Carbide Uravan Mill Tailings Evaluation. Castro, G. (Geotechnical Engineers, Inc., 1017 Main Street, Winchester, MA, 01890). **Project number:** B-6926. **Contract:** NRC-02-79-055. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will review all applicant submittals which pertain to the embankment design to determine compliance with NRC Regulatory Guide 3.11 and proposed 3.11.1. The review will include: (1) a detailed assessment of site conditions including climate, groundwater hydrology, geology, and seismology to evaluate their impact on the tailings retention systems; (2) evaluation of detailed data and an inspection of typical undisturbed embankment samples; (3) evaluation of the applicants' assessment of settlement, seepage, embankment erosion due to overlapping of waves, and flood storage

capacity; (4) evaluation of the applicants' plan for continuing operation and maintenance to assure retention embankment safety; and (5) inspection (before operation of pond 2) at the site as required to assure compliance with approved construction plans and specifications.
Keywords: mill tailings; feed materials plants; evaluation; meteorology; hydrology; geology; seismology; radioactive waste management; environmental impacts; site selection; site preparation.

160145 Cyprus Mines Corporation, Hansen Project Mill Tailings Evaluation. Delaney, B.T. (Fred C. Hart Associates, Inc., New York, NY, 10022). **Project number:** B-6927. **Contract:** NRC-02-79-056. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will evaluate tailings management alternatives for the Cyprus Mines Corporation Proposed Hansen Project Uranium Mill to be located in Fremont County, Colorado. In addition, the contractor will submit a report to the project officer documenting the contractor's site visit and stating if other locations in the mill vicinity offer probable major improvement in long-term stability over the applicant's proposed location. The contractor will also submit to the project officer a file containing one copy of each document referenced and/or developed in connection with this site evaluation.
Keywords: mill tailings; radioactive waste management; feed materials plants; colorado; site selection; evaluation.

160146 Study of Consumer Products Containing Radioactive Material. Simmons, G.L. (Science Applications, Inc., 1200 Prospect Avenue, La Jolla, CA, 92038). **Project number:** B-0280. **Contract:** B-0280. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective is a reevaluation of the adequacy of the existing policy pertaining to the distribution of consumer products containing by-product and source material. As part of the reexamination, a generic environmental impact statement is required.
Keywords: radioactive materials; consumer products; environmental impacts; radiation hazards; regulations.

160147 Environmental Review of Spent Fuel Storage Installation. Glenn, R.D. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2207. **Contract:** B-2207. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The performing organization shall provide technical assistance to the Office of Nuclear Material Safety and Safeguards (NMSS) in carrying out environmental reviews of (1) the proposed expansion of the GE Morris Operation, and (2) the McGuire Nuclear Station spent fuel pool. The results of these efforts will be environmental appraisals, or environmental impact statements, as determined to be required. The performing organization shall prepare the necessary documents in accordance with instructions to be provided by the NMSS PM.
Keywords: environmental impacts; radioactive waste storage; radioactive waste facilities.

160148 Physical Characteristics of Waste Tanks and Contents: West Valley, NY. Kaser, J.D. (Rockwell Hanford Operations, Richland, WA, 99352). **Project number:** B2210. **Contract:** EY-77-C-06-1030. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The performing organization will provide technical assistance to NMSS. Phase I of the work will have been completed during fiscal year 1979. Phase I is the development of the most effective plan, including a safety analysis, for accomplishing the Phase II work. Phase II will be initiated during FY 1979 and includes procuring and/or fabricating sampling and inspection equipment and negotiating arrangements with Nuclear Fuel Services, Inc., for onsite assistance. Detailed operating procedures and safety reviews will be completed during Phase II. All of this work, initiated during FY 1979, will extend through FY 1982.
Keywords: radioactive waste facilities; containers; physical properties; inspection; risk assessment; safety.

160149 Assessing the Capability of Existing Plutonium Facilities to Withstand Natural Phenomena. Newmark, N.M. (Consulting Engineering Services, Urbana, IL, 61801). **Project number:** B6150. **Contract:** NRC-03-78-150 Task. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will: (1) provide the rationale and approach for selection of site specific parameters; (2) provide the guidance in selection of analytical methodology for structural analysis; (3) provide support to the detailed review by others of specific facilities and the study of backfitting alternatives where applicable; (4) assess, if necessary, the value of possible backfitting to minimize risk; (5) review and contribute to final site specific natural phenomena characterization and structural analytical reports and to the final risk assessment reports; and (6) serve as an expert witness in various meetings and public hearings on these facilities, if required.
Keywords: plutonium; nuclear facilities; risk assessment; disasters; safeguards.

