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DOE/EV 0057 Volume 2 (of 3)

DR. 677

Inventory of Federal Energy-Related Environment and Safety Research for FY 1978

MASTER

Volume II - Project Listings and Indexes

MASTER

Published: December 1979

U.S. Department of Energy
Assistant Secretary for Environment
Office of Program Coordination



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Inventory of Federal Energy-Related Environment and Safety Research for FY 1978

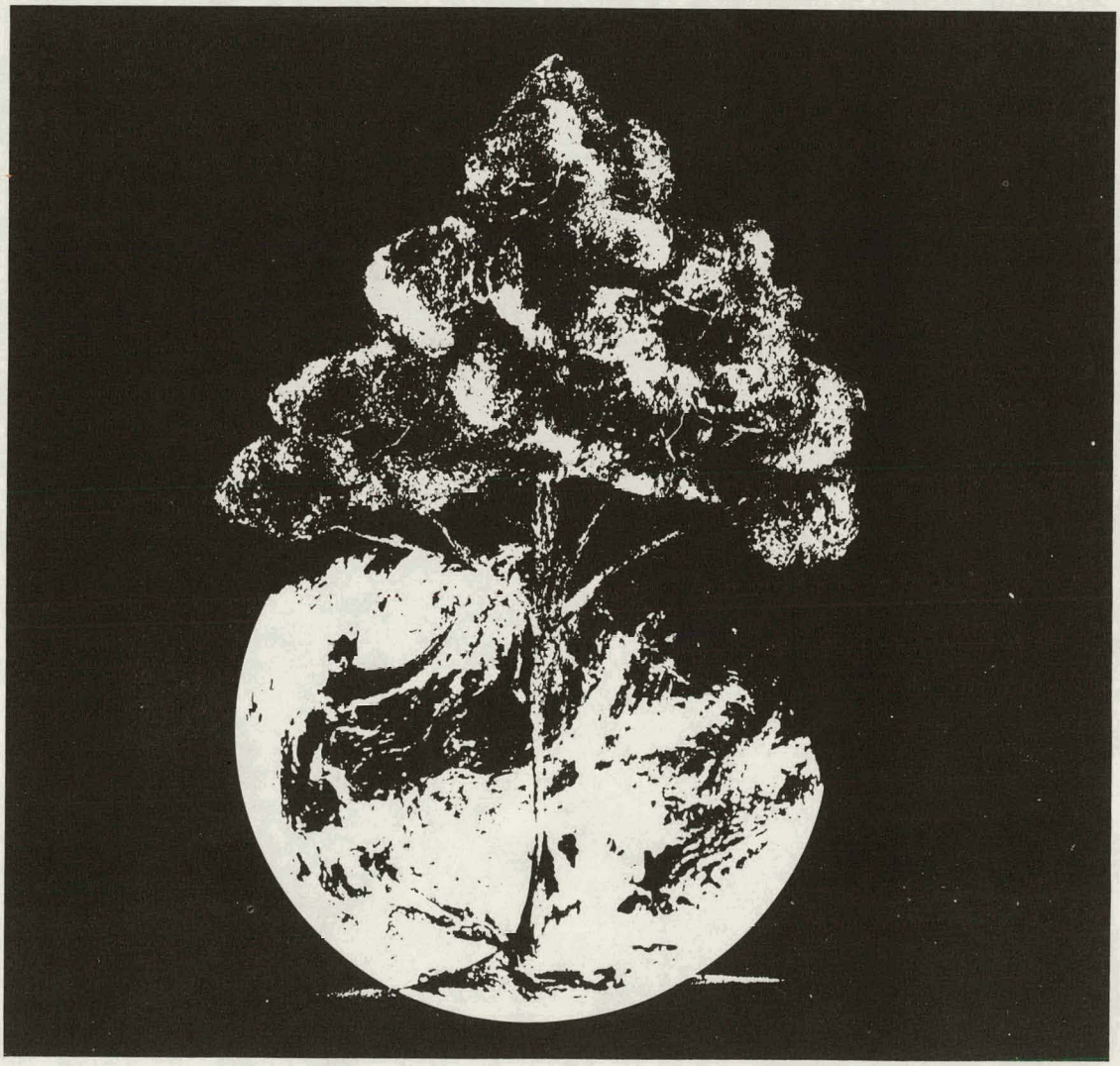
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Assistant Secretary for Environment
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Washington, D.C. 20545



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PREFACE

This volume contains summaries of FY-1978 government-sponsored environment and safety research related to energy. Project summaries were collected by Aerospace Corporation under contract with the Department of Energy, Office of Program Coordination, under the Assistant Secretary for Environment. The summaries and other information relating to the projects were input to a computer file by the Department of Energy's 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.

A duplicate file is available for on-line searching at Oak Ridge National Laboratory (ORNL). (See Volume III.) The file was also used at ORNL to develop the statistical information contained in the Executive Summary, Vol. I. In addition, the file is available for on-line searching via the Department of Energy RECON system, and the Department's input to the Smithsonian Science Information Exchange (SSIE) is partially fulfilled using the file.

Summaries are arranged 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	1–10,000
Department of Commerce	10,001–20,000
Department of Defense	20,001–30,000
Department of Health, Education and Welfare	30,001–40,000
Department of the Interior	50,001–60,000
Department of Transportation	60,001–70,000
Environmental Protection Agency	70,001–80,000
Department of Energy	80,001–110,000
National Science Foundation	110,001–120,000
National Aeronautics & Space Administration	120,001–130,000
Tennessee Valley Authority	130,001–140,000
U. S. Coast Guard	140,001–150,000
Nuclear Regulatory Commission	150,001–160,000

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 Volume IV.

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PART A

PROJECT LISTINGS

DEPARTMENT OF AGRICULTURE

24 Economics of Coal and Oil Shale Development on Environmental Quality in Rural Areas. Skold, M.; Juers, L. (Colorado State University, Department of Economics, Fort Collins, CO, 80521). **Project number:** NRE-42-309-08-01. **Supported by:** Economic Research Service, Washington, DC (USA). Natural Resource Economics Div. **Funding:** USDA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

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 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 will be developed 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: RURAL AREAS; ECONOMICS; COAL; OIL SHALES; LAND USE; ENERGY SOURCE DEVELOPMENT; WATER DEMAND; ECONOMIC IMPACT; ENVIRONMENTAL IMPACTS; COAL INDUSTRY; OIL SHALE INDUSTRY.

25 Economics of Coal and Oil Shale Development on Environmental Quality in Rural Areas. Magleby, R.; Schaub, J.; Krause, O. (Economic Research Service, Natural Resource Economics Division, Washington, DC, 20250). **Project number:** NRE-42-309-11-00. **Supported by:** Economic Research Service, Washington, DC (USA). Natural Resource Economics Div. **Funding:** USDA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The objective is to assess the economic implications of alternative coal and oil shale development and associated activities of environmental quality and the competition for resources in rural areas. The approaches are 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; 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 utilize budgeting techniques and linear programming to estimate water demand and to appraise the economic and environmental implications of alternative water supplies.
Keywords: RURAL AREAS; ECONOMICS; COAL; OIL SHALES; LAND USE; ENERGY SOURCE DEVELOPMENT; WATER DEMAND; ECONOMIC IMPACT; ENVIRONMENTAL IMPACTS; COAL INDUSTRY; OIL SHALE INDUSTRY.

33 Microspectrophotometric Analyses of Tissue Changes in Vertebrates Exposed to Water Pollutants. Anthony, A. (Pennsylvania State University, Agricultural Experiment Station, University Park, PA, 16802). **Project number:** PEN-01921. **Supported by:** Pennsylvania Agricultural Experiment Station, University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are to develop and evaluate short term methods for detecting (by means of quantitative histochemical bioassays) the presence of hazardous levels of specified toxicants in streams. Tissue samples will be obtained from fish exposed to sublethal and lethal levels of metal toxicants and acidity simulating conditions found in waters polluted by acid mine drainage. Laboratory and field studies will be made on fish subjected to acute (1 to 7 day) and longer term (1 month) exposures to different concentrations of heavy metal ions in acidified water. Emphasis will be on histophysiological effects of single metallic ions, ion-ion interactions and ion-acid interactions. Quantitative cytophotometry will be used to assess toxicant induced aspects of tissue damage.
Keywords: VERTEBRATES; BIOLOGICAL EFFECTS; WATER POLLUTION; METABOLISM; SPECTRA; FISHES; ACID MINE DRAINAGE.

34 Socio-Economic Analysis of Economic Development and Environmental Degradation: Four Corners Area. Stevens, T.H. (New Mexico State University, Agricultural Experiment Station, Las Cruces, NM, 88003). **Project number:** MM-00203. **Supported by:** New Mexico State Univ., Las Cruces (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objective is to calculate the social and economic benefits and costs of economic development and environmental degradation in the Four Corners Area. 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: SOCIO-ECONOMIC FACTORS; ECONOMIC DEVELOPMENT; ENVIRONMENTAL IMPACTS; SOCIAL IMPACT; ECONOMIC IMPACT; ENERGY DEMAND; POLLUTION ABATEMENT; REGIONAL ANALYSIS; INPUT-OUTPUT ANALYSIS; INCOME; MANPOWER; ENERGY SOURCE DEVELOPMENT; AIR POLLUTION; WATER POLLUTION; LAND POLLUTION; COAL INDUSTRY.

36 Ethical Choices in Environmental Decisions. Heberlein, T.A. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS-01888. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objectives are to determine conditions under which individuals and organizations make ethical choices about action which has environmental impact; discover the attitudes, values and perceptions of those individuals who are influenced by environmental standards; and learn how decision makers in public utilities make tradeoffs between environmental and economic concerns in decisions involving power generation. Actual behavior will be observed in a situation where the individual could choose to act consistently with an environmental standard at a high cost or to violate the standard by taking some cheaper or easier alternative action. Mailed questionnaires will be used to assess attitudes, values, and perceptions of these groups. Several case studies of the decision making process are involved in the development of electrical generating facilities.
Keywords: ENVIRONMENTAL POLICY; DECISION MAKING; ETHICS; SOCIAL IMPACT; SOCIOLOGY; PUBLIC OPINION; ENVIRONMENT; MANAGEMENT; ECONOMIC IMPACT; POWER GENERATION; ENERGY POLICY;

HUMAN POPULATIONS; BEHAVIOR; POLLUTION REGULATIONS; IMPLEMENTATION.

38 Air Pollution Interactions on Crop Plants. Tibbitts, T.W. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS01947. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives are to: determine sensitivity of selected crop cultivars to ozone, sulfur dioxide and nitrogen dioxide alone and in combination; and evaluate symptomology and 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 hours for carrots, mint, peas, turfgrass, and alfalfa. The threshold 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: FOSSIL-FUEL POWER PLANTS; FLUE GAS; OZONE; SULFUR DIOXIDE; NITROGEN DIOXIDE; BIOLOGICAL EFFECTS; PLANTS; THRESHOLD DOSE; AIR POLLUTION; FUMIGANTS; ENVIRONMENTAL IMPACTS; ALFALFA.

42 Implications of Atmospheric Environment on Coal Development in Western North Dakota (SEAM Phase I). Ramirez, J.M.; Method, T.; Nantt, D. (North Dakota State University, Department of Soils, Agricultural Experiment Station, Fargo, ND, 58103). **Project number:** ND02535. **Supported by:** North Dakota State Univ., Fargo (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

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 GASIFICATION; COAL; COMBUSTION; FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; NORTH DAKOTA; METEOROLOGY; TEMPERATURE INVERSIONS; CHEMICAL EFFLUENTS; ENVIRONMENTAL TRANSPORT; WIND; TEMPERATURE MEASUREMENT; MATHEMATICAL MODELS; GASEOUS WASTES.

44 Toxicological and Physiological Effects of Heavy Metals and Selected Air Pollutants on Animals. Verlangieri, A.J. (Rutgers University, Agricultural Experiment Station, New Brunswick, NJ, 08903). **Project number:** NJ-00620. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objectives are to 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); determine the acute (LD50) and chronic (MED50) parameters of CO, SO2, and NOx; determine these parameters in combination; 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, cardiovascular system (atheregenesis); and 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, methodology will be utilized in mobilization and precursor studies. Quantitative statistical analyses will be run and extension to human levels made.
Keywords: MERCURY; LEAD; SULFUR DIOXIDE; CARBON MONOXIDE; NITROGEN OXIDES; MERCURY COMPOUNDS; RATS; RABBITS; CHICKENS; BIOLOGICAL EFFECTS; CARDIOVASCULAR SYSTEM; LEAD COMPOUNDS; ORAL ADMINISTRATION; BIOCHEMISTRY; INHALATION.

51 Interactions of Chemical Pollutants and Microorganisms in the New Jersey Coastal Environment. Bartha, R. (Rutgers University, Agricultural Experiment Station, New Brunswick, NJ, 08903). **Project number:** NJ-00507. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to identify and assess specific pollution hazards that will suggest remedies or cleanup procedure. The interaction of various pollutants such as petroleum hydrocarbons, polychlorinated biophenyls, persistent pesticide residues, 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; WATER POLLUTION; ENVIRONMENTAL EFFECTS; CHEMICAL EFFLUENTS; MICROORGANISMS; METABOLISM; COASTAL REGIONS; HYDROCARBONS; ORGANIC CHLORINE COMPOUNDS; AROMATICS; AQUATIC ECOSYSTEMS; EUTROPHICATION; PESTICIDES; ECOLOGICAL CONCENTRATION; BIOLOGICAL EFFECTS; NITROGEN FIXATION.

56 Woody Plants in Northeastern United States. Davis, D.D. (Pennsylvania State University, Agricultural Experiment Station, University Park, PA, 16802). **Project number:** PEN 12210. **Supported by:** Pennsylvania Agricultural Experiment Station, University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to determine the relative SO2 susceptibility of woody plants in northeastern United States; study the influence of environmental factors on response; and 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; ENVIRONMENTAL EFFECTS; TREES; INJURIES; LEAVES; CHRONIC EXPOSURE; METABOLISM.

58 Role of Microorganisms in Waste Disposal. Moe, P.G. (West Virginia Univeristy, Agricultural and Forestry Experiment Station, Morgantown, WV, 26506). **Project number:** WVA00244. **Supported by:** West Virginia Univ., Morgantown (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The following topics will be studied: anaerobic digestion for disposal of wastes generated in a family dwelling unit; disposal of effluent and sludge from community sewage disposal plants; generation of methane gas through the anaerobic digestion of animal manures; aerobic composting of manures; soil applications as a waste disposal system for industrial waste materials; disposal of acid mine drainage; and the 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 antagnoism within the populations will be investigated.
Keywords: MICROORGANISMS; WASTE DISPOSAL; ANAEROBIC DIGESTION; HOUSES; MANURES; SEWAGE SLUDGE; METHANE; PRODUCTION; COMPOSTING; GROUND DISPOSAL; INDUSTRIAL WASTES; MUNICIPAL

WASTES; ACID MINE DRAINAGE; ENVIRONMENTAL IMPACTS; TOXICITY; SYNERGISM; TOLERANCE; PHYSIOLOGY; TECHNOLOGY ASSESSMENT; WASTE PRODUCT UTILIZATION; WATER POLLUTION CONTROL; AEROBIC DIGESTION.

62 Impacts of Coal-Energy Development in Northeast Wyoming on Agriculture and Related Environment Aspects. Jacobs, J.J. (University of Wyoming, Agricultural Experiment Station, Laramie, WY, 82070). **Project number:** WY000998-WS. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

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 programming model will be used to estimate the impact of coal developments on agriculture.
Keywords: WYOMING; ENERGY SOURCE DEVELOPMENT; COAL MINES; LAND USE; WATER REQUIREMENTS; SOCIO-ECONOMIC FACTORS; LAND LEASING; GROUND WATER; AQUIFERS; LAND RECLAMATION; MATHEMATICAL MODELS; AGRICULTURE.

63 Perceptions of Scarcity and Willingness to Alter Consumption Patterns in New Mexico. Eastman, C.; Stevens, T. (New Mexico State University, Agricultural Experiment Station, Las Cruces, NM, 88003). **Project number:** NM00250. **Supported by:** New Mexico State Univ., Las Cruces (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Integrated assessment.

The objectives of this study are to: estimate future energy resource scarcity and identify associated environmental problems in New Mexico; determine citizens' perception of scarcity of energy resources and associated environmental problems; determine citizens' willingness to alter consumption patterns in response to environmental problems; develop scenarios of alternative life styles on the basis of preferences revealed in the study of citizens' perceptions; and elaborate policy options. Estimates of resources will be based on secondary data. Perceptions and willingness to alter consumption will be determined by questionnaire survey. The scenarios and policy will be based on questionnaire results.
Keywords: NEW MEXICO; ENERGY SOURCES; ENVIRONMENTAL IMPACTS; PUBLIC OPINION; ENERGY CONSUMPTION; LIFE STYLES; ENERGY SHORTAGES.

64 Forest Engineering Systems for Steep Mountain Forestry. Gardener, R.B. (Intermountain Forest and Range Experiment Station, P.O. Box 1376, Bozeman, MT, 59715). **Project number:** INT-3701. **Supported by:** Forest Service, Ogden, UT (USA). Intermountain Forest and Range Experiment Station. **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective of the project is to identify and evaluate alternative engineering systems that can improve the economic efficiency and environmental acceptability of forest resource utilization, with special emphasis on wood harvesting and transportation. The research program will emphasize synthesis and evaluation of engineering systems based on currently available or developing technology, with field tests of the most promising systems and methods. Field evaluations will be conducted in cooperation with NFS and industry participants. Major problems identified for early action include developing methodology and evaluating alternative systems to efficiently harvest timber, including currently unused wood being left as residue; providing efficient environmentally acceptable transportation methods for utilization and protection of forest resources; improving efficiency of energy use in timber harvesting, transportation, and utilization activities; and protecting surface resources that may be endangered by timber or mineral extraction operations.
Keywords: TERRESTRIAL ECOSYSTEMS; WATERSHEDS; MOUNTAINS; FORESTRY; WOOD; HARVESTING; ENERGY CONSUMPTION; ENERGY CONSERVATION; ENVIRONMENTAL IMPACTS; LAND USE; TRANSPORT; WASTE PRODUCT UTILIZATION; SOILS; FEASIBILITY STUDIES; TECHNOLOGY UTILIZATION.

65 Sewage Disposal on Forest and Associated Lands. Urie, D.H. (Michigan State University, East Lansing, MI, 48823). **Project number:** NC-1651. **Supported by:** North Central Forest Experiment Station, St. Paul, MN (USA). **Funding:** USDA.
Related energy source: biomass(80); conservation(20). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives of the project are to: (1) determine methods for disposal and utilization of sewage effluent and sludge on forest lands without pollution of ground and surface waters; (2) determine soil physical and chemical characteristics necessary for proper sewage effluent and sludge disposal and renovation on forest lands; (3) determine the effects of sewage effluent and sludge applications on native and exotic forest vegetation; and (4) determine the movement and hydrologic effects of stream sediments. Municipal and industrial sewage effluents will be applied to a comprehensive range of soils and forest vegetation at field locations in conjunction with municipal land disposal projects. Soil and ground-water samples will be analyzed for nutrient elements and for potentially toxic materials. Sludge tests will be conducted on acid coal-mine spoil banks and on impoverished forest soils where ground and surface water quality effects will be tested. Accumulation of the nutrients and toxic elements in soils and plant materials will be determined. Changes in composition in native plant communities and growth of native and exotic plants will be studied following application of chlorinated secondary sewage effluent, waste water from sewage lagoons, and stabilized sewage sludge to forest lands. Three studies of stream sediment movements, covered by written agreements with fisheries research groups, will be completed.
Keywords: INDUSTRIAL WASTES; MUNICIPAL WASTES; SEWAGE; SEWAGE SLUDGE; WASTE PRODUCT UTILIZATION; FORESTS; SOILS; BIOLOGICAL EFFECTS; PLANT GROWTH; SPECIES DIVERSITY; STREAMS; SEDIMENTS; ENVIRONMENTAL TRANSPORT; GROUND WATER; NUTRIENTS; TOXIC MATERIALS; SPOIL BANKS; ENVIRONMENTAL EFFECTS; ECOLOGICAL CONCENTRATION; WASTE WATER; WASTE DISPOSAL; LAND RECLAMATION.

66 Reclamation of Surface-Mined Areas (Surface-Mined Area Rehabilitation). Curtis, W.R. (Berea College, Northeastern Forest Experiment Station, Berea, KY, 40403). **Project number:** NE-1605. **Supported by:** Northeastern Forest Experiment Station, Upper Darby, PA (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to develop practical methods of reducing damage to the environment and forest resources during surface-mining operation, and 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. Quantities will be determined and sources of sediment and chemicals entering streams from surface-mined areas will be characterized and effect on streamflow will be determined. Techniques for controlling erosion, sedimentation and runoff from these areas will be studied. Ways of reducing spoil bank instability such as spoil movement and placement, improved drainage and grading will be studied. Physical and mechanical properties of spoils will be studied. Physical, chemical and biological factors of spoils which affect plant establishment and growth will be studied. Procedures such as liming, fertilization, mulching, and site preparation will be tested to overcome any adverse effects. Methods of establishing herbaceous cover and trees at the same time will be developed. Potential for wildlife habitat and improved aesthetics will be studied.
Keywords: COAL MINING; LAND RECLAMATION; SURFACE MINING; WATER QUALITY; FORESTS; WILD ANIMALS; RECREATIONAL AREAS; LAND USE; WATER QUALITY; WATER POLLUTION; APPALACHIA; EROSION; RUNOFF; SPOIL BANKS; STABILITY; REVEGETATION.

67 Fixed-Wheel-Track Operation: Engineering and Agronomic Effects. Rice, C.E. (University of Georgia, Agricultural Experiment Station, Athens, GA, 30601). **Project number:** GEO-03-0383. **Supported by:** Georgia Univ., Athens (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil and gas(75); conservation(25). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective of this program is to determine the effects of fixed wheel-track for tractors on energy and forces required, soil

compaction, porosity, root zone environment, yields of organic crops, and soil and water management including subsurface irrigation and drainage. Three treatments will be used: conventional, compacted soil surface, and artificially surfaced. A tractor will be instrumented to measure and record torque, draft, time, slip, distance and fuel. Irrigation will be used.
Keywords: AGRICULTURE; FARMS; IRRIGATION; FARM EQUIPMENT; VEHICLES; ENERGY CONSUMPTION; FUEL CONSUMPTION; CROPS; PRODUCTION; SOILS; WATER RESOURCES.

68 Reclamation of Strip Mined Land in Ohio. Sutton, P. (East Ohio Resource Development Center, Caldwell, OH, 43724). **Project number:** OHO 00406-S. **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:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to investigate methods restoring vegetation, evaluate establishment and growth of new plant species on spoil material, correlate soil tests and fertilizer responses on spoils, and evaluate use of animal wastes in spoil reclamation. Field experiments will be conducted on toxic spoils to evaluate combinations of fertilizer, mulch, and limestone for establishment and maintenance of vegetative cover. Spoils where vegetation has been established will be used to determine the relationships between soil test values and plant response to P, K, and lime. New plant materials that appear to have a possible use for establishing a vegetative cover on toxic spoils will be obtained and evaluated. Cattle manure will be applied at different rates on toxic spoils to determine its effect in regard to establishing vegetation.
Keywords: COAL MINING; SURFACE MINING; LAND RECLAMATION; OHIO; REVEGETATION; SPOIL BANKS; MANURES; FERTILIZERS; LIMESTONE; SOIL CHEMISTRY; POTASSIUM; PHOSPHORUS; PREFERRED SPECIES.

69 Influence of Water Pollutants and Temperatures on Life History and Dynamics of Minnow Fish. Smith, L.L. (University of Minnesota, Agricultural Experiment Station, St. Paul, MN, 55108). **Project number:** INT-3701. **Supported by:** Minnesota Univ., St. Paul (USA). Agricultrual Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objectives are to study effects of temperature on growth, mortality and food habits of white suckers to describe parameters for ecological modeling; and determine acute and chronic influence of various toxicants on six fish species and various invertebrates. Suckers at various stages of life history will be subjected to temperature ranges including those characteristic of power plants. Food intake, growth rate, and mortality will be determined. Effect of temperature shock will be determined. Cyanide studies will employ HCN and various compounds of cyanide in acute toxicity tests and in chronic tests on long-term survival growth and fecundity of various fish species and invertebrates. The effects of photo degeneration on cyanide compounds will be determined by exposure to direct sunlight.
Keywords: WATER POLLUTION; BIOLOGICAL EFFECTS; FISHES; POPULATION DYNAMICS; ENVIRONMENTAL IMPACTS; ANIMAL GROWTH; MORTALITY; NUTRIENTS; TOXICITY; INVERTEBRATES; THERMAL POLLUTION; TEMPERATURE EFFECTS; POWER PLANTS; THERMAL EFFLUENTS; CYANIDES; ACUTE EXPOSURE; CHRONIC EXPOSURE; SURVIVAL CURVES; REPRODUCTION.

70 Effects of Multiple Land Use Practices on Big Game Habitat and Behavior in the Central Rocky Mountains. Ward, A.L. (University of Wyoming, Rocky Mountain Forest and Range Experiment Station, Laramie, WY, 82070). **Project number:** RM-1712. **Supported by:** Forest Service, Fort Collins, CO (USA). Rocky Mountain Forest and Range Experiment Station. **Funding:** USDA.
Related energy source: coal(50); biomass(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives of this project are to determine the environmental impacts and the interrelationships of major land use practices on the spectrum of habitats essential for optimum big game populations, and to develop means for evaluating the adequacy of restoration of mined area in the northern Great Plains region. The movements, habits, and other behavioral characteristics of big game in the vicinity of road systems of various standards will be determined and methods to mitigate unfavorable effects of these developments will be developed. Patterns of big game behavior and movements following timber harvest will be determined as will activities related to increased human ingress. Baseline ecological guidelines will be developed for evaluating the adequacy of restoration measures on surface mined areas.
Keywords: GREAT PLAINS; LAND USE; SURFACE MINING; ENVIRONMENTAL EFFECTS; HABITAT; WILD ANIMALS; POPULATION DYNAMICS; LAND RECLAMATION; BASELINE ECOLOGY; FORESTRY.

71 Predicting Runoff and Streamflow from Agricultural Watersheds in the North Appalachian Region. Hamon, W.R. (Agricultural Research Service, Appalachian Experiment Watershed Research, Coshoctin, OH, 43812). **Project number:** 3305-20810-001. **Supported by:** Agricultural Research Service, West Lafayette, IN (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives of the project are to derive hydrologic models of the complex interaction of precipitation, soil, geology, geomorphology, vegetation, land treatment, climatic factors, and streamflow; and to employ models to predict the influence of various agricultural land management, strip mining, and other watershed parameters on surface and subsurface watershed hydrology and on the transport of agricultural chemicals, sediment, and other pollutants. Onsite precipitation and surface flow data from gaged watersheds of about 2 acres provide information on effect of soil, vegetation, and land treatment on surface flow. Lysimeter, soil water, flow-potential, and soil physical data relate to saturated and unsaturated water flow through porous media. Well levels, spring-flow, and stream base-flow show the effect of geology. Fitting the watershed flow system into a mathematical model of a gaged watershed involves geomorphology. Model flow values were checked with gaged watershed flow data and the sensitivity of various watershed factors in the model were evaluated. Factor coefficients were adjusted to improve the accuracy of the model, and the adjustment in values was related to physical characteristics of the flow system so that coefficients can be reasonably predicted.
Keywords: APPALACHIA; WATERSHEDS; SURFACE WATERS; GROUND WATER; HYDROLOGY; MATHEMATICAL MODELS; AGRICULTURE; CULTIVATION TECHNIQUES; SURFACE MINING; ENVIRONMENTAL IMPACTS; WATER POLLUTION; ENVIRONMENTAL TRANSPORT; ATMOSPHERIC PRECIPITATIONS; RUNOFF; LAND USE; SOILS.

72 Soil and Water Management Systems for Appalachia. Bennett, O.L. (Agricultural Research Service, Soil and Water Management Research, University of West Virginia, Agronomy Department, Morgantown, WV, 26506). **Project number:** 1210-20770-001. **Supported by:** Agricultural Research Service, Hyattsville, MD (USA). Northeastern Region. **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives of the project are to develop methods for ameliorating unfavorable soil conditions, especially on steep slopes and strip mine spoil areas; permit growing row crops on the steep slopes; and establish economically usable vegetative cover on the strip mine spoil areas. Field, laboratory greenhouse, and growth chamber studies will be conducted to evaluate treatment effects. Treatments include liming material to alleviate excess acidity and toxic trace elements, and major soil fertility amendments both for establishment and maintenance of vegetative cover, and a wide range of plant materials both singly and in various combinations.
Keywords: APPALACHIA; LAND USE; COAL MINING; SURFACE MINING; SPOIL BANKS; REVEGETATION; PLANTS; PREFERRED SPECIES; SPECIES DIVERSITY; GROUND COVER; SOILS; PH VALUE; METALS; TOXICITY; TRACE AMOUNTS; CALCIUM CARBONATES; CULTIVATION TECHNIQUES; AGRICULTURE; FIELD TESTS; BENCH-SCALE EXPERIMENTS; FERTILIZERS; SOIL CONSERVATION; LAND RECLAMATION; WASTE PRODUCT UTILIZATION; WATER RESOURCES; ENVIRONMENTAL IMPACTS; ECONOMIC IMPACT.

73 Vegetative Stabilization of Drastically Disturbed Lands. Berg, W.A. (Colorado State University, Agricultural Experiment Station, Fort Collins, CO, 80521). **Project number:** COI00020. **Supported by:** Colorado State Univ., Fort Collins (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of the project 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 used in meeting these objectives includes: (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 studies on seeding and planting of native shrubs on topsoiled areas as influenced by herbaceous species competition and cultural treatments.
Keywords: COLORADO; OIL SHALE DEPOSITS; MINING; SPOIL BANKS; SPENT SHALES; LAND RECLAMATION; REVEGETATION; PREFERRED SPECIES; PLANTS; MILL TAILINGS; COAL MINING; FIELD TESTS; BENCH-SCALE EXPERIMENTS; CULTIVATION TECHNIQUES; AGRICULTURE; FEASIBILITY STUDIES; ECONOMICS; SHRUBS; SOILS; SURFACE MINING.

74 Farmstead Electric Power Use and Safety. Hellickson, N. (South Dakota State University, Agricultural Experiment Station, Brookings, SD, 57006). **Project number:** SD00483. **Supported by:** South Dakota Agricultural Experiment Station, Brookings (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(70); hydroelectric(20); solar(5); conservation(5). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives of this program are to: (1) study the time and amount of electrical energy used within buildings and within farmsteads; (2) develop design criteria for wires, entrance switches, and overcurrent devices based on actual load rather than maximum demand or connected load; (3) evaluate the potential of expanding existing electrical systems if mechanization is initiated; and (4) evaluate the handling of power failures in environmental control systems such as stand-by generators and automatically controlled doors. Actual livestock producers will be used as cooperators. Equipment and instrumentation will be installed in order to secure the most reliable information and data possible. Attempts will be made to secure livestock cooling information, as well as heating. The data secured will be compared and correlated with reliable existing livestock requirements such as in the case of a power outage. Laboratory studies will be conducted under controlled conditions to simulate seasonal conditions. This will secure initial information to further test under field conditions. Some installations will be made on University owned farms, such as the Dairy Unit.
Keywords: SAFETY; FARMS; FARM EQUIPMENT; POWER DEMAND; BUILDINGS; DOMESTIC ANIMALS; ENERGY CONSERVATION; ELECTRIC POWER.