160150 Fuel Trac Systems Services. (Nuclear Assurance Corp., 24 Executive Park West, Atlanta, GA, 30329). **Project number:** B-6435. **Contract:** DR-79-0864. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

This subscription renewal of Fuel Trac Systems Services will satisfy a continuing requirement for technical information required by the Division of Fuel Cycle and Material Safety.
Keywords: information needs; fuel cycle centers; information systems.

160151 Forum Entitled Nuclear Radiation: How Dangerous Is It. White, R.R.; Koshland, D.E. (National Academy of Sciences, 2101 Constitution Avenue, Washington, DC, 20418). **Project number:** B-6931. **Contract:** NRC-02-79-057. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor provided the necessary facilities, material, and personnel to convene a forum on September 27, 1979, to discuss nuclear radiation and its dangers. The forum was designed to: (1) clarify the confusion among the public as well as that among experts concerning the accuracy and the implications of key data on nuclear radiation; (2) examine the range of nuclear radiation risk as perceived by the public and by the experts who study it; and (3) compare the assessment and perception of nuclear radiation risk with other known and accepted risks.
Keywords: meetings; public opinion; ionizing radiations; radiation hazards; risk assessment; comparative evaluations.

160152 ALARA in Radiopharmaceutical Industry. Philbin, T. (Ecological Analysts, Inc., 275 Broad Hollow Road, Melville, NY, 11746). **Project number:** B-6414. **Contract:** NRC-02-79-037. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The contractor will perform studies of current practices and procedures at radiopharmaceutical manufacturing facilities to provide a data base. The study will include: (1) throughput per year of each specific radionuclide; (2) installed equipment, technology, and procedures for use and handling of radioactive materials; (3) occupational exposures, both external and internal, received as a result of processing and manufacturing operations; and (4) quantities of each radionuclide released per year as airborne and waterborne effluents.
Keywords: radiopharmaceuticals; manufacturers; materials handling; personnel; radiation doses; radioactive effluents; data compilation; radiation protection.

160153 Tritium Analysis of Bioassay and Environmental Samples. Westerman, B. (Univ. of Arizona, 1827 E. Mabel, Tucson, AZ, 85724). **Project number:** B-6925. **Contract:** NRC-02-79-053. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The contractor shall perform tritium analyses on approximately 600 bioassay or environmental samples at a cost of $15 per sample, total cost not to exceed $10,000. The samples will be supplied to the contractor by the Arizona Atomic Energy Commission. Human bioassay samples will be identified by sample number only.
Keywords: tritium compounds; bioassay; environmental materials; cost; human populations; radionuclide kinetics; uptake; radiochemical analysis; tissues.

160154 Guidance Documents for Off-Site Emergency Instrumentation for Accidents Involving Light Water Nuclear Power Plants.

Keller, J.H. (EG and G Idaho, Inc., Idaho National Engineering lab., Idaho Falls, ID). **Project number:** B-1604. **Contract:** 80-79-006. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of this program is to develop a series of six guidance documents to provide recommendations on types of radiological emergency instrumentation and monitoring techniques that could be used to assess the off-site radiation hazards resulting from a serious accident at a light-water nuclear power plant. These guidance documents will be made available to assist Federal, state and local government agencies in the conduct of radiological assessments involving the milk pathway, the airborne plume, and the food and water pathway, both during the emergency phase as well as the recovery period.
Keywords: pwr type reactors; bwr type reactors; nuclear power plants; reactor accidents; environmental impacts; radioactive effluents; radiation monitors; radiation monitoring; reactor safety; radiation protection.

160155 Feasibility Study Regarding an Emergency Preparedness Simulation Facility. Sandusky, W.F. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA). **Project number:** B-2302. **Contract:** 80-79-001. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective of the program is to determine the feasibility of designing and constructing a portable computerized Emergency Preparedness Simulation Facility (EPSF) for use by NRC in testing state and local radiological emergency plans for coping with unscheduled releases of radioactive material. The facility would be used to enhance emergency drill realism and to improve drill evaluation methods through automation. The purpose of the facility would be to create a simulated emergency environment that closely approximates conditions which might actually exist during a nuclear emergency but without jeopardizing the environment, property, or public welfare and to provide a means for evaluating the effectiveness of state and local emergency response plans.
Keywords: nuclear facilities; radioactive effluents; accidents; radiation monitoring; radiation protection; simulators; emergency plans.

160156 Assessment of Radiation Doses Resulting from Uranium Mining and Milling. Travis, C.C.; McDowell, L.M.; Watson, A.P. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0281. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The principal objective of this assessment is to provide estimates of integrated population exposure and resultant dose to American, Canadian, and Mexican populations which would result from releases of radon-222 from uranium mining and milling activities in western United States. The assessment will be performed as four integrated tasks: (1) estimation of population exposure and dose from inhalation of radon-222 and daughters, (2) estimation of population exposure and dose from ingestion of lead-210, (3) review of environmental transport parameters and dose conversion factors for lead-210, and (4) review of environmental transport parameters and dose conversion factors for radium-226.
Keywords: uranium; radon 222; human populations; radiation doses; inhalation; ingestion; radionuclide migration; radionuclide kinetics; radium 226; daughter products; fuel cycle; nuclear fuels; usa; canada; mexico; lead 210; feed materials plants; health hazards; radioactive wastes; ores; mill tailings.

160157 Review of the Environmental Impacts of High Level Radioactive Waste Management. Cohen, S. (Teknekron, Inc., 1483 Chain Bridge Rd., McLean, VA, 22101). **Project number:** B-6136. **Contract:** NRC-02-77-165. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The contractor will: (1) acquire and be aware of the existing body of information on the environmental effects of the management of high-level radioactive wastes; (2) develop the areas of communication and contacts necessary to maintain this body of information as current as possible; (3) inform the Commission on a quarterly basis of the status of this body of information; and (4) suggest to the Commission areas where insufficient information exists and where the basis for existing information is inadequate.
Keywords: radioactive waste management; environmental impacts; high-level radioactive wastes; data acquisition; information needs.

160158 Volume Reduction Techniques in Low Level Radioactive Waste Management. Kniazewycz, B.G. (Teknekron, Inc., 1483 Chain Bridge Rd., McLean, VA, 22101). **Project number:** B-6413. **Contract:** NRC-02-79-024. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The contractor will conduct a literature search to compile a complete list of volume reduction techniques developed for radioactive and non-radioactive applications. The contractor will describe the engineering designs and economics of each concept. Based upon his analysis of contractor recommendations made under this task, the COAR will identify those techniques to be evaluated with respect to cost effectiveness in the economic analysis. This analysis will be based on waste volume projections supplied by the NRC and will consider utilization of the technique at the nuclear facility, on a regional basis, and at the burial site. Applications to both fuel cycle and non-fuel cycle wastes will be evaluated.
Keywords: low-level radioactive wastes; radioactive waste processing; volume; economic analysis; technology transfer; radioactive waste management.

160159 Environmental Impact Statement for Low-Level Waste. (Dames and Moore, 20 Haarlem Ave., White Plains, NY, 10603). **Project number:** B-6420. **Contract:** NRC-02-79-025. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The contractor will prepare a chapter outline and description of the methodology to be employed in the preparation of the EIS, and schedule for completion. The preliminary draft Task 2 Report and the draft Task 2 Report will contain a complete discussion of the contractor's findings, relevant observation about the progress of the work and any pertinent recommendations concerning the project. The contractor will prepare a draft EIS to guide and support development of the Part 61 regulation following currently effective guidelines promulgated by the Council on Environmental Quality, NRC guidance, and 10 CFR Part 51. To obtain an independent assessment of the completeness, accuracy and validity of the work performed under this contract, the contractor will organize and host a meeting of an independent technical review group consisting of qualified representative of both the private and public sectors. Subject to approval of the Project Office, the contractor will prepare the final EIS document.
Keywords: low-level radioactive wastes; environmental impact statements; technology transfer; radioactive waste management.

160160 Systems Analysis of Shallow Land Burial. Lester. (Science Applications, Inc., 1200 Prospect St., P.O. Box 2351, La Jolla, CA, 92038). **Project number:** B-6428. **Contract:** NRC-02-79-032. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The contractor will furnish an exhaustive shallow land burial radionuclide release pathway list for existing shallow land burial sites and a reference site utilizing release pathways postulated in existing literature, and systematic techniques such as technological forecasting, morphological and fault/event tree analysis, and develop or obtain models and transport dose equations for the potential radionuclide release pathways and calculate uncertainty bands for each pathway. The contractor will develop a systems methodology and calculational computer model to assess shallow land burial sites. Using the system model, the contractor will perform a parametric study and a sensitivity analysis varying operational, solids performance, site suitability, site design and other parameters. Identifying functional parameter relationships optimizing waste confinement is another task. The contractor, utilizing the system model, will also assess release pathway doses, isotope doses, and total site impacts from a reference shallow land burial facility and source term.
Keywords: radioactive waste disposal; underground disposal; environmental exposure pathway; systems analysis; radionuclide migration; environmental impacts; soils; fresh water.