75 Laundry Practices of University Students. Glee, R.; Warden, J. (Agricultural Research Service, Tallahassee, FL, 32306). **Project number:** HE-FLA-00006. **Supported by:** Agricultural Research Service, Tallahassee, FL (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this program are to determine laundry practices of university students and supply local and state government with information which might be used to assist them in adopting energy conservation programs. The approach used was the testing and evaluation of a questionnaire and its distribution to 800 Florida State University students. Based on the results, measures will be adopted to supply local and state officials on energy conservation practices that could cut down on power usage.
Keywords: CLOTHING; CLOTHES WASHERS; ENERGY CONSERVATION; CLEANING; EDUCATION; PERSONNEL.

76 Production of Power Fuel by Anaerobic Digestion of Feedlot Waste. Turk, M. (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, CT, 06096). **Project number:** N1-1-371(c)A. **Supported by:** Agricultural Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to study generation of fuel gas by anaerobic digestion of feedlot waste to determine if a continuous process is feasible as a method of pollution control. The approach to be used is to: (1) establish fermentations to evaluate continuous production of a largely methane fuel gas by anaerobic fermentation of feedlot waste; (2) for input material, use representative composite animal waste from feeding beef cattle a high-energy, low-fiber ration; (3) obtain information on fermentation parameters during stable digestor operation and on changes in these parameters which accompany variation in loading or other operating conditions as a basis for a monitoring and correction system designed to maintain optimum fermentation; (4) conduct essentially continuous fermentations for 12 months; and (5) based on results, derive conclusions, recommendations, and projected cost data for field operation.
Keywords: MANURES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; STEADY-STATE CONDITIONS; LOADING RATE; OPTIMIZATION; CONTINUOUS CULTURE; ECONOMICS; FEASIBILITY STUDIES; WASTE MANAGEMENT; CATTLE.

77 Impact of Copper and Industrial Activity of Lower Silesia on the Chemical Composition of Plants. Kabata, P.A. (Institute of Soil Science and Plant Center, Pulawy, Poland). **Project number:** 8003-20791-024. **Supported by:** Agricultural Research Service, Beltsville, MD (USA). **Funding:** USDA.
R and D categories: Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives of the project are to measure the accumulation in soil and uptake by a variety of economic crops of copper aerially deposited by a copper smelter, and to design measures counteracting the negative effects on plants of an excess of copper and related metals. At pre-selected sites, soils and vegetation will be sampled prior to the start of the smelter operations. Following activation of the latter, the build-up of copper will be followed in soil and vegetation at these sites. Various on-site treatments will be applied to reduce excessive copper uptake by certain food crops. Laboratory and growth room experiments will supplement the field data by sorting out the various factors which affect plant growth in the field. This factorial diagnosis of the metal-caused soil infertility and plant injury will aid in designing proper counter measures. The approach is aimed at facilitating the regional co-existence of industry and commercial agriculture.
Keywords: INDUSTRIAL PLANTS; COPPER ORES; SMELTING; CHEMICAL EFFLUENTS; COPPER; ECOLOGICAL CONCENTRATION; BIOLOGICAL ACCUMULATION; UPTAKE; SOILS; MINERAL CYCLING; CROPS; PLANT GROWTH; TOXICITY; AIR POLLUTION.

78 Agricultural Wastes for Removing Heavy Metal Ions from Solutions. Goodban, A.E. (Agricultural Research Service, Western Region Research Center, 800 Buchanan Street, Albany, CA, 94710). **Project number:** 5102-16060-002. **Supported by:** Agricultural Research Service, Berkeley, CA (USA). **Funding:** USDA.
R and D categories: Physical and chemical processes and effects.

The objective of the project is the utilization of agricultural waste materials for the removal and recycling of toxic heavy metal ions in industrial and mining waste solutions. Dilute solutions of heavy metal cations and complexes will be contacted with various agricultural wastes, such as walnut expeller meal, peanut skin, wood bark, straw, and hulls to determine the efficiencies of the substrates in removing the metal ions from solution. Both equilibrium (batch) and column (continuous) processes will be evaluated as will the effects of anion, pH, competition between ions, and concentration of cation. Actual metal-containing industrial and environmental wastes will be used to determine if the ion exchange process can consistently reduce the metal contents to levels considered safe according to new Federal and local water quality standards. The most promising approaches will be scaled up to sizes appropriate for field testing at pollution sites.
Keywords: AGRICULTURAL WASTES; WASTE PRODUCT UTILIZATION; METALS; REMOVAL; RECYCLING; INDUSTRIAL WASTES; SPOIL BANKS; WATER POLLUTION; POLLUTION REGULATIONS; ION EXCHANGE; LIQUID WASTES.

79 Safety, Reliability and Operational Characteristics of Electrical Irrigation Equipment. Stetson, L.E. (Agricultural Research Service, Agricultural Engineering Research, Room 5, Agricultural Engineering Building, University of Nebraska, East C, Lincoln, NE, 68583). **Project number:** 3416-20400-001. **Supported by:** Agricultural Research Service, Clay Center, NE (USA). North Central Region. **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objectives of this work are to: (1) determine electrical requirements and operational characteristics of irrigation machines and develop guidelines for operation of machines near overhead power lines; (2) develop systems and procedures necessary to integrate irrigation scheduling with electrical demand to use water and energy efficiently; (3) evaluate effects of irrigation-applied chemicals on electrical components; and (4) develop and refine electrical standards. The approaches used in the studies are to: (1) measure energy consumption and operational characteristics of irrigation machines in the field; (2) integrate methods and equipment to control electrical demand with irrigation scheduling; (3) study laboratory exposures of electrical components to agricultural chemicals; (4) survey irrigation machines to evaluate field corrosion effects; and (5) determine needs for further work on standards.
Keywords: AGRICULTURE; IRRIGATION; POWER DEMAND; OPERATION; POWER TRANSMISSION LINES; CORROSION; ENERGY CONSUMPTION; WATER RE-

QUIREMENTS; OVERHEAD POWER TRANSMISSION; STANDARDS.

80 Revegetation of Surface Mined Areas. Armiger, W.J. (Agricultural Research Service, Environmental Quality Inst., Biological and Waste Management and Soil Nitrogen Lab., Room 124, Building 007, Beltsville, MD, 20705). **Project number:** 1103-20770-001. **Supported by:** Agricultural Research Service, Beltsville, MD (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives of the project are 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 to 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 adapatability of crop species and varieties to these disturbed sites. Site chemical and physical characteristics will be correlated with crop requirements for predictive purposes.
Keywords: SURFACE MINING; ENVIRONMENTAL EFFECTS; SPOIL BANKS; LAND RECLAMATION; REVEGETATION; CROPS; FORAGE; PREFERRED SPECIES; CULTIVATION TECHNIQUES; SOILS; EROSION; ACID MINE DRAINAGE; WATER POLLUTION; GROUND COVER; FIELD TESTS; BENCH-SCALE EXPERIMENTS; GREENHOUSES; CALCIUM CARBONATES; FERTILIZERS; AGRICULTURE.

81 Investigations on the Utilization of Peanut Hulls in Feed and Non-Feed Products. Burdick, D. (R.B. Russell Agricultural Research Center, P.O. Box 5677, Athens, GA, 30604). **Project number:** 7902-20520-003. **Supported by:** Agricultural Research Service, Athens, GA (USA). Southern Region. **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives of the project are to evaluate peanut hulls and other cellulosic wastes as well as wax substitutes and wax extenders for use in manufacturing artificial fireplace logs; and to determine the efficacy of peanut hulls as a carrier for liquid supplements. Various cellulosic wastes will be evaluated alone and in combination with peanut hulls for combustibility and other properties related to development of quality fireplace logs. Various waxes and combinations of waxes and tall oil pitch, low mol. wt polyethylene waxes, binders, etc. also will be evaluated to determine their feasibility in log manufacture. The absorption by peanut hulls of liquid supplements will be determined as well as their suitability for feeding to dairy cows.
Keywords: PEANUTS; AGRICULTURAL WASTES; CELLULOSE; WAXES; WASTE PRODUCT UTILIZATION; COMBUSTION PROPERTIES; PITCHES; SORPTIVE PROPERTIES; ANIMAL FEEDS; COWS; REFUSE DERIVED FUELS.

82 Effects of Selected Air Pollutants on Plants. Apple, J.L.; Heck, W.W. (North Carolina State University, Agricultural Experiment Station, Raleigh, NC, 27607). **Project number:** 7091-20790-003-A3. **Supported by:** Agricultural Research Service, Raleigh, NC (USA). **Funding:** USDA.
Related energy source: solar(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objectives of the project are to determine the effects of ozone on nodule number and nitrogen fixing capacity of Ladino clover and on the productivity of two horticultural crops, and to determine the effect of Cd upon symbiotic nitrogen fixing capacity in soybeans. Ladino clover will be exposed to ozone in phytotron chambers at various growth stages to determine the most sensitive stage. Nodule number and total nitrogen fixing capacity of the clover will be determined only at this sensitive stage. Two commercial horticulture species will be treated in greenhouse chambers to various acute ozone doses at selected growth stages. Injury and final productivity will be determined and the stage of growth at which each species is most sensitive will be identified. Soybeans will be tested (via sprays) to three levels of an organic and an inorganic form of Cd. Cadmium uptake and effects on nitrogen fixation will be determined.
Keywords: AIR POLLUTION; OZONE; CADMIUM; CHRONIC EXPOSURE; EXPOSURE CHAMBERS; BIOLOGICAL EFFECTS; TOXICITY; CLOVER; CROPS; NITROGEN FIXATION; GLYCINE HISPIDA; PRODUCTIVITY; AGRICULTURE.

83 Economic Impact of Slope Restrictions in Surface Mining. (Economic Research Service, Natural Resource Economics Division, Washington, DC, 20250). **Project number:** NRE-41-305-11-00. **Contract:** Crosswhite, W.M. **Supported by:** Economic Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The objectives are to evaluate the economic impacts of slope restrictions in surface mining; determine the potential land area in West Virginia that may be disturbed due to surface coal mining; and estimate the land that can be surface mined. The potential land area that may be disturbed in West Virginia due to surface coal mining will be determined by applying MAIDS (May Identification and Development System), the coal seam and mapping technique developed by SCS. The amount of coal that will be available for surface mining for different slope restrictions will be determined using MAIDS. Estimates of the impacts on production, employment and income for the coal industry in West Virginia will be made.
Keywords: SURFACE MINING; WEST VIRGINIA; COAL MINING; ECONOMIC IMPACT; INCLINATION; COAL INDUSTRY; REGULATIONS.

84 Surface Environment and Mining in the West. Scholz, K.C. (U.S. Forest Service, Billings, MT, 59101). **Project number:** SEAM-WEST (TBD). **Supported by:** Forest Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to determine and evaluate the environmental impacts of mining and related activities both on site and surrounding areas. The approach is to study the adaptability and suitability of a large number of grass, forb, shrub, and tree species to surface-mined environments. Various spoil-bank treatments such as topsoiling, fertilizing, mulching, and watering are under study.
Keywords: SURFACE MINING; ENVIRONMENTAL IMPACTS; COAL MINING; LAND RECLAMATION; REVEGETATION; SPOIL BANKS.

85 Electric Demand Characteristics of Farms and Farm Equipment. Soderholm, L.H. (Iowa State University, Agricultural Research Service, Agricultural Engineering Building, Ames, IA, 50011). **Project number:** 3408-20400-001. **Supported by:** Agricultural Research Service, Columbia, MO (USA). North Central Region. **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this program are to determine electric demand characteristics of farms and farm equipment through development and application of instrumentation techniques for demand measurement of farmstead electrical loads, and apply acquired data to energy control techniques and improvement of energy efficiency of farmstead electrical distribution systems and electrically operated farm equipment. The approaches to be used are to: (1) develop and install improved demand instrumentation on farmstead electrical services to determine operating characteristics of electrical farm loads; (2) apply load control technologies to modify demand characteristics of farmstead electrical systems and equipment; and (3) utilize techniques such as deposition of particulates by air ions and modification of energy input requirements by use of auxiliary sources such as wind-electric power to reduce air pollution and modify electrical demand.
Keywords: FARMS; FARM EQUIPMENT; ENERGY EFFICIENCY; ENERGY CONSERVATION; POWER DEMAND.

86 Solar Heat for Heating and Cooling Greenhouses and Residences. Short, T.H.; Bond, T.E. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** 7096-20690-009-A2. **Supported by:** Agricultural Research Service, Tifton, GA (USA). **Funding:** USDA.
Related energy source: conservation(100).

The objective is to reduce current fossil fuel heating requirements for greenhouses and rural residences while maintaining or improving the environment within the structures. The approach is to: (1) investigate use of properly controlled salt concentration to make solar ponds capable of storing solar energy at temperatures up to 80 to 90 degrees C; (2) collect solar energy in two 18 by 90 ft greenhouses and store for later use in greenhouses or rural residences; (3) develop and evaluate methods of exchangig heat between solar ponds and greenhouses or residences; and (4) develop and test mechanized methods of adding or removing insulating greenhouse covers.
Keywords: GREENHOUSES; RESIDENTIAL BUILDINGS; RURAL AREAS; SOLAR PONDS; COVERINGS; SOLAR SPACE HEATING; SENSIBLE HEAT STORAGE.

87 Pilot Plant Production of Methane by Digestion of Feedlot Waste. Coe, W.B.; Rhodes, R.A. (United Aircraft Corp., Hamilton Standard Division, Windsor Locks, CT, 06096). **Project number:** 3090-20401-001-C1. **Supported by:** Agricultural Research Service,

Peoria, IL (USA). Northern Regional Research Center. **Funding:** USDA.
Related energy source: biomass(60); conservation(40). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to confirm performance of anaerobic digestion of feedlot waste for production of fuel gas and establish the nutritional value of effluent solids. The approaches will be to design and construct a pilot plant at US Meat Animal Research Center to process 350 pounds per day of beef cattle waste; monitor operation to determine process stability, equipment performance, and yield of methane gas; incorporate effluent solids from digestion of the waste into experimental diets and evaluate with sheep and cattle to determine acceptability and nutritional value; and ascertain feasibility of the process as a pollution abatement and energy conservation system for feedlots.
Keywords: MANURES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; PILOT PLANTS; ANIMAL FEEDS; NUTRIENTS; CHEMICAL REACTORS; PERFORMANCE; MONITORING; YIELDS; WASTE MANAGEMENT; SHEEP; CATTLE; OPERATION.

88 Effect of Chemical Properties of Surface Mining Overburden on Revegetation and Outflow Water Quality. Olsen, S.R.; Gardner, H.R. (Agricultural Research Service, Irrigation Water Management Research, P.O. Box E, Ft. Collins, CO, 80521). **Project number:** 5602-20770-001. **Supported by:** Agricultural Research Service, Fort Collins, CO (USA). **Funding:** USDA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of the project are to measure water quality of streams entering and leaving surface mined areas; develop chemical criteria for evaluating the suitability of overburden for revegetation; and develop corrective measures for unsuitable spoil materials. Water samples will be taken near flow measuring devices at the entrance and the exit of the streams through the mined area. Plot areas and ground water within revegetated areas will be included. Soil samples will be examined for plant nutrients, nutrification rate, exchangeable ammonium, and possible toxic elements.
Keywords: ROCKY MOUNTAIN REGION; COAL MINING; SURFACE MINING; SPOIL BANKS; LAND RECLAMATION; REVEGETATION; PLANTS; PREFERRED SPECIES; PLANT GROWTH; SOILS; CHEMICAL ANALYSIS; STREAMS; WATER QUALITY; WATER POLLUTION; OVERBURDEN; CHEMICAL COMPOSITION; CHEMICAL EFFLUENTS; NUTRIENTS; TOXIC MATERIALS; ENVIRONMENTAL EFFECTS; TOXICITY; AGRICULTURE.

89 Hydrology and Water Quality of Watersheds Subjected to Surface Mining. Hamon, W.R. (Agricultural Research Service, Appalachian Experiment Watershed Research, Coshocton, OH, 43812). **Project number:** 3305-20810-002. **Supported by:** Agricultural Research Service, West Lafayette, IN (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of the project are to assess hydrologic and water quality effects of surface mining for coal on watersheds in the North Appalachian area; and to develop guideline data for assessing adequacy and costs of alternative methods of runoff, sediment, water quality control, and permit costs. The approach to these objectives includes the following: (1) instrument four watersheds on representative coal formations with requisite hydrologic instrumentation to obtain precipitation, runoff, spring flow, soil moisture, and water quality data for one year prior to and three years after commercial surface mining; and (2) characterize watershed soil, overburden material and geology. Standard runoff and erosion plots will be located in the watersheds to obtain erosion and sedimentation information. Mathematical models to predict the quantity and quality of runoff before, during and after mining will be developed.
Keywords: APPALACHIA; COAL MINING; SURFACE MINING; CHEMICAL EFFLUENTS; ENVIRONMENTAL EFFECTS; WATER POLLUTION; WATERSHEDS; WATER QUALITY; HYDROLOGY; RUNOFF; WATER POLLUTION CONTROL; COST; TECHNOLOGY ASSESSMENT; SOILS; OVERBURDEN; GEOLOGY; EROSION; SEDIMENTATION; DATA ACQUISITION; MATHEMATICAL MODELS; SPOIL BANKS.

90 Equipment and Structures to Manage and Utilize Agricultural Wastes and Residues for Energy Products. Fischer, J.R. (University of Missouri, Agricultural Research Service, Bioengineering Research, Agricultural Engineering Building, T-12, Columbia, MO, 65201). **Project number:** 3402-20400-003. **Supported by:** Agricultural Research Service, Columbia, MO (USA). North Central Region. **Funding:** USDA.
Related energy source: biomass(50); conservation(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objective is to develop methods and equipment for on-farm anaerobic digestion of agricultural residues for energy utilization. Laboratory studies on anaerobic digestion will develop design and operational criteria for digestion equipment through determination of physical and chemical parameters such as optimum carbon-nitrogen ratio, digester loading rates, gas production, heavy metal, ammonia, and antibody toxicities. The effect of using a hydraulic manure flushing system and settling basin in conjunction with digestion will be investigated. A prototype anaerobic digester, funded by the University of Missouri, is being built at the UMC swine complex. The design and operational feasibility of this digester will be evaluated to provide a basis of recommendations for on-farm facilities. These studies are being coordinated with research at the NRRC on methane generation from animal waste.
Keywords: AGRICULTURAL WASTES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; FARMS; ENERGY SOURCES; QUANTITY RATIO; LOADING RATE; POISONING; CHEMICAL REACTORS; MANURES; OPERATION; DESIGN.

91 Impact of Strip Mining and Reclamation Processes on the Quality and Quantity of Water in Mined Areas. Rogowski, A.S.; Pionke, H.B. (Pennsylvania State University, Reg. Pasture Research Lab., Curtin Road, University Park, PA, 16802). **Project number:** 1302-20771-001. **Supported by:** Agricultural Research Service, Ithaca, NY (USA). Northeastern Region. **Funding:** USDA.
Related energy source: coal(75); oil shales and tar sands(25). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to identify key relationships that determine the quantity and quality of water in a mined area, and then, generalize these relationships for application to other sites. The ongoing physical and chemical processes will be simulated mathematically for a site then simulations will be field tested at the site. Specifically, the approach in sequence is: simulate spoil bank hydrology using available data to predict the amount, travel times, and quality of water at the experimental site; develop methods for determining field parameters needed to predict quantity and quality of subsurface flow and surface runoff; field validate simulation models; generalize results to other sites; and identify key areas where expanded research is needed.
Keywords: COAL MINING; OIL SHALE MINING; SURFACE MINING; LAND RECLAMATION; WATER QUALITY; RUNOFF; MATHEMATICAL MODELS; SPOIL BANKS; HYDROLOGY; GROUND WATER; FIELD TESTS; ENVIRONMENTAL IMPACTS; WATER RESOURCES.

92 Conservation Tillage Equipment and Systems. Erbach, D.C. (Agricultural Research Service, Iowa State University, Agricultural Engineering Building T-12, Ames, IA, 50011). **Project number:** 3408-20190-001. **Supported by:** Agricultural Research Service, Columbia, MO (USA). North Central Region. **Funding:** USDA.
Related energy source: conservation(100).

The objectives of the project are: to develop energy efficiency equipment for modification of the soil environment to improve crop production and pest control with conservation tillage systems; and to improve conservation tillage planting equipment. Soil condition changes and equipment fuel consumption, draft, and other operational characteristics will be measured for various conservation tillage field operations. Energy inputs and costs for production of corn and soybeans, in rotation, using several tillage systems will be obtained, and the effects of energy reducing systems on crop yield will be determined. Field and growth room studies with hand prepared seedbeds will investigate the effects of seed placement, plant residue location, soil aggregation, and soil topography on corn and soybean germination and emergence. Seed zone conditions created by commercial and experimental furrow openers in a range of soil conditions will be measured. Results of these studies will be used to design improved tillage equipment and planters.
Keywords: AGRICULTURE; CROPS; CULTIVATION TECHNIQUES; FARM EQUIPMENT; OPTIMIZATION; ENERGY CONSUMPTION; ENERGY CONSERVATION.

93 Environmental Improvement and Multiple Use Management in the Northern High Plains. Bjugstad, A.J. (South Dakota School of Mines and Technology, Rocky Mountain Forest and Range Experiment Station, Rapid City, SD, 57701). **Project number:** RM-1752. **Supported by:** Forest Service, Fort Collins, CO (USA). Rocky Mountain Forest and Range Experiment Station. **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to develop means to increase production of wood, water, and animal products in the Black Hills; maintain and reestablish the prairie woodlands; and 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. The use of naturally wooded draws by livestock, deer, and wintering species of nongame birds, the type of management needed for regeneration of woody species, and the effects of more intensive timber management practices on understory and overstory vegetation and water yield and quality in the Black Hills will be determined.

Keywords: BIOMASS; PRODUCTION; WOOD; WATER; ANIMALS; SURFACE MINING; SPOIL BANKS; REVEGETATION; WILD ANIMALS; BIRDS; MANAGEMENT; IDAHO; RESOURCE ASSESSMENT; RESOURCE CONSERVATION; LAND RECLAMATION.

94 Management of the Quantity and Quality of Surface and Subsurface Runoff From Disturbed Lands. Gardner, H.R.; Smith, R.E.; Woolhiser, D.A. (USDA-ARS, Irrigation Water Management Research Div., P.O. Box E, Fort Collins, CO, 80521). **Project number:** 560-20770-003. **Supported by:** Agricultural Research Service, Fort Collins, CO (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is 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 plant establishment. Procedures will be developed to evaluate hydrologic effects of surface mining and to prepare environmentally effective mining plans.

Keywords: SURFACE MINING; COAL MINING; WATER POLLUTION; EROSION; WATER QUALITY; SEDIMENTS; SPOIL BANKS; WEATHERING; REVEGETATION; RUNOFF; HYDROLOGY; ENVIRONMENTAL IMPACTS; INHIBITION; WYOMING; COLORADO; LAND RECLAMATION.

95 Alleviation of Physical and Hydrologic Impacts of Surface Mining Activities. Burroughs, E.R. (USDA, Intermountain Forest and Range Experiment Station, Bozeman, MT, 59715). **Project number:** INT-1652. **Supported by:** Forest Service, Ogden, UT (USA). Intermountain Forest and Range Experiment Station. **Funding:** USDA.

Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

The objectives are to: (1) assess effects of mining-related transportation systems on water resources; (2) develop methods for minimizing impacts; (3) assess methods for depositing and stabilizing mine spoils to keep water quality within acceptable limits; (4) develop techniques for mineral exploration with minimal environmental impacts; and (5) develop techniques to repair and stabilize streams containing deposits of mine spoils of tailings. Through in-house and extramural research, equations will be developed to predict changes in spoil materials and environmental impacts of mining operations and associated road systems, and available data will be utilized to evaluate effects of spoils placement and land placement techniques. Exploration procedures to minimize environmental impacts will be developed, and studies will be carried out to determine how channels containing deposits of spoils and tailings can be rehabilitated.

Keywords: COAL MINING; SURFACE MINING; ENVIRONMENTAL IMPACTS; HYDROLOGY; WATER RESOURCES; INHIBITION; SPOIL BANKS; STABILIZATION; ROADS; LAND RECLAMATION; WATER POLLUTION; INHIBITION.

96 Snapbean, a Model to Study the Effects of Exhaust Gases from Energy Production on Crop Productivity. Apple, J.L. (North Carolina State University, Agricultural Experiment Station, Raleigh, NC, 27607). **Project number:** 709-20790-006-A. **Supported by:** Agricultural Research Service, Raleigh, NC (USA). **Funding:** USDA.

Related energy source: all(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of the project is to develop a crop system model for the effects of exhaust gases O3, SO2, and NO2 using the bush snapbean (Phaseolus vulgaris L.) as the study organism. The approach to the project includes the following steps: determine dose-response curves for a group of bean cultivars and identify a resistant and sensitive cultivar for indepth study; use these 2 cultivars as a basis for understanding resistance mechanisms; determine the effects of exhaust gas dose on stomatal resistances, net CO2 exchange, transpiration rates, and plant water potentail; follow changes in soluble carbohydrates and nitrogen fractions with changes in exhaust gas composition; determine the effects on selected enzyme systems (i.e., nitrogenase and polyphenol oxidase); determine the effects on nitrogen fixation; determine how temperature, light intensity, and humidity affect the response of snapbean to exhaust gases (at ambient concentrations); and develop predicative conceptual models of overall response for snapbean and, where possible, mathematical models for subcompartments or generalized responses.

Keywords: EXHAUST GASES; AIR POLLUTION; OZONE; SULFUR DIOXIDE; NITROGEN DIOXIDE; CARBON DIOXIDE; BIOLOGICAL EFFECTS; PHASEOLUS; PLANT GROWTH; CROPS; PRODUCTIVITY; AGRICULTURE; BIOLOGICAL MODELS; MATHEMATICAL MODELS; DOSE-RESPONSE RELATIONSHIPS; TRANSPIRATION; NITROGENASES; OXIDASES; NITROGEN FIXATION; AMBIENT TEMPERATURE; VISIBLE RADIATION; HUMIDITY.

97 Safety, Reliability, and Operational Characteristics of Electrical Irrigation Equipment. Stetson, L.E. (Agricultural Research Service, University of Nebraska, Agricultural Engineering Building, Room 5, Lincoln, NE, 68583). **Project number:** 3416-20740-001. **Supported by:** Agricultural Research Service, Lincoln, NE (USA). **Funding:** USDA.

Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology.

The objectives of the project are to: determine electrical requirements and operational characteristics of irrigation machines and develop guidelines for operation of machines near overhead power lines; develop systems and procedures necessary to integrate irrigation scheduling with electrical demand to use water and energy efficiently; evaluate effects of irrigation-applied chemicals on electrical components; and develop and refine electrical standards. Energy consumption and operational characteristics of irrigation machines in the field will be measured. Methods and equipment to control electrical demand with irrigation scheduling will be integrated. Laboratory exposures of electrical components to agricultural chemicals will be studied, and irrigation machines will be surveyed to evaluate field corrosion effects and determine needs for further work on standards.

Keywords: AGRICULTURE; IRRIGATION; POWER DEMAND; WATER REQUIREMENTS; FARM EQUIPMENT; OPERATION; MANAGEMENT; ENERGY CONSERVATION; OVERHEAD POWER TRANSMISSION; POWER TRANSMISSION LINES; ELECTRICAL EQUIPMENT; SAFETY STANDARDS; CORROSION; FERTILIZERS; PESTICIDES; CORROSIVE EFFECTS; ENERGY CONSUMPTION; ENVIRONMENTAL EFFECTS.

98 Conversion of Poultry Manure to Useful Products. Bressler, G.O. (Pennsylvania State University, Agricultural Experiment Station, University Park, PA, 16802). **Project number:** PEN01829. **Supported by:** Pennsylvania Agricultural Experiment Station, University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: conservation(100). **R and D categories:** Environmental control technology.

The objectives of the project are to: develop for layers, an automatic system for drying manure to low levels of moisture; eliminate obnoxious odors for manure use in plant growth media; and prepare products by combining dry manure or ash with anthracite refuse to test under greenhouse and field conditions. The experimental approach includes steps to: dry manure from 80% to 30% moisture by stirring and aerating; dry from 30% to 9% by commercial dryer; obtain least cost combination; develop automatic system for floor and cage operations; determine the relationship between stirring and aerating manure and production of obnoxious odors; establish minimum commercial dryer temperatures to achieve moisture stability, minimize microorganisms, and retain maximum plant nutrients; combine dry or ashed poultry manure with anthracite refuse and other waste products; conduct greenhouse and field trials to determine physical and chemical capability of product for plant growth; apply to strip mine and spoil banks to establish cover crops; and measure the benefits to soil and acidity.

Keywords: AGRICULTURE; WASTE PRODUCT UTILIZATION; MANURES; DRYING; USES; FERTILIZERS; ODOR; REMOVAL; ECONOMICS; SPOIL BANKS; REVEGETATION; FIELD TESTS.

99 Mine Spoil: Potentials for Plant Growth and Water Quality. Jencks, E.M. (West Virginia Univ., West Virginia Agricultural and Forestry Experiment Station, Morgantown, WV, 26506). **Project number:** WVA00217. **Supported by:** West Virginia Univ., Morgantown (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to 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; rates of change by natural or induced weathering; interaction between plants and properties of spoil and water; effectiveness of plant cover, microorganisms and related practices in prevention of erosion and water pollution; and precision of spoil classification. Core 4 samples will be taken and analysed for sulphur, carbonates, neutralizing capacity, mineralogy, and available plant nutrients. Attempts will be made to 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: OVERBURDEN; SPOIL BANKS; REVEGETATION; NUTRIENTS; LITHOLOGY; SOIL CHEMISTRY; RUNOFF; WATER QUALITY; MINERALOGY; EROSION; COAL MINES; WEATHERING; LAND RECLAMATION.

100 Biodegradation of Oil Slicks in the Marine Environment. Barth, R. (Rutgers Univ., Biochemistry and Microbiology Agricultural Experiment Station, New Brunswick, NJ, 08903). **Project number:** NJ00504. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are: to determine the rate of natural biodegradation of oil sicks in various marine environments; to identify predominant degradation pathways, intermediary products and their biological activity to evaluate currently used emergency measures as to their effect on the ultimate biodegradation of the polluting oil; and to develop new techniques for accelerating the biodegradation of oil slicks in the marine environment. A model petroleum will be used in laboratory test with sea water, beach sand and sediments added. Hydrocarbon degradation will be monitored by periodic sampling and gas chromatograph. Oxygen consumed or carbon dioxide produced will be measured. Pure cultures of marine microorganisms will be used in studies of degradation pathways. Detergents used to clean up oil slicks in emergency situations will be tested for effects on biodegradation of crude oil and of model petroleum in laboratory and field studies. Results of these studies will be used to develop new techniques for accelerating the biodegradation of oil slicks.
Keywords: OIL SPILLS; BIODEGRADATION; BIOCHEMICAL REACTION KINETICS; DETERGENTS; CLEANING; BENCH-SCALE EXPERIMENTS; FIELD TESTS; MICROORGANISMS; AQUATIC ORGANISMS; SEAWATER.