160161 Standardized Analysis of Fuel Shipping Containers. Whitesides, G.E. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0172. **Contract:** 40-550-75. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The goal of this project is a system of unified computer programs for the standardized safety analyses of nuclear fuel shipping containers and other equipment assciated with the nuclear fuel cycle. The initial version of the SCALE system (Standardized Computer Analysis for Licensing Evaluation) performs multidimensional criticality safety and shielding analyses. An advanced version of SCALE will include heat transfer analyses. It will also include an

interactive capability for specifying input and a deliberate capability for establishing inter-modular execution paths.
Keywords: s codes; casks; safety; shielding; criticality; heat transfer; fuel elements; transport; licensing; standards.

160162 Methods in Dosimetry. Eckerman, K.F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0410. **Contract:** B-0410. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(80); nuclear fusion(20) **R and D categories:** Health protection, safety, and industrial hygiene.

The objective is to provide NRC with resource capabilities in dose and risk estimations and with documentation of methodology and data bases used by groups such as NCRP and ICRP. Of special emphasis is the examination of the risk to non-adult members of the population. The approach includes the development and documentation of a series of pediatric mathematical phantoms and appropriate age-dependent metabolic models to permit calculation of dose conversion factors for the members of the population. The results include a consistent series of mathematical phantoms for newborn, 1-, 5-, 10-, and 15-year olds. Age-dependent metabolic models are being derived from data available in the literature.
Keywords: risk assessment; radiation doses; children; infants; adolescents; age groups; mathematical models; dose equivalents; standards.

160163 Pathogenic Organisms in Closed Cycle Cooling Systems. Tyndall, R.L. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B 0418. **Contract:** 40-550-75. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

Analysis of power plant cooling systems for the presence of pathogenic amoeba has been completed. Pathogenic naeglerin were not more prevalent in southern cooling systems relative to control waters. Pathogenic naeglerin were found in many of the northern power plant cooling systems and were significantly associated with such waters relative to control waters. We are now beginning the search for Legionnaire's Disease Bacterium (LDB) in cooling towers of nuclear electric power plant by using the fluorescent antibody technique and guinea pig inoculations. When finished these studies will indicate whether power plant cooling systems foster the growth of pathogenic amoeba and/or LDB. Studies will then be needed to determine how to effectively control these pathogens.
Keywords: closed-cycle cooling systems; health hazards; microorganisms; power plants; thermal effluents; population dynamics; habitat.

160164 Mathematical Simulation of Sediment and Contaminant Transport in Surface Waters. Onishi, Y. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2271. **Contract:** B-2271. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are: (1) to provide mathematical models for simulations of radionuclide transport in surface waters, including rivers (tidal and non-tidal), lakes, estuarines, and oceans, by considering the effects of radionuclide adsorption/desorption, sediment transport (including suspended sediments), and sediment deposition and resuspension; and (2) to review the literature of sediment and radionuclide transport models, studies of radionuclide transport in water and sediments, distribution of radionuclides in sediments, and sorption and release of radionuclides by sediments to determine the availability of existing information and data for use in model simulations and verification. Currently, mathematical models applicable to rivers, estuaries, and oceans have been developed. Models for estuaries and oceans are currently being tested to examine their validity.
Keywords: surface waters; sediments; radionuclide migration; water; mathematical models.

160165 Sediment and Radionuclide Transport in Rivers: Field Sampling Program, Cattaraugus and Buttermilk Creeks, New York. Onishi, Y. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2275. **Contract:** B-2275. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fusion(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are: (1) to collect data under varying water discharge conditions (low, medium, and high flows) on Cattaraugus and Buttermilk Creeks, New York, for the purpose of validating a Sediment and Radionuclide Transport Model (SERATRA); (2) to provide data input to the program Sediment and Radionuclide Transport in Rivers--Transport Modeling to perform the mathematical simulation of radionuclide-sediment transport in Buttermilk and Cattaraugus Creeks, New York; and (3) to assess the potential for offsite migration of radionuclides released from the West Valley Burial Site to the mouth of Cattaraugus Creek (Lake Erie). Flow, sediment, and radionuclide analysis under the medium flow were completed. Currently field data collected under low and high flow conditions are being analyzed.
Keywords: sediments; radionuclide migration; mathematical models; rivers; new york.

160166 Follow-Up Study of Persons Who Had I-131 and Other Diagnostic Procedures During Childhood. Hamilton, P.M. (Bureau of Radiological Health, 5600 Fisher Lane, Rockville, MD, 20857). **Project number:** B-5771. **Contract:** B-5771. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC; HEW.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The objective is to assess the risk of development of thyroid neoplasms following exposure to 131-I by evaluating the thyroid neoplasm experience in young adults who received diagnostic 131-I during childhood, compared to the experience in a similar group of unexposed young adults and a group of unexposed siblings.
Keywords: iodine 131; thyroid; epidemiology; biomedical radiography; human populations; neoplasms; carcinogenesis; dose-response relationships; radiation doses.

160167 Thorium-230 in Uranium Mill Workers. Fisher, D. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-0205. **Contract:** B-0205. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The contractor will collect and interpret data concerning the degree of accumulation of 238-U and 230-Th in the tissues of uranium mill workers. The specific purpose is to determine whether 230-Th may be present in higher concentrations than 238-U in the tissues of long-term workers and to compare these and other measurements to the predictions of ICRP's models of human physiology. The contractor will identify a population of approximately 30 workers who have at least 5 years work experience in crushing operations at approximately 5 uranium mills. The contractor will measure the 238-U and 230-Th in the urine and feces of each worker on the first day following a work interruption of at least 4 days. Retired employees will be included in the study if possible. Exposure histories will be recorded.
Keywords: uranium 238; thorium 230; radiation monitoring; personnel monitoring; tissue distribution; personnel; uranium ores; ore processing; nuclear facilities; chronic exposure; icrp; mathematical models; comparative evaluations; radionuclide kinetics; contamination.

160168 Environmental Statement Concerned with Exemption of Low-Enriched Uranium and Technetium-99 as Residual Contamination in Smelted Alloys. Baker, D.A. (Battelle Pacific Northwest Lab., Box 999, Richland, WA, 99352). **Project number:** B-2126. **Contract:** B-2126. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objectives of this project are to gather information, perform necessary analysis, and prepare both rough draft and camera-ready copy for inclusion into a Draft Environmental Statement (DES) concerning the exemption from licensing requirements for smelted alloys contaminated with low levels of uranium and technetium-99. Two revisions of the DES were sent to the sponsor, the last being the camera-ready copy for the printing of the DES. No major milestones were reached in this period. The sponsor's comments on the second draft were received on 19 November 1979, and the draft was suitably modified. This revised draft was sent to the sponsor on 6 December 1979. This was reviewed and the few remaining changes to the draft were communicated by telephone from the sponsor. Subsequently, after final revisions, the camera-ready copy of the DES was sent to the sponsor on 22 December 1979.
Keywords: uranium; technetium 99; smelting; alloys; contamination; environmental impacts; radioactivity.

160169 Safety and Costs Related to Decommissioning Light Water Reactors. Smith, R.I. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2117. **Contract:** B-2117. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objective of the program is to develop the technology, safety, and costs of decommissioning light water reactors. The study of pressurized water reactors has been completed. The study of a boiling water reactor and of a multiple reactor power station are underway. Studies of reactors which have experienced an accident and floating reactors have yet to be initiated.

Keywords: pwr type reactors; bwr type reactors; reactor decommissioning; cost; radiation protection; safety.

160170 Safety and Costs for Decommissioning Nuclear Fuel Cycle Facilities. Smith, R.I. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2036. **Contract:** B-2036. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objective of the program is to develop the technology, safety, and costs of decommissioning various nuclear fuel cycle facilities for light water reactors (exclusive of the reactors themselves and uranium mills) and of non-fuel cycle nuclear facilities. Individual studies of fuel reprocessing plants, small mixed oxide fuel fabrication plants, and low level waste burial grounds have been completed. Other studies of uranium fuel fabrication and of non-fuel cycle nuclear facilities are underway. Yet to be started is a study of a uranium fluoride conversion plant.
Keywords: pwr type reactors; bwr type reactors; fuel cycle; cost; fuel reprocessing plants; fuel fabrication plants; decommissioning; safety; radiation protection.