101 Market Structure Analysis of Farm Input Retailing Industries. Erlandson, G.W. (North Dakota State University, Agricultural Experiment Station, Fargo, ND, 58103). **Project number:** ND-01346. **Supported by:** North Dakota State Univ., Fargo (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

The objectives are to describe changing trends in size and number, integration, entry and exit, and other organizational features of firms supplying inputs to the agricultural sector; define the competitive environment in which these firms operate; and evaluate operational efficiency and profit rates of these firms. Data on specific dimensions of market structure, conduct and performance of selected key industries will be collected from primary and secondary sources. Market structure analysis will be utilized to suggest hypotheses which will be empirically tested with regression, correlation, and similar statistical techniques.**Keywords:** MARKET; AGRICULTURE; INPUT-OUTPUT ANALYSIS; STATISTICAL MODELS; REGRESSION ANALYSIS; FARM EQUIPMENT; FERTILIZER INDUSTRY; ANIMAL FEEDS; PESTICIDES; INDUSTRY; ECONOMICS.

102 Ecology of Hot Creek Valley: Vegetation and Soil Response to Underground Detonations. Tueller, P.T. (University of Nevada, Agricultural Experiment Station, Reno, NV, 89507). **Project number:** NEV00699. **Supported by:** Nevada Univ., Reno (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to investigate influences of AEC underground testing on the flora, fauna, and soils in the Hot Creek Valley and surrounding areas. An ecological resource inventory of Hot Creek Valley is in progress. To determine underground testing influence on native vegetation and soils, the following areas will be studied: (1) change in species composition; (2) change in water uptake capacity as a result of root damage; (3) possible accumulation of radioactive materials by native speices; (4) soil moisture patterns before and after detonation; and (5) possible root-soil interface damage. Revegetation and denuded areas will be studied. Suitable adapted species and artificial revegetation methods will be determined.
Keywords: ENVIRONMENTAL EFFECTS; ALMENDRO EVENT; CONTAINED EXPLOSIONS; PLANTS; ANIMALS; SOILS; WATER; UPTAKE; RADIOACTIVITY; REVEGETATION; ROOTS; TERRESTRIAL ECOSYSTEMS; FISSION PRODUCTS.

103 Reclamation of Strip-Mining Spoils Banks in Southeast Kansas. Geyer, W.A. (Kansas State Univ., Agricultural Experiment Station, Manhattan, KS, 66506). **Project number:** KAN-05-958. **Supported by:** Kansas State Univ., Manhattan (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The project consists of an evaluation of existing timber crops, including a survey of plantations and volunteer stands. Spoil material will be related to plant growth. Approaches utilized will be to: inventory USFS and CCC plantations in SE Kansas, evaluate condition and growth, and estimate economic value; establish growth plots on existing 20 plus year cottonwood stands on spoil banks and unmined land and make growth comparisons; and characterize spoil banks under existing plantations and relate chemical, physical, and topographic factors to tree growth.
Keywords: SURFACE MINING; LAND RECLAMATION; KANSAS; TREES; GROWTH; SPOIL BANKS; EFFICIENCY; SOIL CHEMISTRY; PHYSICAL PROPERTIES; FORESTS; COAL MINING.

104 Air Pollution Effects on Forest Trees. Lester, D.T. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS-01595. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

Sensitivity of major forest-tree species in Wisconsin to single air pollutants, response to mixture of pollutants, and the relevance to current ambient conditions will be determined. Emphasis will be upon studies with white pine and larch; biochemical evaluation of terpenes, phenolics and isoenzyme profiles will be correlated with chamber exposures to air pollutants. Data from a fossil-fuel power generating site will be evaluated to determine ambient conditions prior to and after initial operation. In the latter study white pine and larch will be the principal indicator species utilized. Study data and associated literature review will be available for decision-making at the policy level within the state. Exposures to air pollutants will be conducted in greenhouse chambers, and effects will be evaluated by appropriate growth response, morphological evaluation, or visual indicator. Genetic repeatability studies will be utilized, and where possible, biochemical evaluations of defined material will be carried out. Attention will be paid to interaction of pollutants and to differences between juvenile and mature physiology. Field studies will focus upon evaluation of chronic fumigation resulting from combustion of fossil-fuels over extended time periods.
Keywords: TREES; AIR POLLUTION; SENSITIVITY; WISCONSIN; BIOLOGICAL EFFECTS; HYDROCARBONS; METABOLISM; ENVIRONMENTAL POLICY; DECISION MAKING; PHYSIOLOGY; FOSSIL FUELS; BIOLOGICAL INDICATORS; PLANT GROWTH.

105 Influence of Air Pollutants on Infectious Tree Diseases. Morton, H.L. (University of Michigan, School of Natural Resources, Ann Arbor, MI, 48104). **Project number:** MICY00019. **Supported by:** Michigan Univ., Ann Arbor (USA). School of Natural Resources; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine if there is a synergistic relationship between air pollutants and selected tree pathogens. The influ-

ence of O3 on sycamore (net photosynthesis), on the pathogen, Gnomonia venata (growth sporulation, germination), and on the interactions of the host and parasite will be studied. Inoculation will occur before, concurrently with, and after exposure to the pollutant. Different pollutant concentrations and durations of exposure will be studied.
Keywords: AIR POLLUTION; TREES; INFECTIVITY; PLANT DISEASES; SYNERGISM; OZONE; BIOLOGICAL EFFECTS; PARASITES.

106 Effects on Selected Organisms of Water Passing Through the Cedar Bayou Generating Station. Strawn, K. (Texas A and M University, Agricultural Experiment Station, College Station, TX, 77843). **Project number:** TEX01869. **Supported by:** Texas Agricultural Experiment Station, College Station (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objective is to determine the suitability of electric power plant cooling water for growth, food conversion, and survival of selected species of crustaceans and fishes in cages, ponds, and temperature-controlled tanks. Animals will be held in cages in front of the plant intake and in the discharge canal, in fish ponds located near the start of the discharge canal, and in aquaria in a laboratory to be built near the fish ponds. After the construction of the cooling pond, animals will be kept in cages in the first and last compartments and occurrence and distribution of selected organisms in the cooling pond will be determined. Temperatures in the aquaria will span the range of temperatures usually occurring in Trinity Bay. The influence of the effluent on phytoplankters both in the field and in culture will also be determined.
Keywords: POWER GENERATION; ELECTRIC POWER; POWER PLANTS; COOLING SYSTEMS; WASTE PRODUCT UTILIZATION; THERMAL EFFLUENTS; WASTE HEAT; WASTE WATER; AQUACULTURE; FEASIBILITY STUDIES; INVERTEBRATES; VERTEBRATES; FISHES.

107 Safety, Reliability, and Operational Characteristics of Electrical Irrigation Equipment. Stetson, L.E. (University of Nebraska, Agricultural Experiment Station, Lincoln, NE, 68503). **Project number:** NEB-11-037. **Supported by:** Nebraska Univ., Lincoln (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology.

The objectives of the project are to: determine electrical requirements and operational characteristics of irrigation machines and develop guidelines for operation of machines near overhead power lines; develop systems and procedures necessary to integrate irrigation scheduling with electrical demand to use water and energy efficiently; evaluate effects of irrigation-applied chemicals on electrical components; and develop and refine electrical standards. Energy consumption and operational characteristics of irrigation machines in the field will be measured. Methods and equipment to control electrical demand with irrigation scheduling will be integrated. Laboratory exposures of electrical components to agricultural chemicals will be studied, and irrigation machines will be surveyed to evaluate field corrosion effects and determine needs for further work on standards.
Keywords: AGRICULTURE; IRRIGATION; POWER DEMAND; WATER REQUIREMENTS; FARM EQUIPMENT; OPERATION; MANAGEMENT; ENERGY CONSERVATION; OVERHEAD POWER TRANSMISSION; POWER TRANSMISSION LINES; ELECTRICAL EQUIPMENT; SAFETY STANDARDS; CORROSION; FERTILIZERS; PESTICIDES; CORROSIVE EFFECTS; ENERGY CONSUMPTION; ENVIRONMENTAL EFFECTS.

108 Regional Problems in Evaluating Environmental Aspects of Electricity Generation. Chapman, D. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-121437. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(80); hydroelectric(20). **R and D categories:** Integrated assessment.

The objectives are to: identify the nature and geographic location of the important environmental consequences of supplying electricity to individual regional service areas for present and potential processes; 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. Engineering data will be used to define the economic matrix of capital and annual costs for generation, abatement, and transmission for the potential generating process. Other findings on public health and ecology will be extrapolated 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 will be conducted. Case study comparison of specific regions and service areas to determine structural similarities relevant to national policies will be conducted. Benefit-cost analysis of optimum levels of demand growth and generation by process will be made.
Keywords: REGIONAL ANALYSIS; ELECTRIC POWER; POWER GENERATION; ENVIRONMENTAL IMPACTS; POLLUTION ABATEMENT; ECONOMIC IMPACT; INFORMATION SYSTEMS; DECISION MAKING; ELECTRIC UTILITIES; PLANNING.

109 Utilization and Disposal of Municipal, Industrial, and Agricultural Processing Wastes on Land. Melsted, S.; Gilmore, A.R. (University of Illinois, Agricultural Experiment Station, Urbana, IL, 61801). **Project number:** ILIU-15-0334. **Supported by:** Illinois Agricultural Experiment Station, Urbana (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine factors influencing long-term utilization of wastes compatible with sustained agronomic production with emphasis on accumulation of toxic quantities of heavy metals in soils and plants. From strip mine spoil areas, surface and core samples to water table depth will be analyzed for total pyrites, sulfides and redox potentials before and after sludge treatments. Results will be used to evaluate effectiveness of sludge in revegetation of strip mine spoils and in abatement of pollution in runoff and leaching waters. Analyses will include pH, SO4, NO3, Zn, Cu, Cd, Ni, Co, and Pb.
Keywords: AGRICULTURAL WASTES; MUNICIPAL WASTES; INDUSTRIAL WASTES; WASTE PRODUCT UTILIZATION; GROUND DISPOSAL; TOXINS; SPOIL BANKS; REVEGETATION; WATER POLLUTION ABATEMENT; RUNOFF; LEACHING; SOIL CHEMISTRY; PH VALUE; SULFATES; NITRATES; ZINC; COPPER; CADMIUM; NICKEL; COBALT; LEAD.

110 Effect of Tillage Systems on Root Environment, Soil and Water Losses, and Tillage Energy Requirement. Taylor, H.M.; Buchele, W.F.; Lovely, W.G. (Iowa State Univeristy, Agricultural Experiment Station, Ames, IA, 50011). **Project number:** 10W01941. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Ecological/biological processes and effects.

The objectives are to determine the effect of conservation tillage systems and chemical soil stabilizers on soil and water losses, nutrient and water uptake and utilization, and physical properties of the soil; and measure the energy inputs, timeliness of operations and farmability of conservation tillage systems. An experiment on the Western Iowa Experimental Farm, Castana, equipped to measure soil and water losses has been converted to a study of conservation tillage and soil stabilizers. Physical properties of the root bed will be studied on the Agronomy-Agricultural Engineering Research Center, Ames. Time and motion studies and energy inputs will be studied on cooperator's farms near Dow City and Waterloo, Iowa.
Keywords: AGRICULTURE; CULTIVATION TECHNIQUES; PLANTS; SOIL MECHANICS; MOISTURE; WATER REQUIREMENTS; ENERGY CONSERVATION; BIOLOGICAL EFFECTS; PLANT GROWTH; CROPS; ENERGY DEMAND; OPTIMIZATION.

111 Ecological Studies of the Lower Mississippi River near St. Francisville, Louisiana. Glasgow, L.L.; Conner, J.V. (Louisiana State University, Agricultural Experiment Station, Baton Rouge, LA, 70803). **Project number:** LAB-01600. **Supported by:** Louisiana State Univ., Baton Rouge (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to outline a program for monitoring the potamology of the lower Mississippi River and a small tributary; collect certain physical, chemical and biological data for two years; and estimate relative quantities of aquatic biota within established transects on a seasonal basis. Approximately 10 river miles of (and a small tributary to) the Mississippi River near St. Francisville, Louisiana, will be surveyed for 24 months. Twenty-five stations will be established (and will be visited each month) on the river and four stations on the tributary, Alligator Bayou. Stations are located above and below the projected influence of a thermal plume from a nuclear power plant. Efforts will be made to correlate relative abundance

and seasonal distribution of aquatic plants and animals with 18 physico-chemical characteristics of the river and bayou waters. **Keywords:** LOUISIANA; MISSISSIPPI RIVER; AQUATIC ECOSYSTEMS; BIOLOGICAL MODELS; THERMAL EFFLUENTS; BIOLOGICAL EFFECTS; THERMAL POLLUTION; WATER POLLUTION; NUCLEAR POWER PLANTS.

112 Economic Strategies for Dealing with Heated Effluents from Electric Power Plants. Dobson, W.D. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS-01950. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objectives are to investigate economic strategies for reducing the amount of thermal effluent discharged by power plants; develop cost functions which reflect the cost of removing varying amounts of heat from cooling water discharged by power plants; and develop damage functions which reflect the economic damages from discharge of varying quantities of waste heat. Functions of the type to be constructed could be employed to develop effluent charges and related measures which would reduce the discharge of waste heat to desired levels. The economic feasibility of using waste heated water from electric power plants for economically beneficial uses in aquaculture and agriculture in the Great Lakes region will be investigated. Employees of engineering firms and power companies will be consulted to obtain estimates of the costs of removing heat from cooling water under varying conditions. Efforts will be made to develop damage functions from evidence in biological studies, water recreation studies, commercial fisheries statistics, public hearing records and consultations with regulatory agencies. Data on costs and returns from use of thermal effluent for aquaculture and agriculture will be developed.
Keywords: ECONOMICS; THERMAL EFFLUENTS; THERMAL POWER PLANTS; WASTE MANAGEMENT; POLLUTION ABATEMENT; WASTE HEAT; AQUACULTURE; AGRICULTURE; WASTE PRODUCT UTILIZATION; COOLING SYSTEMS; MATHEMATICAL MODELS; AQUATIC ECOSYSTEMS; ECONOMIC IMPACT; WATER POLLUTION; THERMAL POLLUTION; MATHEMATICAL MODELS.

113 Anaerobic Conversion of Organic Wastes into Methane by Thermophilic Bacterial Associations. Zeikus, J.G. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WISO-1957. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(60); conservation(40). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objective is to improve the anaerobic digestion process currently employed in biological waste treatment. The important bacterial species responsible for the anaerobic decomposition of organic waste will be isolated and characterized. Thermophilic species with high metabolic activities will be selected and the feasibility of using them to convert agricultural wastes into methane determined. Bacterial enrichment cultures containing innocula from various sediment systems that are active in anaerobic decomposition of organic matter will be incubated at mesophilic and thermophilic temperatures. Pure cultures of important bacterial species will be isolated by the Hungate anaerobic culture technique and their physiological properties determined. Associations of thermophilic bacteria which possess high metabolic activities will be added to agricultural wastes in a model digestor. Important parameters which may influence the rate of digestion and methane production will be determined.
Keywords: AGRICULTURAL WASTES; ORGANIC WASTES; ANAEROBIC DIGESTION; THERMOPHILIC CONDITIONS; METHANOGENIC BACTERIA; PHYSIOLOGY; METHANE; BIOSYNTHESIS; BIOCHEMICAL REACTION KINETICS.

114 Development of an Environmental Data Bank, Phase II. Murray, B.H. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS-01900. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Environmental control technology; Integrated assessment.

The objectives are to develop comprehensive decision-making models and data bank of natural and cultural features at a uniform scale, pertinent to locating an electric energy transmission corridor in greater Southeastern Wisconsin, and to conduct an interaction seminar made up of representatives from a variety of federal, state, local, and special interest groups for the purpose of assigning relative values to each of the 220 natural and cultural characteristics mapped. The second-phase study was initiated by developing a list of general considerations that comprehensively describe aspects that should be factored into an electric energy transmission corridor decision in the region serviced by the Wisconsin Electric Power Company. Subsequent to generating the list of primary considerations, the researchers generated a comprehensive list of data (information) pertinent to each of the primary considerations. The next step was to search and retrieve all necessary data and to develop information maps at a uniform scale of one square inch to one square mile for an area of 4,500 square miles.
Keywords: DECISION MAKING; POWER TRANSMISSION LINES; ELECTRIC POWER; POWER TRANSMISSION; INFORMATION SYSTEMS; ENVIRONMENT; MANAGEMENT; MATHEMATICAL MODELS.

115 Effects of the Brunswick Nuclear Power Plant on the Productivity of Spartina Alterniflora. Seneca, E.D.; Stroud, L.M. (North Carolina State University, Agricultural Experiment Station, Raleigh, NC, 27607). **Project number:** NC-05276. **Supported by:** North Carolina Agricultural Experiment Station, Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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, sampling of above and below ground vegetation to determine productivity. After initial gathering of data and vegetation samples, analysis of data, by computer and laboratory tests, will be carried out and a model developed for the area.
Keywords: BRUNSWICK-1 REACTOR; BRUNSWICK-2 REACTOR; ENVIRONMENTAL EFFECTS; GRASS; PRODUCTIVITY; BIOLOGICAL MODELS; TERRESTRIAL ECOSYSTEMS.

116 Identification and Amelioration of Adverse Conditions Limiting Reclamation of Coal Mined Lands. Hutnik, R.J.; McKee, G.W. (Pennsylvania State University, Agricultural Experiment Station, McIntire--Stennis Program, University Park, PA, 16802). **Project number:** PEN 02089. **Supported by:** Pennsylvania Agricultural Experiment Station, University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to identify the factors limiting the reclamational revegetation of strip-mine spoil and deep-mine refuse; identify plant species and strains tolerant of the adverse conditions; and 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 herbeceous 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 MINING; SURFACE MINING; UNDERGROUND MINING; SPOIL BANKS; REVEGETATION; INHIBITION; PREFERRED SPECIES; SOIL CHEMISTRY; EVALUATION.

117 Methane Gas Production from Farm Waste. Branding, A.E.; Person, S.; Branding, A.E. (Pennsylvania State University, Agricultural Experiment Station, University Park, PA, 16802). **Project number:** PEN02132. **Supported by:** Pennsylvania Agricultural Experiment Station, University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to: determine the technical requirements and economic feasibility for methane production from farm waste; compile basic information on methane production from organic material; design pilot plant for producing methane from farm waste; and build and test the system.
Keywords: AGRICULTURAL WASTES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; CHEMICAL REACTORS; DESIGN; OPERATION; FEASIBILITY STUDIES.

118 Blue Hills Nuclear Power Plant Environmental Study. Inglis, J.M. (Texas A and M University, Agricultural Experiment

Station, College Station, TX, 77843). **Project number:** TEX06024-R1. **Supported by:** Texas Agricultural Experiment Station, College Station (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to estimate ecological impact and commitment of terrestrial vertebrates caused by construction and operation of a nuclear power station; estimate the same for aquatic resources; and estimate the botanical and forest resources. The kinds of organisms present locally at the power station site and along transmission corridors will be associated with habitat types listed by taxon and classified in terms of, aesthetic, economic, and scientific importance, abundance, trophic status and likely response exposure to station disturbance and effluents. Damage of planned construction and operation of the power station to populations by habitat destruction, construction disturbance, effluent effects and entrainment, etc. will be predicted in terms of information available in the literature, expert opinion of project staff and others, observations around similar stations, and field studies. Radiological exposure and trophic exchange of radionuclides will be estimated of and for various taxa in cooperation with radiation safety personnel. Results will be collated to give an estimate of the ecological impact and resource commitment of the planned station following AEC guidelines.
Keywords: NUCLEAR POWER PLANTS; ENVIRONMENTAL IMPACTS; TERRESTRIAL ECOSYSTEMS; BIOLOGICAL MODELS; AQUATIC ECOSYSTEMS; POPULATION DYNAMICS; PLANTS; ANIMALS; CONSTRUCTION; RADIOACTIVE EFFLUENTS.

119 Utilization of Agricultural Wastes. Rowe, R.J.; Hassan, A. (University of Maine, Agricultural Experiment Station, Orono, ME, 04473). **Project number:** ME06100. **Supported by:** Maine Univ., Orono (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objectives are to investigate alternatives for constructive utilization of Maine's organic agricultural wastes; investigate anerobic digestion; investigate algae culture for further waste treatment and as a food source for aquaculture systems; and investigate an integrated agriculture--aquaculture production system with waste recycling.
Keywords: AGRICULTURAL WASTES; ANAEROBIC DIGESTION; ALGAE; AQUACULTURE; RECYCLING; MAINE; WASTE PRODUCT UTILIZATION; METHANE; BIOSYNTHESIS; AQUATIC ECOSYSTEMS; FOOD CHAINS.

120 Quality Housing Environment for Low-Income Families. Hurst, H.T.; Montgomery, J.E.; Hackett, J.E. (Virginia Polytechnic Institute, Environmental and Urban Systems, Agricultural and Life Sciences Research Division, Blacksburg, VA, 24061). **Project number:** VA-0623215. **Supported by:** Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Agriculture and Life Sciences Research Div.; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objectives of this study are to: identify housing related aspirations, expectations, needs and satisfactions of low-income families and examine limitations to the attainment of quality housing; formulate and evaluate innovative delivery systems in production, marketing, and financing in order to improve housing conditions; and develop and determine the acceptability and economic feasibility of innovative designs including housing components, new combinations of materials and building techniques such as peripheral heating systems and modular panels. The approach will be to assess relationships between social environment and income use, social satisfaction, health, age, and tenure of low-income families and physical environment and restraints by financiers, codes, unions, and producers of housing. Relationships between in-place costs, acceptability and adequacy of new or existing house and/or component designs will be evaluated.
Keywords: LOW INCOME GROUPS; HOUSES; MARKET; FINANCING; DESIGN; ECONOMICS; HEATING SYSTEMS; SOCIO-ECONOMIC FACTORS; DESIGN.

121 Heavy Metal and Radionuclide Pollution in Relationship to Crop Plants and Possible Means of Amelioration. Wallace, A. (University of California, Agricultural Experiment Station, Riverside, CA, 92507). **Project number:** CA-R*-SSE-2912. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to explore the impact of synthetic chelating agents on the environment, particularly in relationship to heavy metal and radionuclide pollution; determine the processes by which heavy metals can become pollutants in agricultural systems; and study the sensitivities of various species, cultivars and genotypes to toxicities of heavy metals. Various types of plants will be grown under environmentally, partially controlled conditions in which responses to levels of various heavy metals and radionuclides can be measured. Field studies also are to be made. Chemical, environmental, biological, and physical factors which regulate behavior of heavy metals in plants are to be evaluated. Metal analyses are to be made by emission spectrography, neutron activation, and cyclotron activation.
Keywords: METALS; RADIONUCLIDE KINETICS; CONTAMINATION; CROPS; PLANTS; REMOVAL; RADIONUCLIDE MIGRATION; AGRICULTURE; RADIOISOTOPES; SOILS; CHEMICAL ANALYSIS; CHELATING AGENTS; RADIOECOLOGICAL CONCENTRATION; DECONTAMINATION.

122 Air Pollutant Effects on a Coniferous Forest: (1) Vegetation and Wildlife. McBride, J.R.; White, M.; Wilcox, W.W. (University of California, Agricultural Experiment Station, Berkeley, CA, 94720). **Project number:** CA-F*-PRU-2913. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to study the effects of oxidant air pollutants on a western coniferous forest ecosystem; and develop a simulation model for the coniferous forest exosystem in the San Bernadino Mountains which can be used to predict changes due to long term exposure to oxidant air pollutants. Field observations combined with laboratory and growth chamber experiments will be used to identify and quantify causes of mortality to dominant tree, shrub, and herb species in the coniferous forest of the San Bernardino Mountains. Additional studies will be conducted to determine the direct effect of oxidant air pollutants on these species as well as their major consumers. This information along with stand age analysis data will be used to develop life tables for the various species. The life tables and mortality probabilities will serve as a basis for predicting future forest age structure and composition.
Keywords: AIR POLLUTION; BIOLOGICAL EFFECTS; FORESTS; PLANTS; TREES; WILD ANIMALS; BIOLOGICAL MODELS; TERRESTRIAL ECOSYSTEMS; PHOTOCHEMICAL OXIDANTS.

123 Pyrolytic Utilization of Organic Residues--Forest and Agriculture--for Energy and Product Recovery. Brink, D.L. (University of California, Agricultural Experiment Station, Berkeley, CA, 94720). **Project number:** CA-F-FPL-2905-H. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objectives are to: develop data for, and design technically and economically feasible, environmentally compatible, and socially acceptable pyrolysis processes utilizing organic residuals generated in forestry and agricultural enterprises; study bench-scale pyrolysis reactor design and parameters applying appropriate analysis of uncondensed vapors, condensates, and ashes; and when justified, extend to larger scale experimental units.
Keywords: AGRICULTURAL WASTES; WOOD WASTES; PYROLYSIS; CHEMICAL REACTORS; BENCH-SCALE EXPERIMENTS; DESIGN; ECONOMICS; PYROLYTIC OILS.

124 Peaking Plant Environmental Report. Murray, B.H. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS02070. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to evaluate and determine the potential social, environmental, biological and visual impacts of a three-hundred megawatt gas fired electric energy peaking plant proposed for three locations in the Milwaukee Metropolitan area. This data developed in this evaluation constitutes the basis of an environmental report to be submitted by the Wisconsin Electric Power Company. The potential types of impact resulting from construction and operation of a 300-megawatt peaking plant at each of three proposed sites will be determined. This served as a basis for developing a research

team. The group was organized to quantify potential impact including quantities and distribution of plant remissions (e.g., NOx and SO2); effects of plant emissions on plant and animal life; effect of the proposed peaking plants on land use and property values; effect of an operation on plant and neighborhood residents; visual effects of the proposed peaking plants; and a detailed impact evaluation of four alternative electric energy transmission right-of-ways associated with one of the three peaking plant sites.
Keywords: FOSSIL-FUEL POWER PLANTS; PEAKING POWER PLANTS; NATURAL GAS; ENVIRONMENTAL IMPACTS; SOCIAL IMPACT; BIOLOGICAL EFFECTS; ENVIRONMENTAL IMPACT STATEMENTS; CONSTRUCTION; OPERATION; NITROGEN OXIDES; SULFUR DIOXIDE; LAND USE; AESTHETICS; AIR POLLUTION; GASEOUS WASTES.

125 Energy from Residues in the Forest Industries. Corder, S.E. (Oregon State University, Forest Research Laboratory, Forest Products, Corvallis, OR, 97331). **Project number:** ORE-F-00944. **Supported by:** Oregon State Univ., Corvallis (USA). Forestry Research Lab.; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to develop and collect technical and economic information on using wood and bark for fuel and publish a bulletin; develop an instructional manual for operators of energy conversion plants which use wood and bark fuel; plan and arrange a conference devoted to the application of wood and bark for energy; study energy needs and possible methods of energy conservation in the forest products industry. The methods to be used are to: make an extensive literature review; determine conversion factors showing average amounts of residues generated in lumber and plywood production mills; obtain technical information from manufacturers of steam-generating equipment and air pollution control equipment; assemble fuel property values of different western species and types of residues; calculate and explain physical and technical factors involved in combustion; contact forest products plants for data collection and their needs for technical information to be presented in writing and during a conference.
Keywords: WOOD WASTES; COMBUSTION; STEAM GENERATION; CALORIFIC VALUE; COMBUSTION KINETICS; DATA ACQUISITION; WOOD PRODUCTS INDUSTRY; FORESTRY; INFORMATION SYSTEMS.

126 Bioconversion of Agricultural Wastes for Energy Conversion and Pollution Control. Jewell, W.J.; Davis, H.R.; Gunkel, W.W. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-123321. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is to determine the overall feasibility of using anaerobic digestion of agricultural organic wastes to provide an energy source for agricultural operations while reducing and controlling pollution. Factors to be determined for a 60 cow dairy operation and 1000 head beef feedlot operation will include: total energy needs of the production operation, net energy available from methane generation after the energy requirements of the process are deducted, opportunities to use net energy, manpower requirements, waste handling and residue disposal alternatives, and economic implications. A multi-disciplinary approach will be used to conduct a study with known or easily synthesized data to determine the feasibility of organic conversion to an energy source. The approach will not be to demonstrate again that methane can be generated from organic wastes. Important areas such as the following: overall contribution of waste handling process to well-being of agriculture and to environmental quality, availability of equipment and technology, detailed disposition of processed waste materials, and net cost of energy production and polluting control.
Keywords: AGRICULTURAL WASTES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; FARMS; ENERGY SOURCES; POLLUTION CONTROL; CATTLE; MANURES; ENERGY DEMAND; NET ENERGY; MANPOWER; ECONOMICS; MATERIALS HANDLING; TECHNOLOGY ASSESSMENT.

127 Hydrology of Lands Disturbed by Surface Mining of Coal in the Pinyon-Juniper Cover Type. Thames, J.L. (University of Arizona, Agricultural Experiment Station, Tucson, AZ, 85721). **Project number:** ARZT-2014-4168-037. **Supported by:** Arizona Agricultural Experiment Station, Tucson (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objectives are to: (1) develop, test and utilize hydrologic models to predict the quantity, quality and distribution of surface runoff within and from areas disturbed by mining; (2) develop models to predict the quantity of water and its rates of flow through recontoured spoil for both ponded and unponded conditions; and (3) determine the causes for spoil heating and develop quantitative methods to estimate its effect on snow melt and subsequent runoff. The major emphasis on the project will be placed on the development of simulation models. Field data will be collected to estimate parameters required by the models and to validate the models. Water quality will be evaluated from samples collected from the runoff plots, after each storm, and from hand catch samples from the watershed as opportunity allows. The causes and extent of heating in the spoil will be determined. Analyses will be made to predict the effects of hot spots on snowmelt.
Keywords: COAL MINING; SURFACE MINING; HYDROLOGY; RUNOFF; MATHEMATICAL MODELS; SPOIL BANKS; SNOW; WATER QUALITY; WATERSHEDS; DATA ANALYSIS.

128 Rehabilitation of Oil Contaminated Soils. Swader, F.N. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-125312. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

Under northeastern conditions, threshold levels of economic damage, persistence in soils, methods of accelerating biodegradation and soil rehabilitation will be determined for light fuel oils. Greenhouse and field experiments are conducted to determine effects on soils and plants. Periodical analyses are conducted to determine residual oil content and effects of differential fertilization. Movement of oils in soils under field conditions is monitored. Recommendations for rehabilitation of oil contaminated soils in the Northeast are formulated.
Keywords: FUEL OILS; ENVIRONMENTAL EFFECTS; LAND POLLUTION; OIL SPILLS; LAND RECLAMATION; ECONOMICS; ENVIRONMENTAL TRANSPORT; BIODEGRADATION; PLANTS.