160171 Preparation of Generic Environmental Impact Statement on Decommissioning of Commercial Nuclear Fuel Cycle Facilities. Moore, E. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2129. **Contract:** B-2129. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Clinical studies in humans.

The objective is to prepare generic environmental impact statement (GEIS) covering decommissioning of nuclear facilities broadly. This is being done in close coordination with the NRC staff. Alternatives are being described in detail. Current status is that a working paper of the draft GEIS has been submitted to NRC which is preparing the formal draft version.
Keywords: environmental impact statements; decommissioning; nuclear facilities; fuel cycle.

160172 Radiation Exposures from Products Containing Radioactive Materials. O'Donnell, F.R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0114. **Contract:** B-0114. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Health protection, safety, and industrial hygiene.

The objectives of this program are: (1) to develop a general methodology for estimating individual and population radiation doses from distribution, use, and disposal of radionuclide-consumer products; and (2) to estimate radiation doses associated with consumer products by applying the methodology. Four reports were published under this program. One describes the methodology and the associated computer code. The other three reports estimate the radiation doses from three specific types of consumer products: wristwatches containing tritium gas, timepieces containing radioluminous paints, and welding electrodes containing thorium.
Keywords: radioactive materials; radiation doses; radiation monitoring; human populations; radioactive wastes; radiation sources; forecasting; computer codes; thorium; electrodes; radioluminescence; paints; welding; tritium; consumer products.

160173 Sediment and Radionuclide Transport in Rivers (Transport Modeling). Onishi, Y. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2275. **Contract:** B-2275. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fusion(100) **R and D categories:** Environmental transport and conversion of pollutants.

The objectives are: (1) to verify the unsteady two-dimensional sediment, and radionuclide transport model, SERATRA, by applying it to Cattaraugus and Buttermilk Creeks near West Valley radioactive waste burial site in New York; (2) to use the data and information collected in the research program entitled Sediment and Radionuclide Transport in Rivers: Field Sampling Program, Cattaraugus and Buttermilk Creeks, New York, as input to the computer code; and (3) to assess the potential migration of radionuclides from the waste burial site to the mouth of Cattaraugus Creek and to Lake Erie. Currently mathematical modeling of flow, sediment, and radionuclide movements in these streams is underway.
Keywords: radionuclide migration; mathematical models; rivers; sediments; water; computer codes; s codes; new york; radioactive waste management; underground storage.

160174 Aerosol Release of Radioactive Materials from Fuel Cycle Facility Accidents. Mishima, J. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2287. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objective of this research project is to determine the aerosol generation characteristics for generic accident scenarios applicable to the major, credible accidents in fuel cycle facilities and the transport of these aerosols in the immediate vicinity of the release point.
Keywords: fuel cycle; radioactive aerosols; nuclear facilities; accidents; environmental transport.

160175 Health Systems, Inc. Dreyer, N. (Health Systems, Inc., 100 Main St., Reading, MA, 01867). **Project number:** B-1090. **Contract:** B-1090. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Epidemiological studies.

The major objective is determination of the feasibility of conducting epidemiologic studies of human health effect of low-level ionizing radiation. This is a project in two phases. Phase I presents suitable epidemiologic approaches to be used in determining health effects from exposure to low-level ionizing radiation. In addition, Phase I includes the selection of suitable exposed population which may be used for human epidemiologic studies. Phase II examines the quality of actual field data on the population selected in Phase I. In addition, those populations, if any, most suitable for further study will be selected. Such things as cost, time needed for followup studies, and how data bases need to be improved are also part of Phase II.
Keywords: health hazards; low dose irradiation; epidemiology; human populations.

160176 Solubility Classification of Airborne Products from LWR Fuel Plants. Kalkwarf, D.R. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B-2123. **Contract:** B-2123. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

This project is being conducted to classify the solubilities of airborne uranium compounds found in light-water-reactor (LWR) fuel plants in terms of the ICRP Task Group Lung Model as day, week, or year . Four principal types of products are under investigation: ammonium diuranate, uranyl fluoride, uranium dioxide, and uranium octoxide. In addition, several other uranium compounds are being investigated that may be formed from these products by side reactions in the plants, e.g., UO3, UF4. Measurements of the rates at which these materials dissolve in simulated lung fluid at body temperature (37 degrees C) will form the bases for the classifications recommended. Dissolution rates of the followup materials have been measured (UO2, U3O8, UO3, UF4). These materials have been obtained by sampling of several process sides. The composition of some of these samples is complex and consists of up to three compounds, e.g., (NH4)2U2O7, U3O8, and UO2.
Keywords: fuel reprocessing plants; radioactive aerosols; uranium compounds; ammonium uranates; uranyl fluorides; solubility; icrp; lungs; mathematical models; body fluids.

160177 Monitoring for Compliance with Decommissioning Criteria. Dickson, H.W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0224. **Contract:** B-0224. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

This effort is to define requisite radiological survey plans for decommissioned facilities to verify compliance with decommissioning criteria and for final regulatory inspection. The program identifies media to be sampled, sampling and survey techniques to be used, and necessary records and documentation. In addition, the project task includes the development of a system of checks and audits which allows inspectors to certify the validity of the monitoring results. As an illustrative example, application of the monitoring program to a hypothetical reactor site is demonstrated as part of the overall effort. Analytical costs and survey costs will be estimated for this portion of a decommissioning effort.
Keywords: reactor decommissioning; reactor sites; radiation monitoring; inspection; sampling.

160178 Distribution Coefficients for Radionuclides in Aquatic Environments. Schell, W.R. (Univ. of Washington, Seattle, WA, 98195). **Project number:** B-5749. **Contract:** NRC-04-76-352. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

Transuranic elements, in trace quantities, may be released into aquatic environments during fuel cycle operations and in larger quantities in the event of a major nuclear reactor accident. Their fate

in aquatic environments cannot be reliably predicted from present information obtained from laboratory experiments or field observations. The general objective is to obtain new or better information for predicting the fate of transuranic elements in aquatic environments. The following are steps toward the general objective: (1) summary of current literature; (2) distribution coefficients for water sediments; (3) release rates from sediments to overlying water; and (4) distribution coefficients for phytoplankton, water and sediments.
Keywords: aquatic ecosystems; radiation monitoring; radioisotopes; water pollution; nuclear power plants; emergency plans; radionuclide migration.

160179 Nuclear Criticality Safety Methods: Solid Angle and Surface Density. Thomas, J.T. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B-0419. **Contract:** 40-550-75. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Pollutant characterization and analysis.

The objectives of the program include the: (1) analysis of the surface density method in sufficient detail to define the method, the safety limits, and the areas of applicability; (2) provision of documentation sufficient to serve as a guide for use of the method; (3) demonstration by examples of application; (4) analysis of the solid angle method in sufficient detail to resolve outstanding questions on areas of applicability and criteria for acceptability; and (5) justification for extension of areas of applicability provision of specific practical criteria for extension of the standard now under development. The present definition of solid angle and surface density methods as used in nuclear criticality safety will be evaluated and the necessary research to better define the methods and their areas of applicability will be performed. The generation of new data bases will be accomplished by validated calculational techniques which satisfy the requirements of ANSI Standard N16.9-1975. Concentrated data base efforts on systems containing 5 wt % 235-U or less will be conducted. Oxides and metals will be studied. The effects of density, hydrogen content, mass and shape of fissionable materials will be characterized.
Keywords: critical size; criticality; density; measuring methods; accuracy; safety.

160180 Translocation of Yellowcake from the Human Respiratory Tract. Spitz, H.B. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** B2283. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The primary purpose of this study is to characterize the solubility of uranium mill yellowcake materials in the human lung by measuring uranium translocation and metabolism in an acutely exposed uranium mill yellowcake worker. Since it is understood that, generically, yellowcake is a soluble compound, the degree of solubility in the human lung must be verified through analysis of acute human exposure incidents. Analysis of uranium sequentially-collected excretu samples from acutely exposed yellowcake workers will characterize and quantitate uranium removal rates. Translocation of uranium from deposition sites in the respiratory system to other organs or tissue will be measured using external in vivo photon detectors. Bioassay and in vivo uranium measurements will be performed with volunteer yellowcake workers at PNL in order to eliminate any additional chronic, low-level uranium exposure which may occur at the mill.
Keywords: man; respiratory system; uranium; lungs; metabolism; radionuclide kinetics; occupational safety; low dose irradiation; inhalation; in vivo; nuclear industry; health hazards.