129 Economic Structure and Performance of the Energy Industry. Chapman, L.D.; Mount, T.D. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-12319. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objectives are to analyze the competitive market structure of the energy industry as it has developed historically and exists today; identify those structural features and behavioral aspects of the industry which are determinative of current economic performance in the areas of pricing, production, aggregate consumption and environmental quality; and evaluate policy alternatives which may contribute to improved performance in the future. The problem of defining the structure of the energy industry must be viewed from many dimensions. The methodologies currently employed in the study are market concentration ratios; joint analysis; financial examination of interfuel ownership of oil (domestic and foreign), natural gas, coal, and uranium; resource reserves and ownership data; and engineering analyses of production cost data. The results of the structural analysis will be combined with econometric estimates of aggregate demand and published estimates of external costs to simulate market and social equilibria according to the market structure assumptions.
Keywords: ENERGY; MARKET; ECONOMIC DEVELOPMENT; INDUSTRY; CONSUMPTION RATES; CHARGES; ENVIRONMENTAL POLICY; FINANCING; OWNERSHIP; ECONOMICS; MARKETING RESEARCH; SOCIO-ECONOMIC FACTORS; ELECTRIC POWER INDUSTRY; DATA ANALYSIS.

130 Plants for Pollution and Erosion Control, Beautification and Browse. Tucker, T.C.; Larson, D.L.; Day, A.D. (University of Arizona, Agricultural Experiment Station, Tucson, AZ, 85721). **Project number:** ARZT-2014-4151-092. **Supported by:** Arizona Agricultural Experiment Station, Tucson (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(50); biomass(50). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objectives are to: (1) identify through field planting, plant species adapted for revegetation of wildlands, stabilization of mining wastes, fallow agricultural land, highway plantings, and other barren

soils; and (2) develop effective cultural practices and soil treatments for establishing and maintaining adapted plants on the foregoing areas. A number of cultivated and native plants will be grown on mining wastes, fallow agricultural land, vacant urban lots and barren soil along highways to determine those plants adapted to control wind and water erosion and dust pollution in each of these environments. Replicated trials will be made to develop effective cultural practices to use in establishing and maintaining adapted plants under each of the foregoing conditions.
Keywords: PLANTS; ORNAMENTAL PLANTS; PREFERRED SPECIES; EROSION; REVEGETATION; STABILIZATION; SPOIL BANKS; MINING; AGRICULTURE; URBAN AREAS; ROADS; AIR POLLUTION ABATEMENT; WATER POLLUTION ABATEMENT; LAND RECLAMATION; CULTIVATION TECHNIQUES; SURFACE MINING.

131 Treatment of Farm Manure and Organic Wastes. Hanson, R.S.; Zeikus, J.G.; Ensign, J.C. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS-05092. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives are to design and test a system for the bioconversion of organic wastes to methane and other useful products. An anaerobic fermenter suitable for a 15-animal confined dairy unit will be designed and the conditions for optimum production of methane will be determined. Additional units for gas purification and water purification by photosynthetic and methylotrophic bacteria will be designed and conditions for optimal production of soil conditioners and/or single cell protein will be determined.
Keywords: ORGANIC WASTES; MANURES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; CHEMICAL REACTORS; DESIGN; OPERATION; PURIFICATION; BACTERIA; SINGLE CELL PROTEIN; FERTILIZERS; PHOTOSYNTHESIS.

132 Conversion of Fermented Waste into Panel Products. Walters, C.S. (University of Illinois, Agricultural Experiment Station, Urbana, IL, 61801). **Project number:** ILIU-55-0337. **Supported by:** Illinois Agricultural Experiment Station, Urbana (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to: study the conversion of a fermented, organic, waste-residue into hot-pressed panels; and determine the physical and mechanical properties of panelboards made from fermented waste. The feasibility of manufacturing methane, a source of energy, by anaerobic fermentation of domestic, organic waste, has been demonstrated. A residue is left for disposal; however, empirical tests have shown that converting the fermented residue into hot-pressed panels and molded fiber products is a highly promising method of utilizing the residue. The properties of boards made, with and without a binder, will be determined. The conversion will yield income, convert a waste into usable products, eliminate a disposal problem, and conserve a natural resource.
Keywords: ANAEROBIC DIGESTION; WASTE PROCESSING; WASTE PRODUCT UTILIZATION; ORGANIC WASTES; HOT PRESSING; MOLDING; METHANE.

133 Studies in Methanogenesis. Olbrich, S.E. (University of Hawaii, Agricultural Experiment Station, Honolulu, HI, 96822). **Project number:** HAW00240. **Supported by:** Hawaii Univ., Honolulu (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to develop, perfect and biologically define an animal waste recycling system(s) for Hawaii which would not only help solve the animal waste disposal problem, but produce some economically valuable by-products (methane, sludge fertilizer and possibly a high protein feed). A two-phase experimental approach will be utilized. The first will involve small-scale controlled laboratory digester experiments to find and define an optimum set of range of conditions needed for maximum methane production. The second phase will involve a pilot plant designed to provide maximum research versatility, thus allowing for comparison of batch vs. continuous fermentation systems, comparison of single vs. series digester systems.
Keywords: MANURES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; CHEMICAL REACTORS; OPERATION; OPTIMIZATION; BENCH-SCALE EXPERIMENTS; PILOT PLANTS; HAWAII; BATCH CULTURE; CONTINUOUS CULTURE; FERTILIZERS; ANIMAL FEEDS.

134 Study of a Complete Disposal-Recycle Scheme for Agricultural Solid Wastes. Norman, R.; Busby, M. (Tennessee State University, Civil Engineering Department, Nashville, TN, 37203). **Project number:** TENX-PR-0002-34994. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The anaerobic conversion of manure to methane gas will be studied to determine if this process is adaptable to the needs of the small farmer. Can this process be used as a complete farm waste recycle scheme. Will the by-products of the process be beneficial to the farmer, i.e., can he make use of the methane and the sludge. Is the process economical. What level of the technical competence is required to construct, operate and maintain the unit. A bio-gas plant will be designed after the design of Singh and constructed by Tennessee State University. Various mixtures of animal manure and farm clippings will be batch fed to the units until gas production commences. An optimum mix for decomposition and methane production of the feed will be analyzed primarily for its fertilizer potential. Based on deisgn efforts, labor required for construction, feed composition, gas quality and quantity, sludge quality and quantity, length of time required for decomposition and gas production, and on the maintenance required, adaptability of the process to the needs of the small farmer will be determined.
Keywords: AGRICULTURAL WASTES; MANURES; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; FARMS; ENERGY SOURCES; BATCH CULTURE; FERTILIZERS; FEASIBILITY STUDIES; ECONOMICS; TECHNOLOGY ASSESSMENT.

135 Response to Sulfur Dioxide by Economic Plants in New Mexico. Booth, J.A.; Throneberry, G.O. (New Mexico State University, Agricultural Experiment Station, Las Cruces, NM, 88003). **Project number:** NM-00567. **Supported by:** New Mexico State Univ., Las Cruces (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to measure responses of selected New Mexico plants to varied SO2 dosages; determine whether economic loss results from SO2 dosages too low to cause visible injury; and determine the effect of SO2 exposure on pecan flowering, pollination, and fertilization. Container-grown pecan trees, cotton, alfalfa, and chili peppers will be exposed to varied doses of SO2 in greenhouse treatment chambers. Untreated control plants will be exposed to identical chamber conditions without SO2. Parameters to be estimated, and evaluations to be made will include height, photosynthetic area, stem diameter, thrift, and color. Physiological determinations will include protein and carbohydrate content, and such enzymatic determinations as are deemed appropriate as the work progresses. Estimation of biomass alterations will be made at the conclusion of the experiments when appropriate. The effects on pecan flowering etc. will be determined on a limited scale in the field using mature trees confined in plastic enclosures for early-season SO2 treatment. Nutlet production and maturation will be followed throughout the season.
Keywords: SULFUR DIOXIDE; ENVIRONMENTAL EFFECTS; NEW MEXICO; AGRICULTURE; PECAN TREES; COTTON; ALFALFA; PEPPERS; GREENHOUSES; CROPS; ECONOMIC IMPACT; AIR POLLUTION.

136 Revegetation of Coal Mine Areas. Bezdicek, D.F.; McNeal, B.L.; Halvorson, A.R. (Washington State University, Agricultural Experiment Station, Pullman, WA, 99163). **Project number:** WNP00244. **Supported by:** Washington State Univ., Pullman (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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; (4) develop an ongoing soil fertility management program by correlating soil test results with greenhouse and field studies; (5) initiate soil sampling program; (6) conduct greenhouse studies involving major soil materials with several grass species; and (7) conduct field plot studies with several grass species and fertility levels following results of greenhouse studies.
Keywords: COAL MINES; SPOIL BANKS; SOIL CHEMISTRY; NUTRIENTS; REVEGETATION; LAND RECLAMATION; GRASS; NITROGEN; PHOSPHORUS; POTASSIUM.

137 Energy and Food Production from Agricultural Waste Products. Harper, J.M. (Colorado State University, Agricultural Experiment Station, Fort Collins, CO, 80521). **Project number:** COI-00055. **Supported by:** Colorado State Univ., Fort Collins (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objectives are to evaluate fermentation processes for increased energy and/or food production from agricultural waste materials. Initial approaches will involve cattle manure as the agricultural waste material. By increasing fermentation rate, the manure will be fractionated into a water soluble and insoluble fraction and the soluble fraction fermented. A thorough study of concentration, pH, nutrient levels, temperature and volatile solids will be made on methane production and gas composition as well as single cell food production and quality. Secondly, hydro-oxidation will be used to partially hydrolyze cellulose and lignin in manure prior to fermentation. Process parameters will be studied and optimized. Techniques found beneficial on cattle manure will be tried on other similar agricultural wastes.
Keywords: AGRICULTURAL WASTES; MANURES; CATTLE; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; BIOCHEMICAL REACTION KINETICS; QUANTITY RATIO; PH VALUE; NUTRIENTS; TEMPERATURE DEPENDENCE; SINGLE CELL PROTEIN; HYDROLYSIS.

138 Energy Requirements of Environmentally Influenced Decisions Involving Water Development and Use. Hagan, R.M. (University of California, Agricultural Experiment Station, Davis, CA, 95616). **Project number:** CA-D-WSE-3351-H. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of this study are to: (1) prepare a preliminary summary of energy requirements associated with alternative solutions to problems of water development and use, waste water disposal, reclamation, and re-use, water quality control including desalting, and drainage; (2) prepare this summary in a form usable by planners, public opinion shapers, and decision-makers as an interim guideline in considering water-related projects and operational plans; (3) seek out personnel with competence and interest in this field and focus such attention on this problem area as the preliminary review may indicate to be justified by needs of society; (4) outline dimensions of a more comprehensive and interdisciplinary approach to energy-water relations, if warranted by Phase I study; and (5) begin selected investigations during Phase II. Energy requirements of proposed alternatives or decisions already made concerning water development and use will be analyzed using data from various agencies and numerous consultations with agencies and environmental groups. Use will be made of the working relations already established with the many water agencies, waste water services, environmental groups, and others.
Keywords: WATER RESOURCES; WATER QUALITY; DESALINATION; USES; WASTE WATER; WASTE DISPOSAL; ENERGY CONSUMPTION; RECYCLING.

139 Thermal Plume at Crystal River: Measures and Indices of Impact. Snedaker, S.C.; Adams, C.A.; Evink, G.L. (University of Florida, Agricultural Experiment Station, Gainesville, FL, 32601). **Project number:** FLA-FY-01721. **Supported by:** Florida Agricultural Experiment Station, Gainesville (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objectives are to quantify and evaluate the structural and functional adaptations of a receiving estuary to a chronic thermal discharge of coolant water from a coastal zone power plant; evaluate the application of whole-systems analyses to problems relating to man-induced impact on natural systems; and define the importance of spatial diversity in a mixed ecosystem. A whole-systems structure and function approach is used in which all measurements are fully quantified as to stocks (mass per unit area) and flows (mass per unit area per unit time). Analog model simulations are used to test hypotheses and to assign research priorities. The primary parameters of interest are those which describe ecosystems.
Keywords: THERMAL EFFLUENTS; ENVIRONMENTAL IMPACTS; COOLING SYSTEMS; POWER PLANTS; COASTAL REGIONS; ESTUARIES; AQUATIC ECOSYSTEMS; SPECIES DIVERSITY; DIFFUSION; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; TEMPERATURE EFFECTS; THERMAL POLLUTION; WATER POLLUTION; BIOLOGICAL EFFECTS.

140 Integration of Mining and Land Reclamation Operations for Returning Land to Economic Productivity. Anderson, C. (Iowa State University, Agricultural Experiment Station, Ames, IA, 50011). **Project number:** IOW-02081. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to: (1) determine the physical, chemical and biological properties of stratigraphic materials over coal deposits in Iowa as they relate to runoff and seepage water quality and plant growth potential; (2) define by field and laboratory tests the needed stratification of the reclaimed overburden to achieve a specified future land use; and (3) develop economic procedures for extracting coal and replacing the overburden in accordance with results. Samples of coal overburden will be physically and chemically analyzed in the laboratory. Greenhouse studies will be used to determine the desired or necessary mixtures and treatments to obtain satisfactory production of forages and row crops. Field research plots will be established based on the foregoing and measures taken of water movement and quality, crop response, and selected soil properties. The mining and reclamation activities will be evaluated both by field observations and measures and by computer simulation.
Keywords: COAL MINING; OVERBURDEN; STRATIGRAPHY; LAND RECLAMATION; SOILS; WATERSHEDS; REVEGETATION; PREFERRED SPECIES; MATHEMATICAL MODELS; ECONOMICS; LAND USE.

141 Impact of a Power Plant on the Biology of the Flint Hills Area of Kansas. Goss, J.A. (Kansas State University, Agricultural Experiment Station, Manhattan, KS, 66506). **Project number:** KAN-00928. **Supported by:** Kansas State Univ., Manhattan (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to assess the impact of the proposed Kansas Power and Light Energy Center on important aspects of the biology of the Flint Hills area of Kansas. Control and impacted sites will be analyzed before and after initiation of power plant operation. Targets for analysis are the agriculturally important species composition, productivity, and reproduction in the grasslands. Species most sensitive to the types of changes produced by the power plant will be identified and studied as predictors of detrimental impact. Aquatic as well as terrestrial habitats will be studied.
Keywords: POWER PLANTS; ENVIRONMENTAL IMPACTS; KANSAS; BASELINE ECOLOGY; AGRICULTURE; PLANTS; BIOLOGICAL INDICATORS; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; SULFUR OXIDES; NITROGEN OXIDES; CARBON OXIDES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS.

142 Yolk Deposition in Birds Subjected to Environmental Contaminants. Grau, C.R. (University of California, Avian Science, Agricultural Experiment Station, Davis, CA, 95616). **Project number:** CA-D-AVS-2990-H. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objective is to 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; TOXICITY; METALS; METABOLISM; PETROLEUM; OIL SPILLS; ACUTE EXPOSURE; ENVIRONMENTAL EFFECTS.

143 Utilization of Animal, Crop and Processing Residues. Akesson, N.B. (University of California at Davis, Agricultural Experiment Station, Davis, CA, 95616). **Project number:** CA-D-AER-2971-H. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: biomass(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

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 would be a basic consideration. Laboratory and field studies would be conducted on open field burning of crop residues and pyrolysis and incineration for any recovery; animal and food processing wastes would be examined for recycling to animal feeds; all types of wastes would be studied in soil plots for recovery of nutrients and encouragement of soil bacteria conversion to useable plant nutrients.

Keywords: AGRICULTURAL WASTES; MANURES; WASTE PRODUCT UTILIZATION; FOOD PROCESSING; RECYCLING; ENERGY CONVERSION; PYROLYSIS; COMBUSTION; ANIMAL FEEDS; NUTRIENTS.

144 Range Grass Breeding. Asay, K.H. (Utah State University, Agricultural Experiment Station, Logan, UT, 84321). **Project number:** UTA-00282. **Supported by:** Utah Agricultural Experiment Station, Logan (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: all(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to develop improved varieties of range grasses; study sterility in intergeneric and interspecific hybrids and response of grasses to environmental stress; evaluate intergeneric and interspecific hybrids involving primarily Agropyron and Elymus species under range conditions; study meiotic irregularities associated with sterility and fix selected qualities of promising hybrids into fertile populations; develop varieties of crested wheatgrass (A. cristatum and desertorum) and bluebench wheatgrass (A. spicatum) for arid rangeland; and develop a species complex that includes E. cinereus, E. triticoides, and E. salina for reclamation of areas disturbed by surface mining. Populations will be screened and genetic effects studied under controlled environmental stress.

Keywords: GRASS; PLANT BREEDING; RANGELANDS; RESOURCE ASSESSMENT; PLANTS; BIOLOGICAL STRESS; REPRODUCTION; LAND RECLAMATION; SURFACE MINING; POPULATION DYNAMICS; GENETIC EFFECTS; WATER REQUIREMENTS; REVEGETATION.

145 Impacts of the Construction and Operation of Coastal Nuclear Power Plants on Estuarine Ecology. Copeland, B.J. (North Carolina State University, Agricultural Experiment Station, Raleigh, NC, 27607). **Project number:** NC-05332. **Supported by:** North Carolina Agricultural Experiment Station, Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to develop information for evaluating the effects of power plant construction and operation on the ecology of North Carolina estuaries. Specific objectives are to establish baseline populations, diversity and movements of organisms in the intake and outfall areas of the Cape Fear River Estuary and adjacent ocean; determine the effects on construction and operation of the discharge canal on the nursery utilization and productivity of Dutchman Creek; determine the impact of entrainment and impingement on larval fish and crustaceans; and 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; CONSTRUCTION; OPERATION; AQUATIC ECOSYSTEMS; BIOLOGICAL MODELS; NORTH CAROLINA; ESTUARIES; BASELINE ECOLOGY; THERMAL POLLUTION; WATER POLLUTION; RADIOACTIVE EFFLUENTS; THERMAL EFFLUENTS.

146 Energy Development and Toxicant By-Products. Miller, G.W. (Utah State University, Agricultural Experiment Station, Logan, UT, 84321). **Project number:** UTA-0056. **Supported by:** Utah Agricultural Experiment Station, Logan (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are to survey plants and animals, both domestic and wild in terms of injury from air pollutants (fluoride, sulfur dioxide and heavy metals); determine level of air pollution, direct air analysis, use of indicator organisms, tissue findings (analysis, morphology, clinical); and evaluate effect of pollutants on organisms, field suvey, field trials, and laboratory studies. Studies proposed will include analysis of air, vegetation, animals, water and soil for individual pollutants where applicable. Biochemical studies will also be conducted to determine whether such laboratory reactions correlate with toxicant levels in the field, i.e., the buildup of aminolevulinic acid in blood or tissue as an indicator of toxic lead levels, sulfonation of amino acids in relation to SO2 pollution, enolase in relation to high fluoride levels. Field surveys will evaluate effects of pollutants as to type and level of animals and plants. Fumigation and feed studies on the laboratory would study ffects on organisms and relate directly to the field trials. Studies would be made in areas of prime agriculture or range importance. Baseline studies would assist the state in planning for the future and give a basis for avoiding controversial problems.

Keywords: ENERGY SOURCE DEVELOPMENT; HEALTH HAZARDS; AIR POLLUTION; FLUORINE; SULFUR DIOXIDE; METALS; TOXICITY; MONITORING; CHEMICAL COMPOSITION; BIOLOGICAL INDICATORS; TISSUES; MORPHOLOGY; PATHOLOGICAL CHANGES; AIR QUALITY; PLANTS; WATER QUALITY; SOILS; METABOLISM; LEAD; AGRICULTURE; BASELINE ECOLOGY; UTAH.

147 Resource Recovery from Livestock Waste. Newton, G.L. (Georgia Coastal Plain Experiment Station, Tifton, GA, 31794). **Project number:** GEO00271. **Supported by:** Georgia Univ., Athens (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: biomass(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives are to: determine if deep-pit stored manure can be used for methane production and the feeding value of digester sludge; develop means of reducing the nitrogen loss from oxidation ditches; develop ways of utilizing fibrous materials removed from the stream of a flush waste removal system; determine if certain algae can be used effectively to produce a usable product from waste waters; and incorporate procedures for resource recovery 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; CATTLE; ANAEROBIC DIGESTION; METHANE; BIOSYNTHESIS; ANIMAL FEEDS; FERTILIZERS; ENVIRONMENTAL IMPACTS; SWINE; ALGAE; BENCH-SCALE EXPERIMENTS; AGRICULTURE; WASTE PRODUCT UTILIZATION.

148 Environmental Impact Tailings Basin Construction and Effluent Discharge. Stormer, F.A. (Ford Forestry Center, Michigan State Univ., East Lansing, MI, 48823). **Project number:** MICZ20231. **Supported by:** Michigan State Univ., East Lansing (USA). Ford Forestry Center; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

Objectives are to determine whether there are any features of certain communities that are of critical environmental concern; provide information for selection of the site on which establishment of a discharge pond will have the least impact on the environment; and provide preliminary base-line data for assessing any changes in the biotic communities that result from the impoundment. The study will consist of two phases: Phase I will provide the information needed for selection of the actual pond site, while Phase II, a pre-operation study, will give more detailed data needed for a preliminary assessment of the environmental impact of the modification, once the actual pond site has been selected.

Keywords: PONDS; CONSTRUCTION; ENVIRONMENTAL IMPACTS; AQUATIC ECOSYSTEMS; ENVIRONMENTAL TRANSPORT; SITE SELECTION; WASTE DISPOSAL; CHEMICAL EFFLUENTS; THERMAL EFFLUENTS; MINING.

149 Oil Shale. Cook, C.W. (Colorado State University, Range Science, Forestry and Natural Resources, Fort Collins, CO, 80521). **Project number:** COL 00143. **Supported by:** Colorado State Univ., Fort Collins (USA). Coll. of Forestry and Natural Resources; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

An evaluation of surface mining on rehabilitation of various soil-plant response units overlying oil shale in the Piceance Creek

Basin in Western Colorado was conducted during 1972--1973. Natural vegetation in the landscape and natural and artificial rehabilitation of disturbed sites were studied. Approximately 50 native species were seeded on various site potentials varying from poor to good in sagebrush, juniper, ponderosa pine, and mountain bush types. All vegetation types showed that rehabilitation could be accomplished if the proper methods were applied. The majority of native species tested were promising when planted in the natural vegetation zones. **Keywords:** OIL SHALE MINING; SURFACE MINING; LAND RECLAMATION; COLORADO; PREFERRED SPECIES; PLANTS; REVEGETATION; DATA ANALYSIS.

150 Selection of Aluminum-Tolerant Trees for Revegetating Acid Mine Spoils. McCormick, L.H. (Pennsylvania State University, Agricultural Experiment Station, University Park, PA, 16802). **Project number:** PEN-02258. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to develop laboratory techniques for evaluating the aluminum tolerance of trees; determine the relative aluminum tolerance between and within tree species; and 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: SPOIL BANKS; REVEGETATION; TREES; GROWTH; INHIBITION; ALUMINIUM; PREFERRED SPECIES; DATA ACQUISITION; GENETICS; ACID MINE DRAINAGE.

151 Zoogeology and Ecology of Fishes in Pennsylvania. Cooper, E.L. (Pennsylvania State University, Agricultural Experiment Station, University Park, PA, 16802). **Project number:** PEN-02276. **Supported by:** Pennsylvania Agricultural Experiment Station, University Park (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to measure the impact of environmental disturbance on patterns of distribution of fish species; and 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 populations 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: FISHES; POPULATIONS; SPECIES DIVERSITY; ACID MINE DRAINAGE; WATER POLLUTION; EROSION; ENVIRONMENTAL IMPACTS; AQUATIC ECOSYSTEMS.

152 Surface Water Quality in Strip-Mining Areas of Iowa. Bachman, R.W. (Iowa State University, Agricultural Experiment Station, Ames, IA, 50011). **Project number:** IOW-02109. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to determine factors influencing water quality in strip-mining areas; inventory impounded waters from past strip-mining in Iowa with emphasis on fish populations and production; and make recommendations on ways to minimize water quality degradation from future mining operations and the reclamation and management of present impoundments for fish production. Primary emphasis will be placed on analyzing data already collected from strip mined areas in Iowa and on summarizing the literature on the subject from other states. This information will be used to prepare guidelines for protecting water quality and for the reclamation and management of strip mine impoundments for fish production.
Keywords: IOWA; SURFACE MINING; ENVIRONMENTAL IMPACTS; WATER QUALITY; SURFACE WATERS; FISHES; POPULATION DENSITY; DATA ANALYSIS; WATER POLLUTION.

153 Establishment and Seed Development of Species Grown on Reclaimed Areas. Wiesner, L.E. (Montana State University, Agricultural Experiment Station, Bozeman, MT, 59715). **Project number:** MONB-00365. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to evaluate seed of species which have promise for revegetation; develop treatments for overcoming dormancy (of seeds to improve establishment); evaluate establishment of species in new plantings; and 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: SPOIL BANKS; LAND RECLAMATION; PLANTS; SEEDS; EVALUATION; GERMINATION; MINING; REVEGETATION.

154 Vegetative Rehabilitation of Arid Land Disturbed in the Development of Oil Shale and Coal. McKeil, C.M. (Utah State University, Agricultural Experiment Station, Logan, UT, 84321). **Project number:** UTA-00754. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to develop techniques for establishing native plants in areas disturbed by coal and oil shale development in arid regions. Specific objectives are to assess suitability of native plants for propagation, study the growth responses of native shrubs grown in containers, select the proper soil surface material and rate for sealing and stabilizing the soil surface, and develop criteria for water harvesting methods adequate to irrigate transplanted native species. Locally adapted native plants will be used and propagated for transplanting into areas where the soil surface has been treated to shed water into basins or deep furrows and thus reduce the need for irrigation.
Keywords: OIL SHALE MINING; COAL MINING; LAND RECLAMATION; REVEGETATION; ARID LANDS; PREFERRED SPECIES; EVALUATION.

155 Research on Potential Effects on Aquatic Resources of Processing and/or Conversion of Iowa Coal. Muncy, R.J. (Iowa State University, Agricultural Experiment Station, Ames, IA, 50011). **Project number:** IOW02165. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to determine possible acute toxicity (LC50, 96 hours) of magnetite slurry used in Iowa Coal Benefication Plant to Iowa fishes; determine chemical composition and changes in closed-system water-magnetite slurry with continual processing; and prepare final report for use in environmental impact analysis of future coal benefication operations. Acute toxicity tests using fish under standardized conditions will be conducted between 1 Jan--May 1977 with magnetite slurry samples from the ISU-ICP Coal Benefication Plant. Slurry samples from different phase of plant operations will be analyzed for physical and chemical composition as well as biological effects.
Keywords: IOWA; COAL PREPARATION PLANTS; ENVIRONMENTAL IMPACTS; WATER POLLUTION; CHEMICAL EFFLUENTS; TOXICITY; FISHES; CHEMICAL COMPOSITION; PHYSICAL PROPERTIES; ENVIRONMENTAL IMPACT STATEMENTS; SLURRIES; WATER RESOURCES.

156 Reclamation of Surface Mined Coal Spoils. Barnhisel, R.I. (University of Kentucky, Agricultural Experiment Station, Lexington, KY, 40506). **Project number:** KY00011. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(); coal(20). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to determine the chemical and physical properties of surface mined coal spoils and determine how these properties affect establishment and survival of vegetative cover; evaluate, in field experiments, the lime rates predicted from both the standard buffer pH method and the newly developed laboratory test for determining the potential acidity; develop methods of tillage to produce a stable microrelief which allows infiltration and subsequent utilization by vegetation and reduces runoff and erosion; and develop forage management systems for reclaimed coal spoils. Several standard commercially available forage species will be used as test crops. Site preparation techniques will consist of readily available equipment. A portable rainfall simulator will be constructed to evaluate tillage and forage treatments as to their ability to retain rainfall and reduce erosion. Forage yields will be taken to evaluate productivity of areas reclaimed.

Keywords: COAL MINING; SURFACE MINING; SPOIL BANKS; LAND RECLAMATION; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; REVEGETATION; PH VALUE; SOIL CHEMISTRY; CULTIVATION TECHNIQUES; EROSION; PLANTS.

157 Use of Sludges and Top Soil in Reclamating Coal Strip-Mine Spoils. Haghiri, F. (Ohio Agricultural Research and Development Center, Columbus, OH, 43216). **Project number:** OH000247-SS. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(40); oil shales and tar sands(40); biomass(20). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to: determine optimum rates of sewage sludge to obtain cover on old acidic mine spoils in greenhouse and under field conditions; determine effect of sludge applied to old acidic mine spoils on heavy metal content of vegetation and leachate; and 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: COAL MINING; SURFACE MINING; LAND RECLAMATION; SEWAGE SLUDGE; ACID MINE DRAINAGE; SOILS; GRASS; CULTIVATION TECHNIQUES; SOIL CHEMISTRY; REVEGETATION.

158 Soil and Vegetation Characteristics of the Leviathan Mine, California, in Relation to Requirements. Tueller, P.T. (University of Nevada, Agricultural Experiment Station, Reno, NV, 89507). **Project number:** NEV00652. **Supported by:** Nevada Univ., Reno (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: fossil fuels(30); nuclear fission(30); biomass(40). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to stratify pit and waste dumps with respect to soils, relief, and microclimate; study plant succession as affected by edaphic, topographic, and microclimatic factors; and determine the most successful plant species, including native conifer species, and planting technique for revegetation. The methods are to make measurements of slope and aspect and collect soil samples to be analyzed for physical and chemical properties; compile species lists of tree and ground cover plants invading the mine dumps and growing in the surrounding area: collect data on plant cover, frequency and density; and conduct greenhouse and field planting trials with native and introduced species using a variety of plating techniques and treatments.

Keywords: SOILS; PLANTS; CALIFORNIA; MINES; REVEGETATION; SAMPLING; WASTE MANAGEMENT; PREFERRED SPECIES; LAND RECLAMATION.

159 Reclamation and Water Relations of Strip Mine Spoils in Northern Arizona. Thames, J.L. (University of Arizona, Agricultural Experiment Station, Tucson, AZ, 85721). **Project number:** ARZT-0206-4168-208. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives are to identify plant species adapted for revegetating and stabilizing strip mine spoil; test cultural and soil treatments for establishing and maintaining adapted species; determine the effects of plantings and cultural treatments on the hydrologic regime of mine spoil; and 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: LAND RECLAMATION; REVEGETATION; SURFACE MINING; COAL MINING; SPOIL BANKS; HYDROLOGY; MATHEMATICAL MODELS; SEEDS; GERMINATION; ARIZONA.

160 Defining, Classifying and Utilizing Topsoils and Substrata in Suitable Classes of Mine Soils. Smith, R.M. (West Virginia University, Agricultural Experiment Station, Morgantown, WV, 26506). **Project number:** WVA00161. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: biomass(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives are to develop satisfactory definitions of topsoils; classify topsoils in terms of specific properties that can be described and measured consistently; develop and test new methods if found necessary to satisfy; determine whether known topsoils react in predictable fashion on designated classes of minesoils; and cooperate with one or more surface mining operators in the planned placement of overburden and topsoil to provide superior land for production of a mutually selected, high value speciality crop. Definitions and classification of topsoils, overburdens and minesoils will be elaborated within legal guidelines, based upon scientific knowledge and popular concepts, in terms of important observable and measurable properties. Interactions of different kinds of topsoils on identified classes of minesoils will be appraised on selected sites in relation to vigor of established vegetation, with emphasis on processes of change in minesoil profiles, development of plant roots, and extent of ground cover. Detailed consideration will be given to the feasibility of creating appropriate minesoil land for profitable production of some high value speciality crop judged to offer long-range economic opportunities in a system that assures soil and water quality.

Keywords: SOILS; SPOIL BANKS; LAND RECLAMATION; REVEGETATION; COAL MINES; PERFORMANCE TESTING.

161 Hydrology and Water Quality of Watersheds Subjected to Surface Mining. Sutton, P. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** OH000248-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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to: (1) obtain complete hydrologic 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 the U.S. Geological Survey, 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: COAL MINING; SURFACE MINING; WATER POLLUTION; HYDROLOGY; WATER QUALITY; WATERSHEDS; RUNOFF; SAMPLING; ECONOMICS; LAND RECLAMATION; SPOIL BANKS.

162 Impact of Coal Fired Power Plants on the Environment-Trace Chemicals Group. Helmke, P.A. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS02241. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: fossil fuels(10); coal(90). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to determine the impact of coal-fired generating stations on the concentrations, distributions and bioavailability of trace elements and sulfur in the environment. The concentrations of trace elements and sulfur in samples of plants, animals, aerosolic dust, sediment, water and soil will be monitored before and after the generating station starts operations and the results interpreted. Analyses will be by neutron activation, x-ray fluorescence and atomic absorption spectrophotometry. Suitable species for monitoring the uptake of trace elements will be identified by these results and laboratory studies using radiotracers of selected elements. Mass spectrometric procedures will be developed and used to study the sources, sinks and pathways of sulfur in the environment by using the ratios of the stable isotopes of sulfur as tracers.

Keywords: FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; SULFUR; ELEMENTS; TRACE AMOUNTS; MONITORING; PLANTS; ANIMALS; DUSTS; SEDIMENTS; WATER; SOILS; ENVIRONMENTAL EXPOSURE PATHWAY; ACTIVATION ANALYSIS; ABSORPTION SPECTROSCOPY; X-RAY FLUORESCENCE ANALYSIS.

163 Impacts of Uncertainty on Coal Supply Response with Implications for Agricultural Resource Adjustment. Adams, R.M. (University of Wyoming, Agricultural Experiment Station, Laramie, WY, 82070). **Project number:** WYO-133-077. **Supported by:** Wyoming Agricultural Experiment Station, Laramie (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

Coal resources within Wyoming display a high level of uncertainty with respect to future development rates, due to an unstable institutional and economic environment. Uncertainty creates decision problems within the private and public sector. Impacts may be pronounced in the agricultural sector, where resource conflicts are most severe. The impacts of increasing institutional uncertainty on decision making within the private mineral extraction sector will be assessed, with subsidiary impacts on: future public sector revenue streams obtainable from energy extraction taxation; future trends in resource shifts from agriculture, specifically water; formulation of optimal decision strategies for public land administrators with respect to the derived demand for coal and resulting extraction rates; empirical framework for measurement of risk and uncertainty; and subjective utility functions. We will determine the alternative supply response and resource transfers under risk with quadratic programming (q.p.) formulation. We will use q.p. to maximize Ricardian rent accruement to public sector under alternative policy/taxation schemes.

Keywords: WYOMING; AGRICULTURE; ENERGY SOURCES; COAL MINES; ENERGY SOURCE DEVELOPMENT; DECISION MAKING; GOVERNMENT POLICIES; STATE GOVERNMENT; LAND USE; TAXES; ECONOMIC IMPACT; MATHEMATICAL MODELS; SOCIO-ECONOMIC FACTORS.

164 Effects of Non-Gaseous Airborne Pollutants from Coal-Fired Power Plants on Plant Growth and Metabolism Adjustment. Landa, E.R. (Oregon State University, Agricultural Experiment Station, Corvallis, OR, 97331). **Project number:** ORE00347. **Supported by:** Oregon Agricultural Experiment Station, Corvallis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Operational safety; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to investigate selected effects of stack emissions associated with coal-burning on plant growth and metabolism. The approach is to study uptake of metallic mercury from the vapor phase by plants and its subsequent biotransformations; study uptake by plants and behavior in soils of inorganic divalent mercury; and study effects of stack emissions upon primary aspects of photosynthesis and photosynthetically-linked nitrogen fixation.

Keywords: FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; PLANT GROWTH; MERCURY; UPTAKE; METABOLISM; ENVIRONMENTAL TRANSPORT; SOILS; PLANTS; FLUE GAS; ENVIRONMENTAL IMPACTS; CONTAMINATION.

165 Mechanization of Greenhouse Cultural and Environmental Systems. Short, T.H. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** OH00576. **Supported by:** Ohio Agricultural Research and Development Center, Wooster (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: fossil fuels(30); solar(20); conservation(50). **R and D categories:** Ecological/biological processes and effects.

The objectives of this study are to establish new technology to reduce labor cost, labor drudgery, and fossil fuel heating requirements for greenhouses. Labor-aid mechanisms will be developed to reduce drudgery and increase labor efficiency of growing greenhouse crops under present cultural systems. Machinery will be developed for high population cultural systems to achieve high production of tomatoes, lettuce and other greenhouse crops. Mechanical methods of adding nighttime insulation to greenhouse covers will be developed and tested. Mechanical systems for transferring heat to a greenhouse from solar collectors and heat storages such as a solar pond will be studied and developed. Greenhouse energy sources will be integrated into workable, efficient and economic systems of crop production.

Keywords: GREENHOUSES; ENERGY SOURCES; CROPS; PRODUCTION; COST; LABOR; TOMATOES; LETTUCE; SOLAR COLLECTORS; EQUIPMENT; HEAT STORAGE.

166 Environmental Effects on the Response of Plants to Selected Air Pollutants. Heck, W.W. (North Carolina State University, Agricultural Experiment Station, Raleigh, NC, 27607). **Project number:** NC05360. **Supported by:** North Carolina Agricultural Experiment Station, Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Ecological/biological processes and effects.

The response of selected plants to O3, SO2, NO2, and NH3 under growth conditions, 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 the effects of these stressors on pollutant uptake and plant nutrition are being investigated. 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. Exposures 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: AIR POLLUTION; BIOLOGICAL EFFECTS; OZONE; SULFUR DIOXIDE; NITROGEN DIOXIDE; AMMONIA; CARBON DIOXIDE; BIOLOGICAL EFFECTS.

167 Anaerobic Fermentation of Agricultural Wastes: Potential for Improvement and Implementation. Jewell, W.J. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-123360. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: biomass(50); conservation(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to determine the potential for optimizing technology related to anaerobic 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. Two general concepts will guide the development of future optimized anaerobic fermentation technology: (1) simplistic operation involving minimal manpower; and (2) the elimination of the waste by production of useful energy-containing by-products. The focus will be on the transformation of a waste into useable but currently unrecovered energy-containing by-products. The Cornell study has identified two unique anaerobic fermentation system designs: one could be capable of operation with the simplest of demands on the farm; whereas a complex unit may accomplish stabilization, methane production, liquid-solids separation and pathogen destruction in one unit operation.

Keywords: ANAEROBIC DIGESTION; CHEMICAL REACTORS; DESIGN; OPTIMIZATION; MANPOWER; METHANE; BIOSYNTHESIS; FERTILIZERS; ANIMAL FEEDS; WASTE PRODUCT UTILIZATION; MANURES; BENCH-SCALE EXPERIMENTS; PILOT PLANTS.

168 Rehabilitation Potential and Practices of Colorado Oil Shale Lands. Sims, P. (Colorado State University, College of Forestry and Natural Resources, Fort Collins, CO, 80521). **Project number:** COL00234. **Supported by:** Colorado State Univ., Fort Collins (USA). Coll. of Forestry and Natural Resources; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil shales and tar sands(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to identify and characterize important natural ecosystems, selection of ecotypes of native shrub species, improvement of plant materials for rehabilitation, and enhancement of spent shale as a plant growth medium; determine fertility requirements for vegetation on disturbed soils; determine appropriate meth-

ods of revegetation of disturbed ecosystems; and determine the interaction between plant species, spoil material, cultural practices, and environmental parameters on rate and direction of succession. The research on the rehabilitation potential of Colorado oil shale lands will be a multi-phased effort by about ten scientists from two Colorado Universities. Both field and laboratory research will be conducted by the scientists, their research associates, graduate students and technical assistants. Each research objective will be a separate phase of the project.
Keywords: OIL SHALE MINING; LAND RECLAMATION; COLORADO; ECOSYSTEMS; PLANTS; SPENT SHALES; NUTRIENTS; REVEGETATION; WASTE PRODUCT UTILIZATION.

169 Soil Development on Mine Spoil and Nitrates as a Potential Contaminant. Singleton, P.C. (University of Wyoming, Agricultural Experiment Station, Laramie, WY, 82070). **Project number:** WYO-00997-WS. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to evaluate soil characteristics developed under spoil bank materials that have not been shaped or topsoiled and compare them to characteristics developed under spoil bank materials that have been shaped, topsoiled and revegetated; and measure levels of soil nitrate developed in stockpiled materials and determine their deposition in the environment. Morphological features developed in old and new spoil bank materials will be determined at various depths in the profile. Samples will be collected at specified depths and analyzed for SiO2, pH, E.C.(s), Al2O3, CaO, MgO, K2O, Na2O, organic matter, CaCO3, and texture to evaluate changes that are occurring in the spoil. Moisture measuring access tubes will be implemented to a depth of 240 cm in spoil bank materials to determine moisture penetration over a period of time. Soil samples will be collected at 15 cm intervals to a depth of 120 cm for NO3--N determination and runoff water will be collected to measure NO3--N being removed from the spoil material.
Keywords: SPOIL BANKS; SOIL CHEMISTRY; REVEGETATION; NITRATES; MORPHOLOGY; SILICON OXIDES; ALUMINIUM OXIDES; CALCIUM OXIDES; MAGNESIUM OXIDES; POTASSIUM OXIDES; SODIUM OXIDES; CALCIUM CARBONATES; PH VALUE; RUNOFF; MOISTURE.

170 Classification of Coal Surface Mine Soil Material for Vegetation Management and Soil Water Quality. Lyle, E.S. Jr. (University of Auburn, Agricultural Experiment Station, Auburn, AL, 36830). **Project number:** ALA-07579. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to characterize features of the coal surface mine that could affect plant establishment, plant growth and soil water quality, and to produce a classification system that can be used to predict cultural treatments necessary for plant production on coal surface mines. Mine sites to be used in this study will be selected from all coal producing counties in Alabama by stratified sampling on the basis of coal production. Mine soil and soil solution characteristics will be determined from representative sites. Plant species proven to be effective in Alabama surface mine revegetation will be grown in amended and unamended mine soils. Soil and site characteristics will be correlated with plant production for each mine soil. A mine soil classification system based on soil site and plant growth characteristics will be developed.
Keywords: SURFACE MINING; COAL MINING; PLANT GROWTH; REVEGETATION; WATER QUALITY; CLASSIFICATION; LAND RECLAMATION; SOILS; SPOIL BANKS.

171 Erosion Effects and Pollutant Movements from Coal and Oil Shale Strip-Mining Deposition. Shen, H.W. (Colorado State University, Agricultural Experiment Station, Fort Collins, CO, 80521). **Project number:** COL-01402. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to study erosion and chemical transport under rainfall and/or snowmelt conditions with both overland and subsurface flow in the research laboratory at Colorado State University. This study would be conducted in a 4-foot wide by 4-foot deep by 64-foot-long steel flume at the Engineering Research Center, Colorado State University. The variables are rainfall intensity, soil (first homogeneous and later heterogeneous layers), variation of soil slopes, and subsurface suction. Snow cover on top of the soil with and without rainfall and various types of simulated vegetation could be added in a later study. The movements of pollutants and sediment erosion would be investigated. Soil (silt and clay) would be obtained from the sites selected by the U.S. Agricultural Research Service for their field study. A rainfall simulator, with maximum rainfall on the order of 8 inches per hour, is available at Colorado State University. Flow properties, sediment erosion by the surface flow and the movements of pollutants will be analyzed.
Keywords: COAL MINING; OIL SHALE MINING; SURFACE MINING; SPOIL BANKS; EROSION; LAND POLLUTION; ENVIRONMENTAL TRANSPORT; RAIN; SNOW; GROUND WATER; RUNOFF.

172 Cleaning and Preservation of Shell Eggs Without Refrigeration. Heath, J.L. (University of Maryland, Agricultural Experiment Station, College Park, MD, 20742). **Project number:** MD-M-111. **Supported by:** Maryland Univ., College Park (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Ecological/biological processes and effects.

The objectives of this program are to: eliminate current hot water--detergent washing of market eggs; eliminate most of the refrigeration in marketing of fresh eggs; and adapt experimental techniques to current practices. Chemical H2O cleaning and storage techniques will be investigated to find a system which will clean the egg properly and allow it to be stored at higher temperatures. Preliminary research has determined both are feasible. Research will be conducted to determine if the system is safe, will clean the egg, maintain quality, use a minimum of energy, present no disposal problems, is economically feasible and is adapatable to present processing--marketing systems. Functional and organoleptic qualities will be investigated from a consumer view-point.
Keywords: ENERGY CONSERVATION; HOT WATER; EGGS; CLEANING; WATER; REFRIGERATION; STORAGE.

173 Energy Conservation in Drying Lumber and Veneer. Corder, S.E. (Oregon State University, Forestry Research Laboratory, Corvallis, OR, 97331). **Project number:** ORE-F-00020. **Supported by:** Oregon State Univ., Corvallis (USA). Forestry Research Lab.; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100).

The objective of this study 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. The approach will be to perform calculations and analysis to predict performance of the proposed systems. Tests will be conducted to verify performance and to help define operational problems which might develop. Energy savings will be identified and the results of the findings will be publicized.
Keywords: WOOD PRODUCTS INDUSTRY; WOOD; DRYING; ENERGY CONSERVATION; HEAT RECOVERY; FEASIBILITY STUDIES; PERFORMANCE; DRYERS.

174 Assessment of Energy Policy and Development Alternatives for New Mexico. Stevens, T.H. (New Mexico State University, Agricultural Experiment Station, Las Cruces, NM). **Project number:** NM00251. **Supported by:** New Mexico State Univ., Las Cruces (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objectives are to estimate demand and supply functions for energy resources of importance to New Mexico; estimate and evaluate the interdependence 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 POLICY; ENERGY SOURCES; ENERGY DEMAND; ENERGY SUPPLIES; ECONOMIC IMPACT; ECONOMETRICS; ENERGY SOURCE DEVELOPMENT.

175 Improvement of the Palzo Ecosystem with Select Vegetation. Spalt, H.A. (Southern Illinois University, McIntire Stennis Program, Carbondale, IL, 62901). **Project number:** ILLZ-75-R-032. **Supported by:** Southern Illinois Univ., Carbondale (USA). McIntire Stennis Program. **Funding:** USDA.

Related energy source: biomass(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The Palzo tract is barren of vegetation because of toxic elements solubilized by H2SO4 produced by oxidative weathering of the pyritic spoils. Project objectives are: restore site to stable, healthy, and attractive vegetation; reduce soil erosion; reduce yield of water and improve quality to comply with state and federal standards; and provide a safe haven for wildlife. Herbaceous and woody species will be established on the site that has high biomass and litterfall production. Herbaceous is to be low in ion accumulations to protect wildlife and woody is to be high in ion accumulations to store ions and reduce stream pollution.

Keywords: REVEGETATION; SULFURIC ACID; WILD ANIMALS; HABITAT; WATER POLLUTION; SPOIL BANKS; METABOLISM; TOXICITY; WATER POLLUTION; DECONTAMINATION; LAND RECLAMATION.

176 Effects of Petroleum Hydrocarbons on Marine Organisms. Caldwell, R.S. (Oregon State University, Agricultural Experiment Station, Corvallis, OR, 97331). **Project number:** ORE00365. **Supported by:** Oregon Agricultural Experiment Station, Corvallis (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil and gas(50); oil shales and tar sands(50). **R and D categories:** Operational safety; Environmental control technology; Ecological/biological processes and effects.

The objectives are to 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; examine the possibility that some of the hydrocarbon components may have more than additive toxicity when present together in WSFs; and 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. The approach is to compare the toxicities of actual oil WSFs 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. The method is to expose a suitable test organism to inducing (mixed function oxidase enzymes) petroleum hydrocarbons and then determine effect on physiological thermal adaptation (e.g., upper lethal thermal limit), determine effect of fatty acid composition of biomembranes, and determine effect on fatty acid desaturase activity in vitro.

Keywords: PETROLEUM; PETROLEUM PRODUCTS; TOXICITY; AQUATIC ECOSYSTEMS; BIOLOGICAL EFFECTS.

177 Effect of Disturbance of Forest Habitat by Oil Exploration on Elk. McCullough, D.R. (University of Michigan, School of Natural Resources, Ann Arbor, MI, 48104). **Project number:** MICY00097-F. **Supported by:** Michigan Univ., Ann Arbor (USA). School of Natural Resources; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objective is to quantify the impact of oil exploration and development in forest habitat on the movements and distribution of elk in the Pigeon River State Forest. Signals from radio-collared individuals will give short-term information on the home ranges and shifts in location of individual elk over time. Track counts and pellet surveys will indicate long-term trends in movement patterns as oil drilling activities progress. Changes in forest habitat and scheduling of oil-drilling activities will be related to animal movement throughout the entire state forest and surrounding forested area.

Keywords: PETROLEUM DEPOSITS; EXPLORATION; ENVIRONMENTAL IMPACTS; WILD ANIMALS; HOME RANGE; RANGELANDS; POPULATION DYNAMICS.

178 Design Parameters and Equations for Anaerobic Bioconversion of Organic Wastes. Yang, P. (University of Hawaii, Agricultural Experiment Station, Honolulu, HI, 96822). **Project number:** HAW00528-S. **Supported by:** Hawaii Univ., Honolulu (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to evaluate the rate constants (based on biological concepts) and equations for the design and prediction of production of methane and degree of stabilization of organic waste in the batch, semi-continuous flow with constant solid recycle systems; and investigate the operational stability of constant sludge recycle system at normal and shock loading conditions. 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 or design parameters evaluated from laboratory and pilot scale studies.

Keywords: MANURES; AGRICULTURAL WASTES; SEWAGE SLUDGE; ANAEROBIC DIGESTION; CHEMICAL REACTORS; DESIGN; OPERATION; BIOCHEMICAL REACTION KINETICS; METHANE; BIOSYNTHESIS; STABILIZATION; BENCH-SCALE EXPERIMENTS; PILOT PLANTS; BATCH CULTURE; SEMIBATCH CULTURE.

179 Oil and the Oyster Industry in the Delaware Estuary. Haskin, H.H. (Rutgers University, Agricultural Experiment Station, New Brunswick, NJ, 08903). **Project number:** NJ00782. **Supported by:** Rutgers--the State Univ., New Brunswick, NJ (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to 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. The approach is to expose adult oysters and larvae to petroleum and its products absorbed on fine clay and determine effects 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: OYSTERS; BIOLOGICAL EFFECTS; DELAWARE BAY; ESTUARIES; OIL SPILLS; WATER POLLUTION; PETROLEUM; TOXICITY; SYNERGISM; PETROLEUM INDUSTRY; PETROLEUM PRODUCTS.

180 Pollution Abatement and Energy Considerations in the Processing of Vegetable and Other Food Products. Carroad, P.A. (University of California, Agricultural Experiment Station, Davis, CA, 95616). **Project number:** CAD-FST-3531-H. **Supported by:** California Univ., Davis (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: conservation(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objectives of this program are to investigate and demonstrate the applicability of process modifications to food processing unit operations for pollution abatement and associated energy considerations. Specifically, the recycle of water in a vegetable blanching system will be studied with a goal of attaining steady-state operation, which would facilitate control of effluent, recovery of heat loss, and which may also influence nutritive value of the product. The prediction of freezing times for food will be studied as a prerequisite to energy analysis of freezing. Green vegetables which are industrially blanched in water will be blanched in a pilot plant thermascrew blancher. Water and vegetable conditions will be monitored to demonstrate the practicability of water recycle and to complete a material balance (1977--1978). Later energy and nutrient retention aspects will be considered. Generalization of mathematical models for prediction of freezing times of food will be investigated in plate and air blast freezers with various food types.

Keywords: RECYCLING; FOOD INDUSTRY; FOOD PROCESSING; VEGETABLES; WASTE WATER; ENERGY CONSERVATION; HEAT RECOVERY; FREEZING; ENERGY ANALYSIS; MATHEMATICAL MODELS; FREEZERS; FOOD.

181 Systems Approach to Tobacco Mechanization. Huang, B.K. (North Carolina State University, Agricultural Experiment Station, Raleigh, NC, 27607). **Project number:** NC02504. **Supported by:** North Carolina Agricultural Experiment Station, Raleigh (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: solar(50); conservation(50).

The objectives of this program are to: characterize the biological factors related to producing and processing tobacco; reduce labor and production costs; improve tobacco quality; develop technology for greater modification and control of tobacco properties; optimize use of solar energy in greenhouse bulk curing system; and improve efficiency of tobacco marketing system. Laboratory, field, greenhouse, and computer modeling studies will be performed to: determine optimal conditions for uniform seed germination and seedling growth; identify economic mechanized system for production of high quality transplants and for transplanting; further mechanize and reduce energy requirements for harvesting and curing;

relate process variables of curing to leaf and smoke chemistry for improved quality; study solar energy utilization in a greenhouse bulk curing system; evaluate and compare alternative market systems; further evaluate and test the concept of close-grown tobacco; and develop computer models to optimize production systems.
Keywords: TOBACCO; TOBACCO PRODUCTS; PRODUCTION; SOLAR ENERGY; HARVESTING; MARKETING RESEARCH; GREENHOUSES; FARM EQUIPMENT; OPTIMIZATION; ENERGY CONSUMPTION; COST; AGRICULTURE.

182 USDA Fugitive Dust Emission. Belt, G.H. (University of Idaho, Forest, Wildlife, and Ranges Experiment Station, Moscow, ID. 83843). **Project number:** IDA-ES-0126. **Supported by:** Idaho Univ., Moscow (USA). Forest Wildlife and Range Experiment Station. **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to measure emission of fugitive dust caused by heavy trucks operating on unpaved roads between mine pit and tipple; measure climatological, road surface, vehicle and traffic conditions which influence the emission factors; and incorporate the above variables in 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: TRUCKS; ENVIRONMENTAL EFFECTS; AEROSOLS; DUSTS; MATHEMATICAL MODELS; SAMPLING.

183 Site Planning Factors in Energy Conservation. Strom, S. (University of Wisconsin, Agricultural Experiment Station, Madison, WI, 53706). **Project number:** WIS-02343. **Supported by:** Wisconsin Agricultural Experiment Station, Madison (USA); Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of this program are to: identify those landscape characteristics and microclimatic patterns within the Madison region that will affect, positively or negatively, energy consumption in this built environment; establish site planning guidelines that reflect the findings of the first objective; and provide a data base and source material to establish a course relating site planning to climatology and energy conservation. By the use of a thermal infrared scanner monitor selected sites within the Madison region will be studied. The thermal imagery with respect to specific climatic and land-scale variables will be analyzed to determine microclimatic patterns, relationships, and anomalies. These findings will be applied to the development of site planning guidelines with regard to energy conservation.
Keywords: ENERGY CONSERVATION; SITE SELECTION; PLANNING; RESIDENTIAL SECTOR; CLIMATES; ENERGY CONSUMPTION; INFRARED THERMOGRAPHY; WISCONSIN; RESIDENTIAL BUILDINGS.

184 Study of the Conversion of Agricultural Wastes to Liquid Fuels. Felbeck, G.T. Jr. (University of Rhode Island, Agricultural Experiment Station, Kingston, RI). **Project number:** RI00019. **Supported by:** Rhode Island Univ., Kingston (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to: determine by means of simulation experiments the naturally occurring conditions under which various organic materials could be converted to hydrocarbons; 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 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/sup 7/ 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; LIQUEFACTION; HYDROCARBONS; SYNTHESIS; ORIGIN; PETROLEUM DEPOSITS; DIAGENESIS; CATALYSIS; GEOCHEMISTRY; SEAWATER; EXPLORATION.

185 Characteristics of New Energy Conserving Communities. Hawkes, G.R. (University of California, Agricultural Experiment Station, Davis, CA, 95616). **Project number:** CB-D-AAS-3573H. **Supported by:** California Univ., Berkeley (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(100).

The objectives are to identify the personal and environmental characteristics which promote energy and resource conservation and/or the early adoption of innovative or alternative technology; and compare the actual energy requirements of households in communities designed to be low energy and resource consuming to that of households in traditional developments. Residents will be surveyed (using a structured interview) regarding: demographic characteristics, consumer choices, transportation, behavior, leisure activities, and their attitudes, interests and opinions of the current resource and energy situation. In addition, the study would note any significant changes in resident composition or characteristics during the three years. Other methods are to monitor the actual gas and electrical consumption of the households through the use of utility company records; observe the interactions and development of any homeowner's or resident's association and note the apparent impacts of such interactions upon resident conservation behavior; and interview developers, planning commission members, design review board members involved in the political and infrastructure aspects of project implementation.
Keywords: COMMUNITIES; ENERGY CONSERVATION; ENVIRONMENTAL EFFECTS; ENERGY SOURCES; LIFE STYLES; SOCIO-ECONOMIC FACTORS; ENERGY CONSUMPTION; RESIDENTIAL BUILDINGS.

186 Solar Energy Collection, Storage, and Utilization for the Improvement of Livestock and Crop Production. Dale, A.C. (Purdue University, Agricultural Experiment Station, Lafayette, IN, 47907). **Project number:** IND46015. **Supported by:** Purdue Univ., Lafayette, IN (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: solar(75); conservation(25).

The objective is to develop solar energy collection systems, solar energy storages, and procedures for the utilization of solar energy to modify the environment for the improvement of both animal and crop production in cold and hot weather. An insulated solar energy collector will be fabricated with reflectors to concentrate the solar energy. The reflectors will be placed at the top and bottom of the collector at such an angle so as to reflect additional solar energy into the collector to improve efficiency. Air will serve as the energy exchange medium between the collector and storage field. The solar heated air will be blown through pipe in an insulated energy storage field of soil and groundwater at a depth of eight feet for transfer of the heat to these materials. Starting in late August or early September, the collector will be placed in operation to build up the stored energy for use in heating animal shelters, shelters, greenhouses and farm houses in the winter. The stored heat will be recovered in a similar manner to which it was added to the soil and groundwater storage with the energy first being used to heat a greenhouse.
Keywords: DOMESTIC ANIMALS; CROPS; PRODUCTIVITY; SEASONAL VARIATIONS; WEATHER; PLANTS; SOLAR COLLECTORS; FABRICATION; GREENHOUSES; HOUSES; SOLAR ENERGY; AGRICULTURE; SOLAR SPACE HEATING; STORAGE; HEAT TRANSFER.

187 Development and Evaluation of Vegetation Sampling on Areas Subject to Open-Pit Mining. Bonham, C.D. (Colorado State University, Agricultural Experiment Station, Fort Collins, CO, 80521). **Project number:** COL-00190. **Supported by:** Colorado State Univ., Fort Collins (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objectives are to determine vegetation measures for premining conditions; determine appropriate methods for obtaining measurements from vegetation types for pre-mining conditions; and develop methods for detecting 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; BASELINE ECOLOGY; PLANTS; LAND RECLAMATION; ENVIRONMENTAL IMPACTS; PREFERRED SPECIES.

188 Economic Impact of Coal Mining and Use on Agriculture and Natural Resources, Appalachia and Central States. Whetzel, V. (West Virginia University, Agricultural Experiment Station, Morgantown, WV, 26506). **Project number:** WVA-00170. **Supported by:** West Virginia Univ., Morgantown (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Integrated assessment.

The objectives are to facilitate cooperation in preparing regional reports on coal resources and mining, land, air, and water affected by coal mining and use, and on agricultural economic implications for future resource use, resource competition and environmental quality resulting from alternative types and levels of coal mining and use in Appalachia and the Central States. The approach is to prepare regional profile reports, including parts thereof on coal resources, land and water resources affected, mined-land reclamation problems and issues, coal transportation and utilization patterns, plans and projections, and implications of the above for agriculture, resource management and public policy.

Keywords: COAL MINING; SURFACE MINING; ENVIRONMENTAL IMPACTS; ECONOMIC IMPACT; AGRICULTURE; APPALACHIA; CENTRAL REGION; LAND RECLAMATION; WATER RESOURCES; LAND USE.

189 Direct Seeding of Commercial Forest Trees on Surface Mine Spoil. Graves, D.H.; Carpenter, S.B.; Wittwer, R.F. (University of Kentucky, Agricultural Experiment Station, Lexington, KY, 40506). **Project number:** KY01208. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objectives are to 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; determine effects of cultural practices such as liming, fertilization, mulching, and mixed species seeding on the success of broadcast seeding; and determine the effects of grass-legume seeding mixtures on the establishment of forest tree species by direct seeding. The approach is to 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; combine liming, mulching, fertilization of small and large plot tests; and 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 seeding development--emergence, survival, and early growth.

Keywords: SPOIL BANKS; REVEGETATION; PREFERRED SPECIES; TREES; CULTIVATION TECHNIQUES; SURFACE MINING; COAL MINING; LAND RECLAMATION.

190 Improving Estimates of Sodium Hazard of Coal Surface-Mined Overburden. Berg, W.A. (Colorado State University, Agricultural Experiment Station, Fort Collins, CO, 80521). **Project number:** COL-01469. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to: determine the change in sodium hazard of western surface-mined coal overburden upon exposure to the atmosphere and subsequent weathering; and determine 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: COAL MINING; SURFACE MINING; OVERBURDEN; WEATHERING; SODIUM; PERMEABILITY; SOIL CHEMISTRY; SAMPLING; ENVIRONMENTAL TRANSPORT.

191 Water Harvesting Parameters on Saline Media Under Arid Conditions. McKell, C.M. (Utah State University, Agricultural Experiment Station, Logan, UT, 84321). **Project number:** VTA-00767. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to determine the quantity of harvested water and salt concentration in relation to surface stabilization treatments; determine the ratio of catchment slope area to terrace planting area for effective plant establishment in an arid region; determine the quality of harvested water from a saline media surface; and determine hydrologic characteristics of processed oil shale. A series of 1 x 2 m field plots on a 1:4 slope of processed oil shale will be treated with various surface stabilizers. Subsequently the plots will receive simulated rainfall treatments typical of summer short-duration intense rainstorms. Water quantity and quality will be measured. A series of three physical models of an oil shale disposal pile will be constructed with a 2 meter 1:4 slope catchment area and a 1 meter wide planting terrace area. These models will be instrumented for moisture and salinity measurement plus surface runoff and leachate. Water and salt movements in the oil shale mass will be mathematically modeled.

Keywords: OIL SHALES; SPOIL BANKS; WASTE DISPOSAL; LAND RECLAMATION; WATER POLLUTION; SALTS; SALINITY; WATER RESOURCES; ENVIRONMENTAL IMPACTS; OIL SHALE INDUSTRY.

192 Establishment, Composition and Productivity of Species Adapted to Areas Disturbed by Strip Mining. Wiesner, L.E. (Montana State University, Agricultural Experiment Station, Bozeman, MT, 59715). **Project number:** MONB-00375. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to evaluate the productivity and composition change of native species recently established on mine spoils; evaluate naturalized species to determine their establishment and productivity characteristics; continue to develop methods for overcoming seed dormancy of species which show promise for use in reclaiming mine spoils; and evaluate the buildup of a dormant seed population on reclaimed areas in comparison to that present in undisturbed areas. Research plots established in 1976 will be evaluated to determine the 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; COAL MINING; REVEGETATION; SPOIL BANKS; LAND RECLAMATION; PLANTS; PREFERRED SPECIES; SEEDS.