160181 Dynamic Simulation of Waste/Rock Processes. Shaw, H. (Geological Survey, Menlo Park, CA). **Project number:** B-6303. **Contract:** B-6303. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to model feedback mechanisms which could affect nuclear waste isolation in geologic media. These phenomena should be investigated for possible inclusion in the risk assessment methodology development project (A1192). The approach is development of a model to simulate dissolution of salt under conditions of thermal expansion. The simulation languages DYNAMO and GASP IV are utilized. The results give a series of overrun times and identify important processes governing dissolution rates. Insights from this work have been included in the risk methodology project A1192 and are guiding the model development in areas of feedback mechanisms.
Keywords: radioactive waste disposal; geologic deposits; salt deposits; dissolution; thermal expansion; risk assessment; computerized simulation.

160182 Scenario Development and Evaluation for Risk Assessment of High Level Waste Repositories. Donath, F.A. (C.G.S., P.O. Box 2801, Champaign, IL, 61820). **Project number:** B-6693. **Contract:** B6693. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The objective is to evaluate the influence of disruptive features on the pattern of groundwater flow and contaminant transport away from a radioactive waste repository. Utilizing a mathematical model of convection and dispersion, the model is applied to a series of disruptive features inserted into a reference repository. The importance of the geologic configuration and spatial location of disruptive features on the transport of radionuclides away from a repository are shown. This will assist in selection of scenarios to be included in risk analysis and give insight into important processes, mechanisms and features of waste isolation. The expected product is efficient computer model and procedures for repository evaluation.
Keywords: risk assessment; radioactive waste facilities; high-level radioactive wastes; ground water; radionuclide migration; flow models; underground disposal; radioactive waste disposal.

COUNCIL ON ENVIRONMENTAL QUALITY

170000 Some Long-Term Consequences of Hypothetical Major Releases of Radioactivity to the Atmosphere from Three Mile Island. von Hippel, F. (Princeton Univ., Center for Energy and Environmental Studies, Princeton , NJ, 08544). **Contract:** EQ9AD278. **Supported by:** Council on Environmental Quality, Washington, DC (USA). **Funding:** CEQ.
Related energy source: nuclear fission(100) **R and D categories:** Biological effects of pollutants in experimental systems.

The contractor modeled a number of postulated accidents at the TMI nuclear power plant to assess the long-term health consequences. The conclusions of the draft report are: Long-term health impacts from major releases of radioactivity in reactor accidents would affect much larger numbers of people at much larger distances than the short-term consequences which can be reduced by timely evaluation. Delayed effects - thyroid damage and radioactive land contamination in particular - can be a concern more than one hundred miles downwind from an accident and for many decades. The public, therefore, has a direct interest in the safety of distant reactors, as well as those nearby. Consequently, emergency planning which focuses on areas close to nuclear power plants (even out to 50 miles) is not sufficient. Although evacuation may not be feasible beyond a distance of tens of miles from the reactor, the availability of thyroid protection medicine, sheltering in buildings, and air filters could all prove valuable in reducing radiation doses and the associated increased incidence of thyroid damage, cancer and other effects of low-level radiation at greater distances. Emergency planning at these distances from specific reactors may require cooperation between different states and, in some cases, cooperation with Canada or Mexico. Delayed cancers and genetic defects due to radiation from ground and buildings contaminated with long-lived radioactive cesium could be one of the largest consequences from a major release. Research on decontamination should therefore be given high priority.
Keywords: reactor accidents; three mile island-1 reactor; three mile island-2 reactor; public health; environmental impacts; air pollution; land pollution; buildings; fission product release; delayed radiation effects; carcinogenesis; mutagenesis; fission products; human populations; man.

OFFICE OF TECHNOLOGY ASSESSMENT

180000 Energy from Biological Processes. (Office of Technology Assessment, Washington, DC). **Supported by:** Office of Technology Assessment (U.S. Congress), Washington, DC. **Funding:** DOE.
Related energy source: conservation(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This study reviews the environmental impacts of production, conversion and use of agricultural products and residues, forage grasses, animal waste, and wood for energy.
Keywords: environmental impacts; agricultural wastes; manures; grass; forage; wood; production; bioconversion; biomass plantations; waste product utilization.

180001 Solar Power Satellite Policy Issues. (Office of Technology Assessment; Washington, DC). **Supported by:** Office of Technology Assessment (U.S. Congress), Washington, DC. **Funding:** OTA. **Related energy source:** solar(100) **R and D categories:** Biological effects of pollutants in experimental systems.

This assessment is reviewing the environmental impacts connected with microwave and laser transmission from space to earth, and the potential effects of launch vehicles on the atmosphere. The project will evaluate public perceptions of these issues.

Keywords: orbital solar power plants; environmental impacts; public opinion; microwave power transmission; lasers; space vehicles.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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