193 Flexible Cultural Practices for Establishment of Perennial and Annual Vegetation on Topsoiled Strip Mining. Wiesner, L.E. (Montana State University, Agricultural Experiment Station, Bozeman, MT, 59715). **Project number:** MONB-000376. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to assess the capabilities of several annual and perennial crop species to function as barriers for the trapping and retention of winter snowfall; 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; monitor species composition changes associated with increased snow cover and increased soil moisture and reduced winter exposure on barrier vs. nonbarrier sites; utilize annual nurse crops, stubble seeding techniques and frost seeding techniques; determine their impact on the success of perennial forage seedings on spoils materials; 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 frobs 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. A portion of the stockpiled topsoil will be seeded with several green manure crops.

Keywords: SURFACE MINING; REVEGETATION; LAND RECLAMATION; SEEDS; PREFERRED SPECIES; COAL MINING; PLANT GROWTH; SPOIL BANKS.

194 Soil Amendments and Artificial Revegetation for Modification of Drastically Disturbed Land Areas. Carpenter, S.B. (University of Kentucky, Agricultural Experiment Station, Lexington, KY, 40506). **Project number:** KY00611. **Supported by:** Kentucky Univ., Lexington (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to develop revegetation techniques for the stabilization and improvement of economic productivity of drastically disturbed land areas; study moisture stress and its effect on the growth of trees and associated plants on drastically disturbed land areas; determine the cost of the various combinations of revegetation and soil modification techniques; and 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: SPOIL BANKS; REVEGETATION; PREFERRED SPECIES; SURFACE MINING; LAND RECLAMATION; TREES; COST; SOILS; COMPUTER SIMULATION; COAL MINING.

195 Environmental Impact of Energy Resource Utilization on Limited-Source Farms in Rural North Carolina. Chen, D.Y. (Agriculture and Technical University of North Carolina, Greensboro, NC, 27412). **Project number:** NC-X-PR-007-20095. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100).

The objectives of this program are to: construct energy uilization coefficients by farm operations and household consumption based on first-hand data; study the environmental impact of energy resource usage on farms; map strategies for conservation and management of energy resource under varying availability; and provide estimates as basis for comparison of state and federal agencies. Along with the establishment and execution of the administrative necessities, starting from the creation of a viable environment for research down to report writing and distribution, this research will be conducted in an area encompassing 14 to 18 western rural North Carolina counties, with the following major enterprises in mind: dairy, beef, burley tobacco, Irish potatoes, silage corn, and hay. Basic statistical techniques are considered to be in the realm of production function estimation, rgression analysis and/or linear programming.
Keywords: FARMS; HOUSES; ENERGY CONSUMPTION; NORTH CAROLINA; AGRICULTURE; ENERGY CONSERVATION; CROPS; PRODUCTION; ENVIRONMENTAL IMPACTS; NUMERICAL SOLUTION.

196 Economic Impacts of Coal Mining in Eastern Oklahoma. Salkin, M.A. (Oklahoma State University, Agricultural Experiment Station, Stillwater, OK, 74074). **Project number:** OKL-01674. **Supported by:** Oklahoma State Univ., Stillwater (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to estimate the quantity and value of current, past, and future coal production in Oklahoma and evaluate production characteristics of Oklahoma coal mining; estimate the demand for Oklahoma coal including an analysis of factors responsible for current demand and potential future uses; estimate local, regional, and statewide social and economic impacts caused by mining; estimate the agricultural uses of the land and resulting values before and after the land is mined and reclaimed; determine the change in public services required as a result of mining and reclamation; and 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: COAL MINING; ECONOMIC IMPACT; OKLAHOMA; COAL; DEMAND FACTORS; SOCIAL IMPACT; LAND USE; INPUT-OUTPUT ANALYSIS; LAND RECLAMATION.

197 Producer Gas as a Petroleum Substitute. Gunkel, W.W. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-123423. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: fossil fuels(50); other advanced(50).

The objectives are to critically examine the known technology of making producer gas; determine the feasibility of using this technology to reduce the dependence of agriculture in the Northeast on conventional fuel sources; design, construct, and test a producer gas system including gas generator, filter, heat exchanger, fine filter, and engine; and 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 an internal combustion engine. Operational characteristics of the system will be measured and any particular problem identified and corrected.
Keywords: PRODUCER GAS; FUEL SUBSTITUTION; PRODUCTION; GAS GENERATORS; FOSSIL FUELS; ELECTRIC POWER.

198 Acid Forming Minerals in Overburden and Lignite as They Relate to Successful Reclamation. Hossner, L.R. (Texas A and M University, Agricultural Experiment Station, College Station, TX, 77843). **Project number:** TEX-06351. **Supported by:** Cooperative State Research Service, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to 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; characterize the acid producing minerals in terms of species, external morphology, surface area and reactivity; determine minerals present in representative mine spoil and lignite overburden materials and characterize their properties during acidification; monitor active or pilot strip mining operations in the state to determine acid production of spoil and potential of leveled spoil for revegetation; and 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: LAND RECLAMATION; OVERBURDEN; SPOIL BANKS; REVEGETATION; SURFACE MINING; ENVIRONMENTAL IMPACTS; COAL MINING; LIGNITE; MINERALS.

199 Behavioral Effects of Coal Conversion Products. Kernan, W.J. (Iowa State University, School of Veterinary Medicine, Ames, IA, 50011). **Project number:** IOWV-429-23-04. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA). Coll. of Veterinary Medicine; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

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: FOSSIL-FUEL POWER PLANTS; EMISSION; FLUE GAS; MERCURY; LEAD; BIOLOGICAL EFFECTS; MONKEYS; BEHAVIOR; RESPONSE MODIFYING FACTORS; AIR POLLUTION; ENVIRONMENTAL IMPACTS; HEALTH HAZARDS.

200 Behavioral Effects of Coal Conversion Products. Buck, W.B. (Iowa State University, School of Veterinary Medicine, Ames, IA, 50011). **Project number:** IOWV-429-23-03. **Supported by:** Iowa State Univ. of Science and Technology, Ames (USA). Coll. of Veterinary Medicine; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

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Keywords: FOSSIL-FUEL POWER PLANTS; EMISSION; FLUE GAS; MERCURY; LEAD; BIOLOGICAL EFFECTS; MONKEYS; BEHAVIOR; RESPONSE MODIFYING FACTORS; AIR POLLUTION; ENVIRONMENTAL IMPACTS; HEALTH HAZARDS.

201 Use of Anaerobically Digested Sludge for Reclamation of Strip Mined Soils as Pasture Lands. Fitzgerald, P.R. (University of Illinois, School of Veterinary Medicine, Urbana, IL, 61801). **Project number:** ILLV-CVM-030-351. **Supported by:** Illinois Univ., Urbana (USA). Coll. of Veterinary Medicine; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are to monitor level of parasitism in cattle grazing on forage irrigated with anaerobically digested sludge; determine the quantities of heavy metals, chemical, or other contaminants translocated to soil, forage and animal tissues; determine the possibility of transmission and/or survival of trichinella spiralis larvae through the anaerobic digestion process; and determine survival and transmissibility of parasite ova through anaerobic digesters to susceptible animals. Anaerobically digested sludge from the Chicago Metropolitan Sanitary District of Greater Chicago will be spread on strip-mined land owned by the district in Fulton County, Illinois. Control and experimental herds of cattle will be allowed to graze on forage irrigated with the sludge. Animals will be observed for evidence of toxicity daily and a number of each group will be necropsied each year for tissues. Heavy metals analysis will be conducted on soil, forage, and animal tissues to determine whether there is significant accumulation that might affect the health of plants or animals. Laboratory studies will be conducted on the survival rates of helminth organisms through the sewage digestion processes.
Keywords: WASTE PRODUCT UTILIZATION; RECYCLING; ANAEROBIC DIGESTION; SURFACE MINING; SOILS; LAND RECLAMATION; REVEGETATION; HELMINTHS; CATTLE; SEWAGE SLUDGE; BIOLOGICAL EFFECTS; TOXICITY; GROUND DISPOSAL; METALS; IRRIGATION; FOOD CHAINS; CHEMICAL EFFLUENTS; METALS; ENVIRONMENTAL TRANSPORT; LAND POLLUTION; SURVIVAL CURVES; PLANTS; TRICHINELLA.

202 Environmental Implications of Heterotrophic Microbial Methane Oxidation. Weaver, T.L. (Cornell University, Agricultural Experiment Station, Ithaca, NY, 14850). **Project number:** NYC-144420. **Supported by:** Cornell Univ., Ithaca, NY (USA). Agricultural Experiment Station; Department of Agriculture, Washington, DC (USA). **Funding:** USDA.
Related energy source: biomass(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objectives are to examine the effects of heterotrophic microbial methane oxidation in soil and water; investigate the involvement of this biological process in denitrification and carbon cycling; examine the microorganisms involved in this process and the interactions between these microorganisms and the soil and water environments; evaluate quantitatively the relative importance of this process in soil and water quality; and 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; ENVIRONMENTAL EFFECTS; BIODEGRADATION; MICROORGANISMS; CARBON CYCLE; DENITRIFICATION.

DEPARTMENT OF COMMERCE

12001 Radiological Pollutants Quality Assurance. Hutchinson, J.M.R. (National Bureau of Standards, Radioactivity Section, Building 245, Room C114, Washington, DC, 20234). **Project number:** 5325485. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$86,000.
Related energy source: fossil fuels(60); coal(40). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

12002 Energy Related Air Pollutant Analysis Instrumentation. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80 BCLb. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to develop instrumental methods for the measurement of particulate sulfate including the development and evaluation of sulfur aerosol generators needed to characterize such instruments. The sulfate analyzer is based upon a combination of electrostatic precipitator, mobility analyzer and flame photometric. A prototype instrument for the continuous and in-situ measurement of particulate sulfate has been developed and has undergone preliminary field evaluation. New burner configurations will be evaluated to provide faster response times for the flame photometric detection of sulfur. A fast response gas and particulate-phase sulfur detection system will be developed and characterized and a final report issued. In parallel sulfate aerosol generators will be characterized with respect to chemical and physical properties for aerosols in the micron and sub-micron size range.
Keywords: AIR POLLUTION; MONITORING; AEROSOLS; SULFATES; PHOTOMETRY; ELECTROSTATIC PRECIPITATORS; MEASURING INSTRUMENTS; SULFUR; AEROSOL MONITORING.

12003 Energy Related Water Pollutant Standard Reference Materials. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80 BCMa. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$300,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to provide the means for the accurate measurement of water pollutants likely to occur with energy production. The pollutants of concern include organic substances, suspended particulates and trace elements. Measurements include the determination of concentrations of pollutants in water, sediments, and biota. The trace elements under consideration include Hg, Zn, Cu, Cd, Ag, Al, Be, As, Se, Cr, Co, Ba, Fe, Mn, Pb, Sr, and V. Organics include aliphatic and aromatic hydrocarbons and polar organic compounds. Standard Reference Materials (SRMs) certified for trace element and trace organic composition will be developed and used for validation of existing measurement methods. A series of workshops have been held to determine the most useful SRMs associated with potentially polluting energy sources and production. Work is in progress in the areas of: (I) toxic and trace metals analysis including (1) certification of an ocean sediment Standard Reference Material (SRM), (2) feasibility study for estuarine and/or seawater SRM, and (3) anion in water SRM; (II) organic analysis including the development of SRM's for polynuclear aromatic hydrocarbons and phenols in water and feasibility studies for an SRM for petroleum in marine sediment and biota; and (III) calibration guidelines and handbooks for water flow measurement.
Keywords: WATER POLLUTION; MONITORING; SAMPLING; AEROSOLS; TRACE AMOUNTS; SEDIMENTS; BIOLOGICAL MATERIALS; ORGANIC COMPOUNDS; MERCURY; ZINC; COPPER; CADMIUM; SILVER; ALUMINIUM; BERYLLIUM; ARSENIC; SELENIUM; CHROMIUM; COBALT; BARIUM; IRON; MANGANESE; LEAD; STRONTIUM; VANADIUM; AROMATICS; HYDROCARBONS; STANDARDS; SEAWATER; PHENOLS; FLUID FLOW; WATER; CALIBRATION.

12004 Energy Related Air Pollutant Standard Reference Materials. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80 BCLa. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$416,000.
Related energy source: fossil fuels(85); coal(10); oil shales and tar sands(5). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to provide the means for the accurate measurement of sulfur dioxide, nitrogen dioxide, carbon monoxide, particulates and other pollutants likely to result from energy produc-

tion. The methods employed are to: (1) develop Standard Reference Materials (SRMs) for use in the validation of pollutant measurement methods and instruments; and (2) develop SRMs characteristic of raw materials used in combustion processes in order to validate measurement methods used to analyze fuel prior to combustion. By assesing the performance of measurement methods on certified SRMs whose properties are accurately known, sources of error in the measurement methods can be identified and the effects of error can be reduced. Several gas cylinder SRMs have been eveloped for SO2, NO2 and NO at stationary source concentrations. Additional stationary source SRMs will be issued in the future. The feasibility of developing cylinder SRMs for ambient concentrations of SO2 and NO2 is being investigated. Particulate SRMs under development include a well characterized urban particulate bulk sample, aerosol generators, film standards for x-ray fluorescence analysis, and a glass fiber filter standard containing lead, sulfate and nitrate. Both coal conversion and oil shale materials are being evaluated as bulk SRMs.
Keywords: AIR POLLUTION; MONITORING; SULFUR DIOXIDE; NITROGEN DIOXIDE; CARBON MONOXIDE; AEROSOLS; STANDARDS; MEASURING METHODS; MEASURING INSTRUMENTS; ERRORS; NITRIC OXIDE; X-RAY FLUORESCENCE ANALYSIS; SAMPLING; FILTERS; COAL; OIL SHALES; EVALUATION.

12005 Reactor Control Room Infiltration. Hunt, C.M. (National Bureau of Standards, Center for Building Technology 742, Washington, DC, 20234). **Project number:** 742-4419. **Contract:** AT(49-24)-0105;NRC-03-78-159. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Site Safety and Environmental Analysis. **Funding:** NRC-$21,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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 that has been treated to remove contaminants. The project is set up to assess the applicability of SF6 methodology to assess the leak tightness of control rooms and their associated ductwork.
Keywords: NUCLEAR POWER PLANTS; CONTROL ROOMS; LEAK TESTING; LEAKS.

12008 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:** NBS-$225,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

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.

12010 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:** NBS-$125,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

12020 Energy Related Water Pollutant Analysis Instrumentation. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80BCKa. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$200,000.
Related energy source: fossil fuels(60); coal(30); oil and gas(10). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to provide means for the accurate measurement of water pollutants likely to occur with energy production. The pollutants of concern include organic substances, suspended particulates and trace elements. Measurements include the determination of concentrations of pollutants in water, sediments, and biota. The trace elements under consideration include Hg, Zn, Cu, Ag, Al, Be, As, Se, Cr, Co, Ba, Fe, Mn, Pb, Sr, and V. Organic include aliphatic and aromatic hydrocarbons and polar organic compounds. Marker compounds, organic compounds characteristic of particular sources, will be investigated as a means for characterizing and quantifying the pollution associated with particular sources. Liquid chromatography-mass spectrometry will be investigated as a means of quantifying polar organic pollutants. Ion microprobe techniques will be investigated for applicability to determine the elemental profile of individual suspended particulates and organic layers on flat surfaces. The ion-microprobe work will include the evaluation of the chemical ionization duoplasmatron ion source. The applicability of selection and general liquid chromatography detectors (cerium oxidation, electrochemical) to the analysis of hydroxylated PAH's and other polar organics will be investigated. Finally, studies will be conducted on the chemical speciation of Cr, Hg, and Sn in water and sediments.
Keywords: WATER POLLUTION; MONITORING; WATER QUALITY; WATER POLLUTION MONITORS; WATER; SEDIMENTS; AQUATIC ORGANISMS; MERCURY; ZINC; COPPER; CADMIUM; SILVER; ALUMINIUM; BERYLLIUM; ARSENIC; SELENIUM; CHROMIUM; COBALT; BARIUM; IRON; MANGANESE; LEAD; STRONTIUM; VANADIUM; POLYCYCLIC AROMATIC HYDROCARBONS; TIN; ECOLOGICAL CONCENTRATION.

12021 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$65,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

12023 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. (U.S. National Bureau of Standards, Washington, DC, 20234). **Project number:** 5323482. **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:** Operational safety; Characterization, measurement, and monitoring.

A data base will be 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 will be 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.

12026 Building Infiltration Evaluation. Hunt, C.M. (National Bureau of Standards, Center for Building Technology 742, Washington, DC, 20234). **Project number:** 742-6543. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). Office of Building and Community Systems. **Funding:** DOE-$100,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The purpose of this program is to test equations for calculating air leakage rates in high-rise buildings. The air leakage in the tower of NBS Administration Building and other high-rise buildings will be determined by measuring the decay rate of an SF6 tracer. Concurrent measurements of weather parameters and inside--outside temperature will be made. Thermal draft and flow resistance of the building envelope will be measured, and Shaw--Tamura equations for predicting the air leakage rate of this type of building will be tested. If the Shaw--Tamura model for predicting air infiltration in high-rise buildings can be validated, it will provide an important tool for mathematical simulation of air exchange rates in this type of building. Study will also provide direct measurements of ventilation rates due to building leakage.
Keywords: PUBLIC BUILDINGS; TRACER TECHNIQUES; LEAK TESTING; MATHEMATICAL MODELS; VENTILATION; RESEARCH PROGRAMS; HEAT LOSSES; AIR INFILTRATION; OFFICE BUILDINGS.

12027 Organic Fine Particulate Standard Reference Materials for Atmospheric Measurements Associated with Coal-Fired Power Plants. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80 BCLc. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Our over-all objective is to develop an organic fine particulate standard reference material (SRM) for ambient air pollution measurements associated with coal-fired power plants. The objective is to characterize this standard with respect to anthropogenic vs. natural components. A radiocarbon measurement system which can be applied to fine particles will be developed and validated. In cooperation with University of Utah Research Inst. and/or EPA at Research Triangle Park atmospheric fine particles will be collected. Chemical methods will be developed to separate the insoluble carbonaceous material. A homogeneous sample (Candidate SRM) of carbonaceous material will be characterized for carbon-14. Selected environmental samples will be run by 14-C and GC-MS to establish or validate carbonaceous pollutant particle source detection.
Keywords: FOSSIL-FUEL POWER PLANTS; PARTICLES; RADIOISOTOPES; EARTH ATMOSPHERE; CARBONACEOUS MATERIALS; STANDARDS; AIR POLLUTION; MONITORING; CARBON 14; GAS CHROMATOGRAPHY; MASS SPECTROSCOPY.

12028 Organic Standard Reference Materials for Calibration of Energy Related Water Pollutants Measurement Methods. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80 BCMb. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA. **Related energy source:** coal(75); oil shales and tar sands(25). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to develop organic Standard Reference Materials (SRM's) for the calibration of Energy Related Water Pollutants Measurement Methods. This project is concerned primarily with the influence associated with the following energy technologies; low-Btu, in-situ; coal gasification, oil shale and leachate from coal fly ash ponds. Priority list, organic SRM's associated with these energy technologies will be developed in consultation with EmSL/Cincinnati. These ability studies will be initiated on the development of analytical techniques and certification of organic SRM's identified above. Test samples will be obtained to evaluate analytical methods and candidate SRM's.
Keywords: CALIBRATION STANDARDS; WATER POLLUTION; COAL INDUSTRY; ENVIRONMENTAL IMPACTS; MEASURING METHODS; COAL GASIFICATION; FLY ASH; OIL SHALE INDUSTRY; LEACHING; ORGANIC COMPOUNDS; MONITORING.

12029 Development Measurement Methods for Non-Volatile Organic Pollutants in Water. Gravatt, C.C. (National Bureau of Standards, Office of Environmental Measurements, Washington, DC, 20234). **Project number:** 80 BCKb. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
Related energy source: coal(80); oil shales and tar sands(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to develop accurate methods for the measurement of non-volatile organic pollutants in water effluents associated with the following energy technologies: low Btu and in-situ coal gasification, oil shale and leachate from coal fly ash pond. A survey will be made of the following potential methods: (1) Raman and Micro-Raman detection for gas chromatography and liquid chromatography; (2) immunochemical techniques; (3) liquid chromatography with mass spectrometric detection; (4) liquid chromatography with electron capture detection; (5) ion probe analysis; and (6) coherent anti-stokes Raman spectroscopy (CARS). Based on this survey and ensuing discussions with EPA's Environmental Sciences Research Laboratory in Athens, high priority methods will be selected for further instrumentation development.
Keywords: WATER POLLUTION; COAL GASIFICATION; OIL SHALE INDUSTRY; FLY ASH; CHROMATOGRAPHY; GAS CHROMATOGRAPHY; ION MICROPROBE ANALYSIS; RAMAN SPECTRA; ORGANIC COMPOUNDS; MONITORING; IMMUNOLOGY; MASS SPECTROSCOPY.

13001 OCSEAP (Outer Continental Shelf Environmental Assessment Program) Data Base Management Support. Audet, J.J. Jr. (National Oceanic and Atmospheric Administration, 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:** NOAA-$450,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

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 maintained upon request.
Keywords: SEAS; AQUATIC ECOSYSTEMS; DATA ACQUISITION; COMPUTERS; ALASKA; CONTINENTAL SHELF; COMPUTER GRAPHICS; DATA PROCESSING; BASELINE ECOLOGY.

13003 Data Management and Archival Services for Interagency Energy Related Marine Programs. Mitchell, F.J. (National Oceanographic Data Center, 2001 Wisconsin Avenue, NW, Washington, DC, 20235). **Project number:** I-AP-77BFA. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Research and Development. **Funding:** EPA-$20,000.
R and D categories: Integrated assessment.

The objectives are to: (1) operate, monitor and define data management system for baseline and pollutant content of ocean waters: (2) interact with agencies (and principal investigators) gathering data and provide formats, acquire data and design data management and information system; and (3) publish plan of system showing methods of user contact and specifics of data and information held.
Keywords: AQUATIC ECOSYSTEMS; SEAS; DATA COMPILATION; DATA TRANSMISSION; OCEANOGRAPHY; ENVIRONMENT.

13005 OCS Base Line Studies. Picciolo, A.R. (DOC/NOAA, Environmental Data and Information Service (EDIS), 2001 Wisconsin Avenue, NW, Washington, DC, 20235). **Project number:** 8E1639. **Supported by:** National Oceanographic Data Center, Washington, DC (USA). **Funding:** NOAA-$30,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

13008 Summarization and Interpretation of Historical Physical Oceanographic and Meteorological Information for the Mid-Atlantic Region. Godshall, F.A.; Williams, R.G. (National Oceanic and Atmospheric Administration, Environmental Data and Information Service, Marine Environmental Assessment Division, 3300 Whitehaven Street, NW, Page Building 2, Room 162, Washington, DC, 20235). **Project number:** RE1201. **Supported by:** Bureau of Land Management, Washington, DC (USA). **Funding:** BLM.
Related energy source: fossil fuels(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are: (1) to compile the historic meteorological and physical oceanographic data necessary to characterize the Mid-Atlantic region between the coast and the 2000m isobath, and between 36 degrees N and 41 degrees N for the purpose of developing offshore baseline information and to provide input to trajectory prediction models in conjunction with offshore oil and gas developments; and (2) to make recommendations for additional physical oceanographic and meteorological field measurements to remedy data deficiencies. Required physical oceanographic and meteorological analysis products, obtained from available federal sources and from other selected institutional files, will be designed and produced. The adequacy of the available observational data base in meeting specific program requirements, such as trajectory predictions, will be evaluated. On-going and planned observational programs will be reviewed in light of the historic data base analysis. Specific recommendations for the design and strategy of future observational sampling programs will be formulated. Statistics on data amount and distributions, together with a statistical analysis of the data itself, are presented, with emphasis on the natural distribution and variability of relevant parameters. The data and analysis products are given in formats most suitable for user application, such as monthly or seasonal tabulations, histograms, charts, contour plots, etc. Graphic and tabular presentations are accompanied by interpretive discussions and conclusions, regarding, e.g., surface winds and waves, circulation patterns, and water column structure.
Keywords: OCEANOGRAPHY; METEOROLOGY; ATLANTIC OCEAN; OFFSHORE OPERATIONS; DATA ACQUISITION; SEASONAL VARIATIONS; DATA ANALYSIS; DESIGN; SAMPLING.

13009 Environmental Assessment of Northern Puget Sound and the Strait of Juan de Fuca. Harris, H.S. (NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA, 98115). **Project number:** B7121278. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Research and Development. **Funding:** EPA-$850,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to provide the ecological data required for making management decisions concerning regional development and for assessing the potential impact of petroleum hydrocarbons on the ecosystem. Specifically, objectives are to: (1) characterize the major marine biological populations subject to impact by pollution resulting from petroleum transportation and refining; (2) determine the existing distribution and concentration of pollutants within the ecosystem which are associated with refinery effluent and petroleum; (3) characterize the principal processes and major pathways by which petroleum moves through the marine ecosystem; and (4) provide decisionmakers with environmental and ecological information and predictions of the effects of oil-related activities upon the ecosystem. The results of this research will be immediately applicable to decisions on the location of deepwater ports, expansion of refinery capacity at existing sites versus the development of new sites, and the regulation of tanker traffic in parts of the Sound. Investigations will be based on existing ecological and environmental data augmented by field and laboratory investigations. Priority will be given to evaluating the ecological factors at risk from the instantaneous release of a large volume of oil. Second priority will be given to the ecological factors at risk from the chronic effects associated with transport, transfer, and processing of oil and oil products. Products will include: (1) description of existing ecological and environmetal conditions; (2) the present occurrence and variability of petroleum related pollutants; (3) a state-of-the-art oil spill trajectory model for northern Puget Sound and the Strait of Juan de Fuca; and (4) estimates of biologic effects and recovery following an oil spill.
Keywords: PUGET SOUND; POLLUTION; AQUATIC ORGANISMS; PETROLEUM; ENVIRONMENTAL EFFECTS; CHEMICAL EFFLUENTS; AQUATIC ECOSYSTEMS; MATHEMATICAL MODELS; REFINING; BIOMASS; HYDROCARBONS; OIL SPILLS; TOXICITY; BASELINE ECOLOGY.

13010 Atmospheric Turbulence and Diffusion Research. Gifford, F.A. (National Oceanic and Atmospheric Administration, Air Resources Atmospheric Turbulence and Diffusion Lab., P.O. Box E, Oak Ridge, TN, 37830). **Project number:** 8AC43040. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). **Funding:** NOAA-$109,000.
Related energy source: fossil fuels(20); nuclear fuels(general)(20); geothermal(20); solar(20); biomass(20). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to characterize boundary layer atmospheric transport, diffusion, and surface removal of waste products of energy generation, to scales of 200 km distance, including waste heat effects. Physical and mathematical modeling, and boundary layer structure observations will be used. The results from this project are in the form of mathematical and physical models describing atmospheric transport and diffusion of energy wastes, the effects of waste heat on the atmosphere, and the structure of the atmospheric boundary layer. These results are directly applicable to environmental impact studies, to federal environmental regulations, to the design and siting of power plants, and to the study of atmospheric effects of energy generation.
Keywords: AIR; TURBULENCE; DIFFUSION; BOUNDARY LAYERS; GASEOUS WASTES; SOLID WASTES; TRANSPORT; WASTE HEAT; MATHEMATICAL MODELS; STRUCTURAL MODELS; ENERGY; PRODUCTION; AIR POLLUTION.

13011 Fate and Effects of Petroleum Hydrocarbons and Selected Toxic Metals in Marine Ecosystems and Organisms. Wolfe, D.A. (NOAA Environmental Research Laboratories, OCS Environmental Assessment Program, Boulder, CO, 80302). **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$425,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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: PETROLEUM; HYDROCARBONS; METALS; AQUATIC ECOSYSTEMS; TOXICITY; ENVIRONMENTAL EFFECTS; POLLUTION; ENVIRONMENTAL TRANSPORT; OIL SPILLS; BIOMASS; SITE SELECTION; BASELINE ECOLOGY.

13014 Lidar Techniques for Measuring Particulate Pollutant from Energy Production and Their Transport and Dispersion Processes. Derr, V.E. (DOC/NOAA, Environmental Research Labs., Wave Propagation Lab., Boulder, CO. 80302). **Project number:** EPA-IAG-D5-0693. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$175,000.
Related energy source: fossil fuels(70); nuclear fuels(general)(20); wind(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The project involves two tasks. The first is to develop economical lidar measurement techniques (optical backscatter intensity) for remote tracing and analyzing of pollutants arising from extrac-

tion and power production. The second task is to develop and test a Doppler lidar (remote velocity sensor) for high resolution measurements of atmospheric wind and turbulence aspects of pollutant transport. We are developing techniques and equipment for pollutant identification and transport processes by modifying NOAA lidar hardware. Modifications based on scattering theory are tested in a field environment. Analysis of the field tests leads to further technique refinement for characterizing aerosols and measuring their transport. The output includes lidar devices, techniques, and understanding to specify cost-effective ground and aircraft systems that characterize ambient and source aerosols by shape and refractive index, and that track their transport and diffusion. Thus far we have demonstrated differentiation of mine dust and fly ash by different depolarization characteristics in backscatter. We have tracked the plume from a coalfired power plant when it was not visible to the eye. We have measured ambient wind profiles, wind around obstructions, and stack effluent velocity.
Keywords: FOSSIL FUELS; POLLUTION; AEROSOLS; DIFFUSION; ENERGY SOURCES; ENVIRONMENTAL EFFECTS; AIR POLLUTION; PHYSICAL PROPERTIES; REMOTE SENSING; CHEMICAL PROPERTIES; PLUMES; ENVIRONMENTAL TRANSPORT; EARTH ATMOSPHERE; METEOROLOGY; WIND; VELOCITY.

13015 Outer Continental Shelf Environmental Assessment Program. Engelmann, R.J. (National Oceanic and Atmospheric Administration, Environmental Research Labs., 1790 Sussex One Bldg., Room 430, Boulder, CO, 80303). **Project number:** R7120815. **Supported by:** Bureau of Land Management, Anchorage, AK (USA). Alaska Outer Continental Shelf Office. **Funding:** DOI-$19,100,000; NOAA-$6,267,000; EPA/USCG-$695,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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: PETROLEUM INDUSTRY; ENVIRONMENTAL EFFECTS; CONTINENTAL SHELF; ALASKA; TRAJECTORIES; POLLUTION; AQUATIC ECOSYSTEMS; AQUATIC ORGANISMS; OCEANOGRAPHY; SEAS; ENVIRONMENTAL TRANSPORT; HYDROCARBONS; OIL SPILLS; TOXICITY; BASELINE ECOLOGY.

13016 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). **Supported by:** National Oceanic and Atmospheric Administration, Research Triangle Park, NC (USA). **Funding:** EPA-$150,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

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 Areas on the regional air quality. Energy development in the area encompassed by the states of Colorado, Wyoming, Utah, New Mexico, and Arizona will be examined. Up to 70 meteorological, emission, plant siting, and plant characteristics will be examined using the new model.
Keywords: AIR QUALITY; ENERGY SOURCES; ENVIRONMENTAL EFFECTS; FUNCTIONAL MODELS; REGIONAL ANALYSIS; EMISSION; METEOROLOGY; SITE SELECTION; AEROSOLS; CLIMATES; WEATHER; NITROGEN OXIDES; SULFUR DIOXIDE.

13017 Air Pollution Studies. Niemeyer, L.E. (NOAA, Environmental Research Center, Air Resources Laboratories, Meteorology Lab., MD-80, Research Triangle Park, NC, 27711). **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Research and Development. **Funding:** EPA-$2,547,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

During FY-1978 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 improvemet 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; PUBLIC HEALTH; BIOLOGICAL EFFECTS; AIR QUALITY; THERMAL EFFLUENTS; WEATHER; REGIONAL ANALYSIS; FUNCTIONAL MODELS; SIMULATION; ENVIRONMENTAL EFFECTS; EARTH ATMOSPHERE; CLIMATES; WEATHER; METEOROLOGY.

13018 Meteorological Research Development of Long-Range Atmospheric Transport Models. Randerson, D. (Weather Service Nuclear Support Office, P.O. Box 14985, Las Vegas, NV, 89114). **Project number:** RK-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: fossil fuels(75); nuclear fission(20); geothermal(5). **R and D categories:** Physical and chemical processes and effects.

Atmospheric Science and Power Production is a book being prepared for DOE-DBER 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.

13019 Atmospheric Turbulence and Diffusion Research. Gifford, F.A. (Air Resources Atmospheric Turbulence and Diffusion Laboratory, P.O. Box E, Oak Ridge, TN, 37830). **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$585,000; EPA-$123,000.
Related energy source: fossil fuels(25); nuclear fuels(general)(25); geothermal(20); solar(10); biomass(20). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to characterize boundary layer atmospheric transport, diffusion, and surface removal of waste products of energy generation, to scales of 200 km distance, including waste heat effects. The methods employed are physical and mathematical modeling and boundary layer structure observations. The results from this project are in the form of mathematical and physical models describing atmospheric transport and diffusion of energy wastes, the effects of waste heat on the atmosphere, and the structure of the atmospheric boundary layer. These results are directly applicable to environmental impact studies, to federal environmental regulations, to the design and siting of power plants, and to the study of atmospheric effects of energy generation.
Keywords: AIR; TURBULENCE; DIFFUSION; BOUNDARY LAYERS; GASEOUS WASTES; SOLID WASTES; TRANSPORT; WASTE HEAT; MATHEMATICAL MODELS; STRUCTURAL MODELS; ENERGY; PRODUCTION; AIR POLLUTION.

13020 Atmospheric Transport and Dispersion of Pollutants and Related Meteorological Studies. Ferber, G.J. (National Oceanic and Atmospheric Administration, 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: all(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

13021 Meteorological Studies. Van der Hoven, I. (National Oceanic and Atmospheric Administration, Environmental Research Laboratories, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** RD840510. **Contract:** EX-76-A-27-1289. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology. **Funding:** DOE-$250,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

The objectives of the program are to conduct research in meteorological dispersion, to obtain diffusion parameters for a variety of sites, particularly LMFBR program and potential reactor sites; and to make field measurements of downwind tracer gas concentrations and related meteorological parameters over a wide range of distances, terrain, weather conditions and source configurations.
Keywords: METEOROLOGY; DIFFUSION; LMFBR TYPE REACTORS; REACTOR SITES; WEATHER; ENVIRONMENTAL TRANSPORT; CHEMICAL EFFLUENTS; CLIMATES; PLUMES; RADIOACTIVE EFFLUENTS.

13022 Flow of Energy, Cycling of Elements and Effects of Environmental Change in Estuarine and Nearshore Oceanic Ecosystems. Rice, T.R. (National Marine Fisheries Service, Beaufort Lab., SEFC, Beaufort, NC, 28516). **Project number:** EX-76-AA-28-005. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$418,000; NOAA-$355,000.
Related energy source: fossil fuels(25); nuclear fuels(general)(25); ocean thermal(25); conservation(25). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective of this research project is to determine the relationship between fishery and ecosystem productivity in estuarine and coastal habitats of the southeastern United States, and to develop the capability to predict the effects of environmental stress resulting from energy-related activities on ecologically and economically important species. The approach consists of a multi-disciplinary generic research effort which emphasizes field and laboratory studies to determine the flow of energy and the cycling and effects of trace metals in selected coastal-estuarine habitats near Beaufort, NC. Results obtained to date consist of: (1) a description of community structure in critical estuarine habitats, including microbes, invertebrates, rooted aquatic plants, and fishes; (2) documenting the response of fishes to specific power-plant-related stresses; and (3) determining the flux, bioavailability and toxicity of trace metals to marine organisms. Results expected in the future include determination of (1) trophic relationships within different estuarine habitats; (2) the importance of food quality and quantity, predation, and temperature in determining natural mortality rates of selected species of fish during their first year of life; and (3) the identification and quantification of physico-chemical forms of metals controlling productivity, bioaccumulation, and toxicity.
Keywords: AQUATIC ECOSYSTEMS; COASTAL WATERS; ESTUARIES; ATLANTIC OCEAN; CONTINENTAL SHELF; NORTH CAROLINA; FISHES; POPULATION DYNAMICS; NUTRIENTS; FOOD; METABOLISM; MEASURING METHODS; AQUATIC ORGANISMS; THERMAL EFFLUENTS; BIOLOGICAL EFFECTS; MATHEMATICAL MODELS; BIOMASS; INVERTEBRATES; AGE DEPENDENCE; SEDIMENTS; SAMPLING; BACTERIA; RESPIRATION.

13024 Physiological Effects of Arsenic, Cadmium, and Copper on Marine Shellfish. Engel, D.W. (National Marine Fisheries Service, Beaufort Laboratory, Beaufort, NC, 28516). **Project number:** R8C213. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$50,000.
Related energy source: fossil fuels(45); nuclear fuels(general)(45); ocean thermal(10). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective of this research project is to demonstrate how trace metals (arsenic, cadmium, copper, and selenium) affect the physiological and biochemical balance of selected life stages of marine and estuarine invertebrates, primarily shellfish. Our experimental approach has involved trace metal exposures of whole animals in situ and then the examination of selected tissues and organs for physiological damage. Also, experiments have been initiated to test the effects of metals on the embryological development of sea urchins as an invertebrate model system. We have demonstrated that the respiratory metabolism of gill tissue from oysters exposed to 0.1 ppM copper for 14 days was significantly different, but that cadmium at the same concentration caused no demonstratable difference. Using electron microscopy, subcellular morphological changes were observed in the gill tissue of copper treated oysters. However, the accumulation of cadmium by the oysters in the 0.1 ppM group caused the production of a low molecular weight, metallothionein-like protein specific for cadmium, but spillover occurred and the cadmium was demonstrated in the higher molecular weight proteins causing damage and death. Experiments were conducted in which sea urchin embryos were exposed to different concentrations of cupric ion (Cu2+) in defined media, and it was shown that these embryos were very sensitive (most sensitive metazoan tested thus far) to copper, and that the cupric ions caused abnormal development and death at the highest concentrations. In the future, our research will be concerned with the effects of copper, cadmium, and selenium on whole organisms, tissues, and early developmental stages.
Keywords: ARSENIC; CADMIUM; COPPER; SELENIUM; WATER POLLUTION; SEAS; TOXICITY; BIOLOGICAL EFFECTS; SEA URCHINS; ONTOGENESIS; LIFE SPAN; OYSTERS; GILLS; ULTRASTRUCTURAL CHANGES; RESPIRATION; EMBRYOS; BIOLOGICAL MODELS.

13028 Environmental Assessment of an Active Oil Field in the Northwestern Gulf of Mexico. Klima, E.F. (National Oceanic and Atmospheric Administration, 4700 Avenue U, Galveston, TX, 77550). **Project number:** IAG-D5-E693-EO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$665,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is to conduct a comparative environmental assessment of an active gas and oil field through intensive field and laboratory investigations, through statistical analyses, synthesis and integration of data collected, and through continued development of descriptive and predictive models. Studies by contractors (universities and industry) will determine the concentration of pollutants in major components of the marine ecosystem: water, sediments, suspended particulate matter, and biota (including sessile organisms, pelagic and reef finfishes, and demersal finfishes and macro-crustaceans). Effects of contaminants will be investigated in terms of acute and chronic effects (bioassays), alteration of composition and abundance of the biotic communities, and accumulation of pollutants in biotic and abiotic components of the ecosystem. Special attention will be given to food web dynamics and physico-chemical modes of transport of pollutants into, within, and away from the oil and gas field ecosystem. Products will include descriptions of changes in a marine ecosystem related to oil and gas exploration and production, descriptions of existing environmental conditions, mathematical models for use in describing and predicting probable sources, fate and effects of oil and gas field pollutants. Results will be presented in semiannual and annual reports.
Keywords: AQUATIC ECOSYSTEMS; GULF OF MEXICO; PETROLEUM; DATA ACQUISITION SYSTEMS; POLLUTION; ENVIRONMENTAL EFFECTS; ENVIRONMENTAL TRANSPORT.

13029 Environmental Studies of the South Texas Outer Continental Shelf. Klima, E.F. (National Oceanic and Atmospheric Administration, 4700 Avenue U, Galveston, TX, 77550). **Project number:** AA550-IA7-21. **Supported by:** Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** BLM-$159,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

This study of historical zooplankton and ichthyoplankton is designed so as to supplement and complement the "Environmental Studies of the South Texas Outer Continenal Shelf, 1975. Plankton, Fisheries, and Physical Oceanography" program conducted by NOAA under Interagency Agreement Number 08550-IA5-19, with BLM, and the "Environmental Studies of the South Texas Outer Continental Shelf, 1976. Ichthyoplankton/Mackerel Eggs and Larvae" program conducted by NOAA under Interagency Agreement Number AA550-IA7-3 with the BLM. To achieve the objective, the method used has been that of collecting and analyzing historical and biological data available from a variety of sources. Those studies in which inhouse expertise existed are conducted by

NMFS personnel. The other investigations are conducted by universities under contract. Data acquired under this study will extend the data base developed under the previous studies, and will allow a better understanding of the fisheries resources of the South Texas OCS Study area. The results will be presented in final reports.
Keywords: CONTINENTAL SHELF; SEAS; TEXAS; AQUATIC ORGANISMS; SEASONAL VARIATIONS; PLANKTON; BENTHOS; FISHES; CRUSTACEANS; MOLLUSCS; POPULATIONS; TEMPERATURE EFFECTS; SALINITY; METEOROLOGY; OCEANOGRAPHY; DATA ACQUISITION; BASELINE ECOLOGY; AQUATIC ECOSYSTEMS.

13032 Behavioral Measures of Environmental Stress: Marine Fishes and Invertebrates. Olla, B.L. (National Oceanic and Atmospheric Administration, NMFS, Sandy Hook Lab., Highlands, NJ, 07732). **Project number:** EX-76-AA-28-3045. **Contract:** EX-76-AA-28-3045-A010 Mod. No. 10. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$27,000.
Related energy source: fossil fuels(12); oil and gas(75); nuclear fission(13). **R and D categories:** Ecological/biological processes and effects.

The objective is to observe and quantify patterns of behavior in marine fishes and invertebrates to use in measuring the effects of selected environmental stresses. In the past emphasis has been centered on the effects of temperature on the behavior of marine fishes and will end in this year with the influence of low temperature on the distribution and activity of juvenile bluefish. The research direction has now shifted to center on the effects of petroleum hydrocarbons on the behavior of marine fishes and invertebrates. Studies have commenced on behaviors mediated by chemoreception in the blue crab and red hake. For chemosensory studies detection thresholds will be established for the blue crab and red hake to a freeze-dried food extract. Utilizing similar techniques sensitivity thresholds for naphthalene and WSF of petroleum will be established, separating detection from higher-order responses to predict what levels of these pollutants each species can detect and at what levels, if any the animal may avoid and thereby remove the effects behaviorally. For temperature studies on bluefish, thermal edges and gradients at low temperatures approximating natural conditions will be established, and the influence of these temperatures on movements and distribution will be monitored.
Keywords: AQUATIC ECOSYSTEMS; ATLANTIC OCEAN; COASTAL WATERS; NEW JERSEY; THERMAL EFFLUENTS; BIOLOGICAL EFFECTS; FISHES; INVERTEBRATES; CRUSTACEANS; POPULATION DYNAMICS; REPRODUCTION; TEMPERATURE DEPENDENCE; PHYSIOLOGY; BEHAVIOR; BIOMASS; TEMPERATURE EFFECTS; BIOLOGICAL STRESS.

13035 Marine Measurement Quality Assurance. Basileo, M.A. (National Oceanic and Atmospheric Administration, Test and Evaluation Laboratory, Code C652, Building 160, Room 300, WNYA, Rockville, MD, 20852). **Project number:** EPA-IAG-D5-E693-EA. **Supported by:** National Oceanic and Atmospheric Administration, Rockville, MD (USA). **Funding:** EPA-$160,000.
Related energy source: oil and gas(95); ocean thermal(5). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

13036 Underway Water Sampling System. Polanin, B.P. (National Ocean Survey/NOAA, 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(80); ocean thermal(20). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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. The elements of work packages of the program include: (1) the current/depth measurement subsystem; (2) the water sampling and measurement subsystem; (3) data processing, display and navigation subsystem; and (4) system integration, test and techniques development.
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.

13037 Outer Continental Shelf Bathymetric Mapping Program. Fefe, C.X.G. (NOAA, National Ocean Survey, 6010 Executive Blvd., WSC 5, Rm 613, Rockville, MD, 20852). **Project number:** R32301. **Supported by:** Bureau of Land Management, Washington, DC (USA). Div. of Minerals Environmental Assessment. **Funding:** BLM-$99,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and 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.

13038 Ocean Oil Spill Concentration and Trajectory Forecast. Barrientos, C.S. (National Oceanic and Atmospheric Administration, National Weather Service, W427, Silver Spring, MD, 20910). **Project number:** 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:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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. Over half of the work is done on contract with six universities. The following are done in-house: management of the project, model integration, and implementation and monitoring of the program. One year of the contract work to six universities was completed; four of the contracts are renewed or are being renewed for the second year. Wind forecast equations for 14 coastal stations were developed and implemented. A computer program for oil spill trajectory has been developed. Various subroutines will be integrated with the program as completed. The model will be implemented operationally in April 1979. The nature of the final product is 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.

13039 Shipboard Environmental Data Acquisition System (SEAS). Reynolds, R.R. (National Weather Service, NOAA, Room 215, Code W44, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** B6220101. **Supported by:** National Weather Service, Silver Spring, MD (USA). **Funding:** EPA-$37,000.
R and D categories: Characterization, measurement, and 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; and (4) 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.

13056 Hydrocarbon Effects on Estuarine Carbon Flux. Van Lopik, J.R. (Louisiana State Univ., Center for Wetland Resources, Coastal Resources Bldg., Baton Rouge, LA, 70803). **Project number:** R/HES-4. **Contract:** 04-8-M01-154. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). **Funding:** NOAA-$9,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objective is to evaluate the effect of long term oil recovery operations on phytoplankton in wetlands of Louisiana.
Keywords: LOUISIANA; AQUATIC ECOSYSTEMS; SALINITY; MARSHES; SURFACE WATERS; AQUATIC ORGANISMS; ESTUARIES; PETROLEUM; PRODUCTION; OIL WELLS; ENVIRONMENTAL EFFECTS; SAMPLING; SEASONAL VARIATIONS; MICROORGANISMS; PHOTOSYNTHESIS; BIOMASS; SAMPLING; HYDROCARBONS; CARBON; METABOLISM; HYDROCARBONS; ESTUARIES.

13075 NOAA Brine Disposal Analysis/DOE Strategic Petroleum Reserve Program. Burroughs, C.A. (National Oceanic and Atmospheric Administration, Marine Environmental Assessment Division, 3300 Whitehaven Street, NW, Page Building 2, Room 162, Washington, DC, 20235). **Project number:** RE1202. **Supported by:** Department of Energy, Washington, DC (USA). Office of Strategic Petroleum Reserve. **Funding:** DOE-$2,200,000.
Related energy source: fossil fuels(50); oil and gas(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Activities are reported in a program to build upon already completed historic physical oceanographic, meteorological, bathymetric, and ecological data reports, a predisposal observation program. These studies are required to generally characterize the northwestern shelf waters of the Gulf of Mexico and to provide site-specific information in order to determine the effects of disposal of a saturated brine solution. This proposed disposal program would be the direct result of leaching out oil storage caverns from subterranean and possibly submarine salt dome structures in the Gulf of Mexico region. Plans are revealed to continue development of state-of-the-art mathematical and physical models to predict the areal extent and spatial concentrations of isohalines associated with the proposed brine discharge system, and to contract for NOAA services through the National Ocean Survey, the National Marine Fisheries Service, the Office of Ocean Engineering, and the Office of Sea Grant to achieve program goals. Quarterly reports are issued to the funding agency along with archived data and information to be utilized for specialized synthesis reports to aid decision makers on environmental matters.
Keywords: STRATEGIC PETROLEUM RESERVE; BRINES; WASTE DISPOSAL; GULF OF MEXICO; CONTINENTAL SHELF; COASTAL WATERS; WATER POLLUTION; ENVIRONMENTAL IMPACTS.

13076 Experiments to Measure the Effects of Biofouling and Corrosion on the Performance of Heat Transfer Surfaces. Spiehler, F.A. (National Oceanic and Atmospheric Administration, Data Buoy Office, NSTL Station, 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: ocean thermal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The primary objective of the project is 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 will be collected. A large deep ocean data buoy will be 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 will be conducted through use of meteorological and water quality indicator instrument systems installed on the buoy. All data will be collected automatically and relayed ashore for analysis of heat transfer coefficients and assessments of fouling film developments. Macrofouling sample panels will be installed at all levels in the water column and recovered for toxonomy analysis ashore. The buoy was deployed for 9 weeks of tests in FY 1978. Results of microbiological growth were obtained. The buoy was recovered and is being refitted for redeployment this fall. Tests will be expanded to include copper, nickel, stainless steel, titanium, and aluminum internal corrosion and aluminum external corrosion. Also, late in FY 1979, multiple tube heat exchanger models will be included in the experiment.
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.

13078 Boundary Layer Wind and Turbulence Prediction. Gilhousen, D.B. (National Weather Service, Techniques Development Laboratory, Room 806, 8060 13th Street, Silver Spring, MD, 20910). **Project number:** RC2901. **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:** Operational safety; Physical and chemical processes and effects.

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. Most of the effort to date has gone into extracting and checking the TV tower data so that it will be in the form needed to derive the equations.
Keywords: METEOROLOGY; WIND; TURBULENCE; VELOCITY; FORECASTING; BOUNDARY CONDITIONS; EARTH ATMOSPHERE; AUTOMATION; WEATHER; MEASURING METHODS; SAVANNAH RIVER PLANT.

13092 Distribution of Hydrocarbon in Narragansett Bay Sediments. Niels, R. (University of Rhode Island, Sea Grant Program, 210 B Woodward Hall, Kingston, RI, 02881). **Project number:** R/ES-10. **Contract:** 04-7-158-44088. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$28,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective is to investigate the qualitative and quantitative distribution of hydrocarbons in Narragansett Bay.
Keywords: HYDROCARBONS; ENVIRONMENTAL TRANSPORT; AQUATIC ECOSYSTEMS; WATER POLLUTION; RHODE ISLAND; COASTAL WATERS; BAYS; SEDIMENTS; ENVIRONMENTAL TRANSPORT; ECOLOGICAL CONCENTRATION; SAMPLING; DRILL CORES; BIOCHEMISTRY; WASTES.

13100 Biological/Chemical Survey of Proposed Salt Dome Brine Disposal Sites (Capline and Texoma Sectors) off Louisiana. Klima, E.F. (National Oceanic and Atmospheric Administration, 4700 Avenue U, Galveston, TX, 77550). **Project number:** CG-13-70040-00. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). **Funding:** DOE-$698,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are: (1) to describe the biological, physical and chemical components of the marine ecosystem for each disposal site; and (2) to assess by analysis of variance of Gulf Coast Shrimp Data the importance of Louisiana shrimping grounds in the vicinity of the proposed salt dome brine disposal site. Surveys at the proposed disposal sites will describe the seasonal abundance, distribution and

community composition of major benthic, planktonic, bacterial, and demersal finfish and macro-crustacean ecosystem components; the sediments; the hydrocarbon and trace metal composition and concentration in the marine ecosystem; and the seasonal variations in inorganic nutrient composition and concentration of the water column. A separate data analysis will assess the importance of shrimping grounds in the vicinity of the proposed disposal sites in terms of historical variations in species composition, marketing size categories, and the location of commercial shrimp catches within the statistical reporting zones off the Louisiana coast. Products of this project will include descriptions of existing environmental conditions (prior to brine disposal) at each site and seasonal variations in these conditions. The research includes inhouse (NOAA/NMFS) elements and contractors (universities and private environmental research companies). Results will be presented in a semi-annual and final report.
Keywords: AQUATIC ECOSYSTEMS; BRINES; WASTE DISPOSAL; SEASONAL VARIATIONS; SALT DEPOSITS; LOUISIANA; PETROLEUM; UNDERGROUND STORAGE; BASELINE ECOLOGY.

13101 Manned Submersible Reconnaissance of Proposed Ocean Thermal Energy Conversion (OTEC) Pipeline Route Ke-Ahole Point, Hawaii. Davidson, J. (University of Hawaii, 1540 Maile Way, Honolulu, HI, 96822). **Project number:** OE/R-3. **Contract:** 07-7-158-44129. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$5,000.
Related energy source: ocean thermal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The project objective is to study the pipeline route (on the bottom) from the OTEC to the shore. The purpose of this is to determine what, if any, impediments there might be.
Keywords: OCEAN THERMAL POWER PLANTS; PIPELINES; UNDERWATER; OCEANOGRAPHY.

13102 Brine Disposal Bioassay--Polycheats. Nowlin, W.D. Jr. (Texas A and M University, Sea Grant Program, College Station, TX, 77843). **Project number:** 6-108. **Contract:** 04-7-158-44105. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$15,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The effect of brine on polycheats is studied.
Keywords: ANNELIDS; BIOASSAY; BRINES; WASTE DISPOSAL; TOXICITY; PETROLEUM; UNDERGROUND STORAGE; WATER POLLUTION.

13103 Brine Disposal Bioassay--Penaid Shrimp. Nowlin, W.D. Jr. (Texas A and M University, Sea Grant Program, College Station, TX, 77843). **Project number:** 6-108. **Contract:** 04-7-158-44105. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$39,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objective is to study the effect of brine on Penaid shrimp.
Keywords: SHRIMP; BIOASSAY; BRINES; TOXICITY; WASTE DISPOSAL; WATER POLLUTION; PETROLEUM; UNDERGROUND STORAGE; BIOLOGICAL EFFECTS.

13104 Studies of Thermophilic Microorganisms Isolated from Undersea Hot Springs, Electric Power Plant Condensers, and Ship Heat Exchangers. Sullivan, J.J. (University of California, Sea Grant College Program A-032, La Jolla, CA, 92093). **Project number:** R/E-21. **Contract:** 04-7-158-44121. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$15,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objective of this project is to learn more about microorganisms which live in warm waters.
Keywords: MICROORGANISMS; THERMOPHILIC CONDITIONS; UNDERWATER; HOT SPRINGS; THERMAL POWER PLANTS; CONDENSER COOLING SYSTEMS; SHIPS; HEAT EXCHANGERS.

13105 Brine Disposal-Bioassay--Phytoplankton. Nowlin, W.D. Jr. (Texas A and M University, Sea Grant Program, College Station, TX, 77843). **Contract:** 04-7-158-44105. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$13,000.
Related energy source: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

The objective is to determine the toxicity of brine on phytoplankton. Brine is from salt dome storage of oil.
Keywords: BRINES; WASTE DISPOSAL; PHYTOPLANKTON; WATER POLLUTION; BIOASSAY; TOXICITY; PETROLEUM; UNDERGROUND STORAGE; BIOLOGICAL EFFECTS.

13106 Long-Term Effects of Sediment-Absorbed Petroleum Hydrocarbons on Aquatic Chemical and Biological Systems. Van Lopis, J.R. (Louisiana State University, Center for Wetland Resources, Coastal Resources Building, Baton Rouge, LA, 70803). **Project number:** R/ASE-7. **Contract:** 04-8-M01-154. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). National Sea Grant Program. **Funding:** NOAA-$20,000.
Related energy source: oil and gas(100). **R and D categories:** Ecological/biological processes and effects.

The objective is to determine the long-term effect of sediment-absorbed petroleum hydrocarbons on chemical changes in estuarine environment.
Keywords: PETROLEUM; BIOLOGICAL EFFECTS; SEDIMENTS; AQUATIC ECOSYSTEMS; OIL SPILLS; AQUATIC ORGANISMS; ESTUARIES; ENVIRONMENTAL EFFECTS; BIOLOGICAL FUNCTIONS.

13107 Ocean Thermal Energy Conversion. Vadus, J.R. (National Oceanic and Atmospheric Administration, OEZ, 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: ocean thermal(97); biomass(3). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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. Several preliminary designs will be developed for the cold water pipe (CWP) subsystem for the OTEC modular experiment plant. Several candidate platform configurations have been developed for the OTEC commercial plant. Conceptual designs will be prepared for the modular experiment plant's stationkeeping subsystem. A three-dimensional mathematical model will be developed for the design of OTEC CWP's. Several candidate CWP designs will be constructed and deployed to supply at-sea data on their behavior.
Keywords: OCEAN THERMAL ENERGY CONVERSION; ENGINEERING; ECONOMICS; OFFSHORE PLATFORMS; SYSTEMS ANALYSIS; OCEAN THERMAL POWER PLANTS; MATHEMATICAL MODELS; PIPES; DESIGN.

13108 NOS Strategic Petroleum Reserve/Brine Disposal Analysis Support. Frey, H.R. (National Oceanic and Atmospheric Administration, 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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

Baseline oceanographic and meteorological measurements are being 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 is to characterize the sites prior to brine disposal. Each site consists of 5 stations; the stations are positioned along a 10 n.mi. alongshore section and a 4 n.mi. transhore section. Each station consists of recording current meters (speed, direction, temperature, conductivity) at 1m and 3m above the bottom mounted on subsurface platforms. Wave and water level gages are affixed to the center station platform. Recording meteorological packages (wind speed, direction, air and sea surface temperature, barometric pressure) are positioned on proximate oil production platforms. In addition to the time series data obtained from the recording instrumentation, monthly CTD casts and water samples are obtained at 7 stations per site and at 2 stations which are intermediate between the sites. The water samples are 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 are being compiled.
Keywords: STRATEGIC PETROLEUM RESERVE; BRINES; WASTE DISPOSAL; PETROLEUM; UNDERGROUND STOR-

AGE; LOUISIANA; METEOROLOGY; OCEANOGRAPHY; ENVIRONMENTAL IMPACTS; SITE SELECTION.

13109 Ocean Pulse: Marine Environmental Assessment, Monitoring and Research. Pearce, J.B. (National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Center, Sandy Hook Laboratory, Highlands, NJ, 07732). **Project number:** NEC036-80-EI-A-5. **Supported by:** National Oceanic and Atmospheric Administration, Washington, DC (USA). **Funding:** NOAA-$600,000.
Related energy source: oil and gas(90); ocean thermal(10). **R and D categories:** Integrated assessment.

Ocean Pulse is a system for continuous monitoring, assessment and research of the state and well-being of inhabitants of coastal waters of the northeastern United States, to determine when, and to what extent, man's activities are modifying the productive ecosystem and directly affect living marine resources. Its objectives are to: (1) provide adequate environmental baselines for assessing long-term change or damage assessments of immediate environmental crisis, (2) conduct periodic long-term monitoring of natural and man-induced environmental variables so as to recognize change and trends and to separate and assess the influence of each of these on the living resources, and (3) integrate data from controlled field and laboratory experiments on cause-effect relationships between environmental variables and living marine resources with data from monitoring. The Program emphasizes six major cruises to over 20 sampling strata located between Cape Hatteras and the Canadian border as well as laboratory experimentation and research on behavior, genetics, physiology, biochemistry and ecology. Ocean Pulse is producing (1) periodic status-of-the-environment reports and newsletters about ongoing research and results which are intended to provide comprehensive and timely information to ocean resource managers, the scientific community and interested public, (2) annual assessments of summaries on the health of the environments and information on causes of change and impacts to living resources, (3) correlations between fishery resource assessments and environmental change or fluctuations, (4) scientific publications on the results of Ocean Pulse monitoring and experimental studies which can be used to support ocean management decisions, (5) an extensive, integrated data base that ocean resource managers and scientists can draw on to study long-term changes in the environment, (6) increased communication and coordination among the various groups who are involved in or doing work related to Ocean Pulse goals and objectives, which should increase total efficiency and effectiveness, and (7) red flag reports or advisories on sudden environmental crises, their immediate impact, cause(s) and projected long range consequences.
Keywords: OCEANOGRAPHY; COASTAL WATERS; AQUATIC ECOSYSTEMS; BASELINE ECOLOGY; POPULATION DYNAMICS; ENVIRONMENTAL IMPACTS; OFFSHORE OPERATIONS; FISHING INDUSTRY; DECISION MAKING; ENVIRONMENTAL POLICY.

13110 Oceanographic Data Base for OTEC. Churgin, J. (National Oceanographic Data Center, 2001 Wisconsin Avenue, NW, Washington, DC, 20235). **Project number:** EX-76-A-29-1041/TO No. 20. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Technology. **Funding:** DOE-$91,000.
Related energy source: ocean thermal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

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.

13111 Climatology and Oceanographic Analysis of the Georges Bank Region of the Outer Continental Shelf. Godshall, F.A.; Williams, R.G.; Bishop, J.M.; Everdale, F. (National Oceanic and Atmospheric Administration, Marine Environmental Assessment Division, Environmental Data and Information Service, 3300 Whitehaven Street, NW, Page Bldg. 2, Room 162, Washington, DC, 20235). **Project number:** RE1206. **Supported by:** Bureau of Land Management, New York (USA). New York Outer Continental Shelf Office. **Funding:** BLM-$210,000.
Related energy source: fossil fuels(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 region, including the Gulf of Maine and the Scotian shelf. 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.

13112 Ocean Currents and Thermal Observations for OTEC. Molinari, R.L. (National Oceanic and Space Administration, AOML, 15 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** B3333318. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE-$457,000.
Related energy source: ocean thermal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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. The approach in the Gulf of Mexico has been to establish three primary monitoring stations where current meter, hydrocast, STD, XBT, and profiler data are periodically collected. In the South Atlantic, several cruises are scheduled to deploy current meter moorings and drifting buoys, and to obtain current profiler, STD-water sample, and biological observations. The results of these programs will be to compare to and augment existing data to provide an adequate environmental background for the possible siting of OTEC plants in these areas.
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.

13113 OTEC Sea Surface Satellite Thermal Resource Data. Maul, G.A. (National Oceanic and Atmospheric Administration, AOML, 15 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** B3333718. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE-$110,000.
Related energy source: ocean thermal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

This research is to provide an analytical tool for synoptic, long-term assessment of thermal resource variations at sites of probable OTEC locations via satellite imagery, to assess the potential application of this technology to baseline studies of the environmental at probable OTEC sites, and to assess the impact of the plant on the environment after operations commence. The approach is to (1) determine OTEC thermal resource data requirements, (2) assess the applicability of existing and near-future satellite technology to OTEC thermal resource variability, (3) develop a methodology for acquiring relevant existing satellite thermal data and demonstrate via a test example in the Gulf of Mexico, and (4) prepare an integrated ship/satellite mooring program of data acquisition and analysis for fiscal year 1979 and 1980, based on the results of the first three methods. Benefits include significant increase in the data base for thermal resource variability; new technology to monitor the effects of an OTEC plant on the environment; and ability to remotely assess new areas without extensive surface exploration.
Keywords: OCEAN THERMAL ENERGY CONVERSION; RESOURCE ASSESSMENT; SATELLITES; ENVIRONMENTAL

IMPACTS; GULF OF MEXICO; MOORINGS; REMOTE SENSING; OFFSHORE SITES; TEMPERATURE GRADIENTS; OCEAN THERMAL POWER PLANTS; SEAS; SITE SELECTION.

13114 Environmental Studies of the South Texas Outer Continental Shelf. Klima, E.F. (National Oceanic and Atmospheric Administration, 4700 Avenue U, Galveston, TX, 77550). **Project number:** AA550-IA7-3. **Supported by:** Burcau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office. **Funding:** BLM-$173,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

This study of ichthyoplankton, mackerel eggs and larvae, and snapper/grouper populations is designed so as to supplement and complement the Environmental Studies of the South Texas Outer Continental Shelf, 1975: Plankton, Fisheries, and Physical Oceanography program conducted by NOAA under Interagency Agreement Number 08550-IA5-19, with BLM. To achieve the objective, a number of discrete investigations were conducted. These investigations were in highly specialized technical fields. Those in which inhouse expertise existed and technically competent personnel were made available, were conducted by NMFS. The other investigations were conducted by a university under contract. Data acquired under this study will extend the data base developed under the previous studies, and will allow a better understanding of the fisheries resources of the South Texas OCS Study area. The results will be presented in final reports.
Keywords: TEXAS; CONTINENTAL SHELF; BASELINE ECOLOGY.

14001 Energy Resources Training and Development Program for Blackfeet and Salish-Kootenai Indians. Cameron, R.E. (Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL, 60439). **Project number:** 10871197. **Supported by:** Old West Regional Commission, Washington, DC (USA). **Funding:** DOC-$36,000.
Related energy source: all(100).

This training program was developed for Native Americans to provide the knowledge and understanding necessary for working on energy development, environmental and reclamation problems on tribal lands. Special attention is given to energy extraction and development with field trips to coal mines on or adjacent to reservation lands to observe mining, environmental impacts, and application of various reclamation technologies. The program consists of a basic and practical six-week educational and training program in energy, resources, conservation, environment, assessment, monitoring, and rehabilitation of disturbed land. The Native Americans are presented lectures, laboratory, and field instruction in geology, energy resources and development, hydrology, soil management, wildlife ecology, data gathering and interpretation, and human factors as related to energy development.
Keywords: AMERICAN INDIANS; EDUCATION; LAND RECLAMATION; ENERGY SOURCE DEVELOPMENT; INDIAN RESERVATIONS; ECOLOGY; GEOLOGY; HYDROLOGY; ENVIRONMENTAL IMPACTS; RESOURCE CONSERVATION.

DEPARTMENT OF DEFENSE

20009 Effects of Power Plant Peaking on Commercial, Sport and Indian Fisheries. Mains, E.M.; Gerlach, A.R. (Corps of Engineers, North Pacific Division, 210 Custom House, Portland, OR, 97209). **Project number:** ZTK-827. **Supported by:** Corps of Engineers, Portland, OR (USA). North Pacific District. **Funding:** DOD-$10,000.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

The objective is to determine the effects of power peaking on commercial, sport and Indian fisheries which are needed for environmental impact statements, litigation with Indian groups and for a better understanding of these matters by the Corps of Engineers, the fish and game agencies, the fisherman and the general public. Conventional, sonic and radio tagging techniques and creel census and interviews will be utilized in studies of impacts of peaking on the fisheries.
Keywords: FISHING INDUSTRY; HYDROELECTRIC POWER PLANTS; ENVIRONMENTAL IMPACTS; FISHES; POPULATION DYNAMICS; AMERICAN INDIANS; OREGON.

20010 Effect of Peaking on Specific Riparian Wildlife Habitat Areas Along the Snake and Columbia Rivers. Mains, E.M.; Gerlach, A.R. (Corps of Engineers, North Pacific Division, 210 Custom House, Portland, OR, 97209). **Project number:** ZTK-802-1. **Supported by:** Corps of Engineers, Portland, OR (USA). North Pacific District. **Funding:** DOD-$149,000.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

The objective is to determine the impact of project power peaking operations on key wildlife habitats and populations along and in the Snake and Columbia Rivers. Special attention will be devoted to the impact of peaking operations on rare, endangered and unique species and their habitats. The approach will depend on the nature, extent and location of the habitats and wildlife populations identified. Where possible, topographic maps and aerial photographs will be utilized to predict innovations of habitats by peaking operations. Ground surveys will also be used.
Keywords: HYDROELECTRIC POWER PLANTS; PEAKING POWER PLANTS; COLUMBIA RIVER; RIVERS; HABITAT; POPULATION DYNAMICS; ENVIRONMENTAL IMPACTS; ENDANGERED SPECIES; FISHES; WILD ANIMALS; OREGON.

20012 Effects of Power Plant Peaking on Migration, Collection and Passage. Mains, E.M.; Gerlach, A.R. (Corps of Engineers, North Pacific Division, 210 Custom House, Portland, OR, 97209). **Project number:** ZTK-690-2. **Supported by:** Corps of Engineers, Portland, OR (USA). North Pacific District. **Funding:** DOD-$140,000.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

The objective is to determine effects of power plant peaking or daily, weekly and seasonal flow regulation on the migration, collection and passage of adult anadromous fish in the Columbia and Snake Rivers. The following methods will be used for making the studies: (1) conventional tagging where fish are trapped and tagged with spaghetti flag tags, disc tags or opercle tags, released in different locations and ultimately recounted upstream and the numbers of various tagged groups compared; (2) sonic tags where fish are trapped, tagged, released and tracked with hydrophones through reservoirs and tributaries; (3) radio tags for similar tracking in the vicinity of spillways and powerhouses where sonic tag signals cannot be heard; and (4) electronic tunnels which operate on an electrical resistance principle and can be placed in the fishway entrances at dams to count fish as they leave the river.
Keywords: HYDROELECTRIC POWER PLANTS; PEAKING POWER PLANTS; ENVIRONMENTAL IMPACTS; FISHES; MIGRATION; COLUMBIA RIVER; RIVERS; BEHAVIOR; POPULATION DYNAMICS; OREGON.

20014 Identification of Riparian and Island Habitats and Wildlife Populations on the Snake and Columbia Rivers. Mains, E.M.; Gerlach, A.R. (Corps of Engineers, North Pacific Division, 210 Custom House, Portland, OR, 97029). **Project number:** ZTK-483-3. **Supported by:** Corps of Engineers, Portland, OR (USA). North Pacific District. **Funding:** DOD-$26,000.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology.

The objective is to survey the shorelines and islands of the Columbia and Snake Rivers to identify and describe Riparian wildlife habitats in this area and to determine animal types and populations. The contractor will develop a plan of approach based on information from files of Federal and state game agencies, Battelle Northwest, Corps of Engineers and others. The plan was completed in September 1973. A Wildlife Study Guidance Group is reviewing actual field studies to insure goals are met.
Keywords: HABITAT; HYDROELECTRIC POWER PLANTS; ENVIRONMENTAL IMPACTS; WILD ANIMALS; POPULATIONS; COLUMBIA RIVER; RIVERS; SPECIES DIVERSITY; BASELINE ECOLOGY; SHORES.

20018 Environmental Fate of Hydrazine Fuels. Zirrolli, J.A. (US Air Force, Civil and Environmental Engineering Development Office, Det 1 ADTC/ECC, Tyndall AFB, FL, 32403). **Project number:** 19004C01. **Supported by:** Air Force Civil Engineering Center, Tyndall AFB, FL (USA). **Funding:** USAF-$40,000.
Related energy source: other advanced(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Because of the increased use of the hydrazine family of compounds in rocket fuels and in monopropellent 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 the atmospheric, aquatic and terrestrial phases. The level of minor components which may be significant will also be determined. Infrared and mass spectral analysis will be used to determine reaction rates and decomposition products.

Keywords: HYDRAZINE; TIME DEPENDENCE; ENVIRONMENTAL EFFECTS; MASS SPECTROSCOPY; INFRARED SPECTRA; DECOMPOSITION; AIR POLLUTION.

20019 Acute Fish Bioassay. Fisher, J.W. (USAF, Aerospace Medical Research Lab., Wright Patterson AFB, OH, 45433). **Project number:** 6302-04-18. **Supported by:** Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, OH (USA). **Funding:** DOD-$30,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objective is to determine the water pollution potential of aircraft fuels and lubricants, missile propellants and their exhaust products, and other AF 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 acute fish bioassay portion of previous workunit (AMRL-6302-04-11) was transferred to this workunit. The approach to this effort 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: WATER POLLUTION; ENVIRONMENTAL IMPACTS; AVIATION FUELS; AIRCRAFT; BIOASSAY; EXHAUST GASES; AQUATIC ORGANISMS; PHYSIOLOGY; HYDRAZINE; DATA ACQUISITION; TOXICITY; FISHES.

20020 Characterization of Hydrocarbon Emissions from Turbine Engines. Conkle, J.P. (U.S. Air Force, School of Aerospace Medicine, Brooks AFB, TX, 78235). **Project number:** 7930-11-35. **Supported by:** Aerospace Medical Div., Brooks AFB, TX (USA). **Funding:** USAF-$86,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The efforts will provide baseline data for assessing the biomedical impact of Air Force aircraft operations, prior to the advent of regulatory restrictions. The information is required not only for assessing environmental impact but also for evaluating combustor design criteria, smoke suppression additives and engine operational cycles. The work is closely coupled and coordinated with on-going turbine engine emissions measurement at the AFWL and AFAPL. Chemical characterization of the organic compounds present in turbine engine exhaust will be accomplished for both gaseous and particulate specie. Samples will be obtained from a variety of sources including Air Force and Navy operational engine test stands and the AFAPL single combustor test rig. Analysis will be performed by a coupled gas chromatograph-mass spectrometer-data system. Results will be screened by AMRL/TH for toxic hazard assessment.
Keywords: HYDROCARBONS; AIRCRAFT; TURBOJET ENGINES; EXHAUST GASES; ADDITIVES; TOXIC MATERIALS; SMOKES; MEASURING INSTRUMENTS; COMBUSTORS; AIR POLLUTION ABATEMENT.

20021 Fuel Dumping by USAF Aircraft. Clewell, H.J. (U.S. Air Force, Civil and Environmental Engineering Development Office, Det 1 ADTC/ECC, Tyndall AFB, FL, 32403). **Project number:** 19004C02. **Supported by:** Air Force Civil Engineering Center, Tyndall AFB, FL (USA). **Funding:** USAF-$8,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to assess the extent and the environmental impact of fuel dumping by USAF aircraft. Major areas of study are quantification of AF fuel dumping and determination of environmental impact. Quantification will be accomplished by establishment of an AF-wide fuel dump reporting system and tabulation of reports. Impact will be studied in three aspects--chemical, physical, and biological. Chemical aspects include photochemical reactivity of JP-4 in the atmosphere, particularly in the presence of NOx from aircraft engine exhaust, and formation of polynuclear aromatic carcinogens from aromatics in fuel. Studies will be performed in a photochemical reaction chamber. Products will be analyzed by long path infrared absorption spectroscopy, with support from uv-visible spectroscopy, uv-visible fluorescence spectroscopy, gas chromatography, and mass spectrometry. Physical aspects of the behavior of dumped fuel include droplet formation, mixing in aircraft wake, droplet fallout and evaporation, aerosol formation, settling to ground, and effect of JP-4 and its photochemical products on atmospheric physical processes. Research will include wind tunnel modeling and occupational simulation, as well as studies of real dumps if possible. Biological aspects include the effect of JP-4 and its photochemical products on living things.
Keywords: AIRCRAFT; ENVIRONMENTAL IMPACTS; AVIATION FUELS; AIR POLLUTION ABATEMENT; EXHAUST GASES; TURBOJET ENGINES; NITROGEN OXIDES; PHOTOCHEMICAL REACTIONS.

20022 Bioassay in Soil Microorganisms. London, S.A. (USAF Aerospace Medical Research Lab., Wright Patterson AFB, OH, 45433). **Project number:** 6302-04-19. **Supported by:** Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, OH (USA). **Funding:** DOD-$92,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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. The data derived from this effort are considered in conjunction with similar results obtained with other biological indicator and test systems to form a data base upon which scientifically valid environmental impact assessments and statements can be prepared. Microbial cultures isolated from soil samples will be investigated concerning their responses to both acute and chronic exposure to potential environmental pollutants. Selection of species will be based upon applicability of physiological requirements to experimental procedures, and relationship of responses to pollutant exposure with ecosystem impact. Microbes will be studied under both closed (batch) system and open (steady state growth) system conditions to ascertain acute and chronic effects. 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: MICROORGANISMS; SOILS; CHRONIC EXPOSURE; ENVIRONMENTAL IMPACTS; AIRCRAFT; AVIATION FUELS; BIOASSAY; POPULATION DYNAMICS; MISSILES; LUBRICANTS; BIOLOGICAL INDICATORS; LAND POLLUTION; WATER POLLUTION.

20026 Direct Exposure of Monolayers of Mammalian Cells to Airborne Pollutants in a Unique Culture System. Rasmussen, R.E. (Univ. of California at Irvine, Dept. of Community and Environmental Medicine, Irvine, CA, 92717). **Project number:** AFOSR-77-3343. **Contract:** AFOSR-77-3343. **Supported by:** Air Force Office of Scientific Research, Arlington, VA (USA). Directorate of Chemical Sciences. **Funding:** DOD-$97,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects; Ecological/biological processes and effects.

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. The unique cell culture/exposure system will permit the study of cellular effects of air pollutants in a manner very similar to in vivo exposure conditions.
Keywords: ANIMAL CELLS; AIR POLLUTION; NITROGEN OXIDES; SULFUR DIOXIDE; OZONE; TOXICITY; AEROSOLS; PARTICLES; RESPIRATORY SYSTEM; LUNGS; METABOLISM.

20036 Evaluation of Efficiency of Juvenile Bypass Systems. Smith, H.; Mains, E.M. (Corps of Engineers, North Pacific Division, 210 Custom House, Portland, OR, 97209). **Project number:** 31458. **Supported by:** Corps of Engineers, Portland, OR (USA). North Pacific District. **Funding:** DOD-$410,000.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

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 by-pass

systems. Holes have been drilled between turbine intake gatewell 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 time that fish are retained and exposed to high concentrations of super-saturated gases and to determine the relative safety of each system to fish passing through them is in progress.
Keywords: HYDROELECTRIC POWER PLANTS; INTAKE STRUCTURES; ENVIRONMENTAL EFFECTS; RESEARCH PROGRAMS; FISHES; SAFETY; SALMON; ENTRAINMENT.

20037 Assessment of the Development of Natural Gas in Lake Erie. McGregor, D.L. (Argonne National Laboratory, 9700 South Cass Avenue, EIS-11A, Argonne, IL, 60439). **Project number:** NCB-IS-78-16. **Supported by:** Corps of Engineers, New York (USA). New York District; Environmental Protection Agency, Chicago, IL (USA). Region V. **Funding:** DOD-$402,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The program objectives focus on: (1) the identification and examination of issues relevant to development of dry natural gas beneath waters of the eastern and central basins of Lake Erie; (2) the assessment of environmental impacts and performance of research or analyses related to producing and transporting natural gas; and (3) the preparation of an environmental impact statement addressing the environmental acceptability of developing this resource in U.S. waters. The program consists of a three-stage effort. Phase I involves an evaluation of issues derived from information in published literature and through contacts with governmental agencies, industry, environmental interest groups and other interested parties. Phase II is comprised of two tasks: (1) confirmatory research recommended in the issue evaluation, and (2) the detailed analysis and synthesis of information and data generated and collated in Phases I and II. Phase III involves the preparation of an Environmental Impact Statement that will address (1) environmental and economic worst case analyses of impact, (2) a total ban on natural gas development, and (3) guidelines, regulation or policy recommendations that would encourage adoption of minimum uniform regulations and enforcement if development of the resource is acceptable.
Keywords: LAKE ERIE; NATURAL GAS DEPOSITS; EXPLOITATION; FEASIBILITY STUDIES; ENVIRONMENTAL IMPACTS; TRANSPORT; DATA ANALYSIS; WATER POLLUTION.

20038 Solid Waste Management Research. Imel, C. (Naval Civil Engineering Laboratory, Construction Battallion Center, Port Hueneme, CA, 93043). **Project number:** DN-587084. **Supported by:** Naval Facilities Engineering Command, Washington, DC (USA). **Funding:** DOD-$458,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

158 major naval installations in the USA will be affected by mandates to institute resource recovery and energy conservation programs. To responsibly comply with legislation and guidelines at acceptable levels of risk and to reduce solid waste handling and disposal costs and the manpower burden at Naval activities, an adequate data/technology base will be compiled to clearly define needs and viable options. The overall objective is to produce the necessary data/technology base at minimal cost. Gaps in the Navy's data base will be identified and efforts made to obtain the critical data. More specific program objectives are: (a) to characterize and quantify Navy solid waste, existing solid waste management system and existing heat and energy systems; (b) to project trends in solid waste characteristics and generation rates that may impact on future system needs; (c) to test and evaluate appropriate solid waste management methods, systems, equipment and products for pollution abatement, energy conservation, and resource recovery; and (d) to develop criteria that will facilitate preparing specifications for system selection, design, operation, and maintenance.
Keywords: MILITARY FACILITIES; WASTE MANAGEMENT; RESOURCE CONSERVATION; ENERGY CONSERVATION; SOLID WASTES; WASTE DISPOSAL; TECHNOLOGY ASSESSMENT.

20039 Industrial, Chemical and Domestic Wastewater Processing. Lard, E.W. (Naval Ship Research and Development Center, Ship Materials Engineering Department, Annapolis, MD, 21402). **Project number:** DN310180. **Supported by:** Naval Sea Systems Command, Arlington, VA (USA). **Funding:** DOD-$300,000.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

A program is reported to develop and evaluate systems for abating water pollution from Navy ships. Part of the effort will be to reduce the use of fresh water. The program includes development of a reduced flow shower system and verification of production design by service evaluation. A user evaluation of hand-held showers on USS Jonas Ingram (DD938) was completed. The shower hydraulic load was reduced by approximately 80% and favorable user acceptance was demonstrated.
Keywords: SHIPS; WASTE WATER; POLLUTION CONTROL; FRESH WATER; USES; VOLUME.

20040 Oil Pollution Control Source Identification and Mitigation. Fileccia, R.J. (Army Construction Engineering Research Laboratory, Champaign, IL, 61820). **Project number:** 4A762720A896-009. **Supported by:** Army Research Office, Washington, DC (USA). **Funding:** DOD-$60,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A program is reported that is devoted to assessment of source, magnitude and nature of petroleum, oil, and lubricants (POL) contaminats discharged on Army installations. Guidelines for solutions to identified POL pollution problems are to be developed. The program includes a survey of Army installations to determine cause, magnitude and chemical nature of oily discharges from Army operations. Methods for determining POL products in water are to be developed along with separation devices for application to spill problems. General guidelines for control and clean-up are to be developed and an Army publication outlining procedures for control and clean-up of POL is to be issued.
Keywords: MILITARY FACILITIES; WASTE MANAGEMENT; WASTE OILS; LUBRICANTS; GASEOUS WASTES; LIQUID WASTES; AIR POLLUTION; WATER POLLUTION; CONTROL; RECOMMENDATIONS.

20041 Low Emissions Variable Geometry. McGregor, R.M. (Air Force Aeropropulsion Laboratory, Wright-Patterson AFB, OH, 45433). **Project number:** 19007001. **Supported by:** Department of Defense, Washington, DC (USA). **Funding:** USAF-$95,000; USN-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to generate and explore in bench or sector testing aircraft gas turbine engine combustor designs that have the capability for extremely low pollutant emissions by using variable geometry combustion techniques. This program supports the Air Force environmental quality assurance program function in that the end product will contribute to the achievement of Air Force turbine engine emission goals as specified in AFR 19-1, January 1978. A research program to accomplish the technical objective will be established by the Air Force Aeropropulsion Laboratory (AFAPL). The work will involve a dual award contract with industry. Program technical direction and funding is provided by CEEDO, AFAPL, and the Naval Air Propulsion Center (NAPC). CEEDO will be represented on the technical proposal evaluation team and throughout the program will provide technical expertise in the area of pollutant emission measurement and data evaluation. This JON covers Phase I, Preliminary Design and Development.
Keywords: AIRCRAFT; GAS TURBINES; AIR POLLUTION ABATEMENT; EXHAUST GASES; COMBUSTION PRODUCTS; DESIGN; INTERNAL COMBUSTION ENGINES; HYDROCARBONS; NITROGEN OXIDES.

20042 Environmental Implications of Alternate Fuels. Jackson, T. (Air Force Aeropropulsion Laboratory, Wright-Patterson AFB, OH, 45433). **Project number:** 19002A49. **Supported by:** Department of Defense, Washington, DC (USA). **Funding:** USAF-$105,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to determine the changes in the quality and quantity of pollutants emitted by various blends of potential AF alternate jet fuels when burned in three different combustor types or utilized in various AF fuel handling systems. Up to 12 different blends of potential AF alternate jet fuels will be burned in three different combustor types (low pressure can, high pressure can, and high pressure annular) to determine the changes in the quality and quantity of emitted pollutants (NOx, CO, smoke, and UBHC). Certain physical and chemical properties of the fuel blends will also be determined. The work will be accomplished by the AFAPL through multiple contracts with industry. The appropriate AFAPL JONs are as follows: 30480581 (low pressure can), 30480584 (high pressure annular), and 30480595 (high pressure can). Emissions and performance testing of the first three test fuels (JP-4, JP-8, JP-8 and Gulf Mineral Seal Oil) is complete for both the J79 and F101 combustor. Very little difference in pollutant emission levels or performance parameters were noted. The second three test fuels have been

delivered to GE; however, voluntary energy conservation measures due to the coal strike have delayed can combustor rig testing. The RFP for the high pressure can combustor evaluation was released and proposals received from Pratt and Whitney and Detroit Diesel Allison are now being evaluated. The high pressure can combustor will either be a DDA TE41 (A70 Aircraft) or a P and W TF30 (F111 Aircraft).
Keywords: JET ENGINE FUELS; EXHAUST GASES; COMBUSTION PRODUCTS; AIR POLLUTION ABATEMENT; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; NITROGEN OXIDES; CARBON MONOXIDE; HYDROCARBONS; PERFORMANCE TESTING; COMBUSTORS.

20044 United States Air Force Theoretical and Experimental Research Program to Study Low Energy Electrons. Ashley, J.C. (Oak Ridge National Lab., Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** RAD80007. **Supported by:** Rome Air Development Center, Griffiss AFB, NY (USA). **Funding:** DOD-$40,000.
Related energy source: nuclear fuels(general)(10); nuclear fission(70); nuclear fusion(20). **R and D categories:** Physical and chemical processes and effects.

The objective is to increase our understanding of the basic mechanisms involved when electrons interact with matter in its condensed phases. Emphasis is being placed on studying the interactions occurring in these materials which are currently used, or which are being considered for use, in electronics systems designed for a space environment which may include exposure to nuclear explosion. In our experimental program, we make observations which can be related to electron interactions in solids. The theoretical portions of the program include predictive calculations for a variety of interaction phenomena as well as interpretive studies in support of our experimental efforts. Results from the basic theoretical and experimental programs are employed in more specific, applied calculations with direct relevance to electronics systems' vulnerability. In this project we have measured the optical properties of polythylene, investigated the possiblity of similar, detailed studies on Kapton, done a theoretical analysis of straggling distributions of low-energy electrons transmitted through carbon foils, studied the optical emission from solids irradiated by low-energy electrons, made theoretical predictions of the dose distribution in the track formed by a heavy ion in passing through silicon, and studied the bulk and surface properties of thin films using optical guided mode techniques.
Keywords: ELECTRON BEAMS; ELECTRON DIFFRACTION; SOLIDS; INTERACTIONS; POLYETHYLENES; OPTICAL PROPERTIES; PHYSICAL RADIATION EFFECTS; SILICON; SURFACE PROPERTIES; MEMORY DEVICES; HEAVY IONS; ION BEAMS.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

30002 Structure-Function Studies on Actin and Myosin. Elzinga, M. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 09028. **Contract:** HL-21471. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$42,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

One basic property of living systems is the ability to use chemically-stored energy to move and carry out work. The contraction of muscles by large animals is the most obvious example of biological movement, but it now seems 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. In this program the structures and organization of these proteins are being studied. The emphasis is on the two largest and most abundant proteins, actin and myosin, from muscle, which are then being compared with corresponding proteins from other tissues. Intracellular organization is studied by electron microscopy of the cytoplasm of certain lung cells, the alveolar macrophages and of in vitro complexes of contractile proteins from both alveolar macrophages and muscle. The results are necessary for the molecular description of the basic contractile mechanism, while the comparative studies will permit correlation of differences in organization of specific proteins with variations in the motile properties of normal and abnormal cells.
Keywords: MUSCLES; DYNAMIC FUNCTION STUDIES; PROTEINS; ACTIN; MYOSIN.

30003 DNA Repair: Human, E. coli Photoreactivating Enzymes. Sutherland, B.M. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 09030. **Contract:** CA23096. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$83,000.
R and D categories: Characterization, measurement, and monitoring; Health effects.

The biochemical, biophysical and biological properties of photoreactivating enzymes and cellular photoreactivation will be studied. The feasibility of uv-induction of transformation in human cells will be investigated. Photoreactivating enzymes from prokaryotes (E. coli) and eukaryotes (man, orchid, silverfish, drosophila) will be isolated and characterized. Cellular photoreactivation will be studied in E. coli and in man. Human cells will be tested for growth in soft agar after uv treatment to test for possession of some characteristics of transformed cells. Four enzymes have been isolated and characterized cellular photoreactivation has been found in cells in culture and in leukocytes taken directly from man. Cells with some properties of transformed cells have been isolated from uv-treated cell populations.
Keywords: DNA; BIOLOGICAL REPAIR; ESCHERICHIA COLI; MAN; ENZYMES; BIOCHEMICAL REACTION KINETICS; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS.

30004 Electron Microscope Facility. Wall, J.S. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 09305. **Contract:** RR-00715. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$264,000.
Related energy source: all(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

Electron microscopy is one of the major tools available for the study of the structure of living matter in health and in disease. Major improvements in this instrument can therefore provide new insights into the health effects associated with various energy technologies. Thus a new Scanning Transmission Electron Microscope (STEM) has been constructed at Brookhaven for the purpose of biological structure determination at 2 A resolution on frozen, hydrated specimens. The STEM is the only one of three such instruments presently operating in this country that is 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; ENERGY; HEALTH HAZARDS; TRANSMISSION ELECTRON MICROSCOPY; MOLECULAR STRUCTURE; MONITORING; PATHOLOGICAL CHANGES.

30005 Fluorescence Electron Microscopy. Hough, P.V.C. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 09306. **Contract:** GM-24799. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$50,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The purpose of this work is to develop means for localizing individual molecular species within cells and tissue using luminescence excited under the scanning electron microscope. The luminescence can be intrinsic, or from a fluorescent conjugant, or from a fluorescent antibody. Effort has been focused on showing that the technique can solve concrete biological and environmental problems. Two are being worked out, the detection of silica particles in tissue and macrophages of the intestinal wall and the localization of DNA and certain proteins in polytene chromosomes. The problem of silica ingestion is important in energy generation by fossil fuels, particularly in the extraction of coal. Test experiments in this laboratory show the uptake of individual silica particles by peritoneal macrophages: strong luminescence images of the particles are produced under the scanning microscope as the specimen is cooled to -100 degrees C and below. Chromosomes are the site of attack by the mutagens and carcinogens produced in energy generation by fossil fuels and attack by radiation in nuclear energy generation. The study of polytene chromosome structure is chosen as a prototype problem in cancer cell biology because of the increased sensitivity afforded by the 1024-fold replication of the genetic material.
Keywords: ELECTRON MICROSCOPY; SILICA; INGESTION; COAL MINING; UPTAKE; CHROMOSOMAL ABERRATIONS; FOSSIL FUELS; IONIZING RADIATIONS; CARCINOGENESIS; DNA REPLICATION; FLUORESCENCE.

30006 Replication of T7 DNA. Studier, F.W. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C 09311. **Contract:** GM21872. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$61,000.
R and D categories: Health effects.

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 particles can be studied by a combination of genetic and physical-chemical 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: DNA REPLICATION; GENETIC RADIATION EFFECTS; ESCHERICHIA COLI; METABOLISM; PROTEINS; MUTAGENESIS; CARCINOGENESIS; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; BIOLOGICAL EFFECTS; MUTAGENS; CARCINOGENS; IONIZING RADIATIONS; BIOLOGICAL MODELS.

30007 Storage Protein Synthesis in Maize Endosperm. Burr, B. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C 09321. **Contract:** GM-24057. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$48,000.
R and D categories: Characterization, measurement, and monitoring.

Plants are often a poor source of protein because they are deficient in some amino acids essential to human health. Our goal is to improve the amino acid composition of protein in the edible portion of corn and other cereal grains. We suspect that the major storage protein in maize endosperm is encoded by one or two genes. We would like to induce mutations in these genes which would cause the substitution of rare essential amino acids into the amino acid sequence of the storage protein. Because this protein makes up 50% of the total seed protein a change in its composition will be reflected in the overall composition of the grain. We have succeeded in making molecular clones from purified storage protein messenger RNA. These highly purified nucleic acids will allow us to count the number of storage protein structural genes and to determine their chromosomal location.
Keywords: MAIZE; STORAGE LIFE; PROTEINS; BIOSYNTHESIS; CEREALS; PLANT BREEDING; MUTAGENS; QUANTITY RATIO.

30008 DNA Mismatch Repair in Transformation and Mutagenesis. Lacks, S.A. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C 09323. **Contract:** AI14885. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$48,000.
R and D categories: Operational safety; Health effects.

This project will investigate DNA base mismatch correction in Diplococcus pneumoniae. Such repair occurs after DNA-mediated genetic transformation and after potentially mutagenic base substitution in DNA replication. In transformation, single-site markers are integrated with different efficiencies because a system, called Hex, recognizes mismatches in the initial heteroduplex product of integration and removes the donor portion with a frequency depending on the mismatched base pair formed. Hex/sup -/ mutants give only high integration efficiency. The molecular mechanism of the Hex system will be determined in vivo by following the biochemical fate of a purified DNA donor fragment containing the amylomaltase gene. This gene has been extensively analyzed genetically. By design of a suitable substrate and use of cell extracts lacking nonspecific nucleases, we hope to demonstrate mismatch repair in vitro. The enzymatic mechanism of the repair process could then be analyzed. Of particular importance is how the system recognizes and excludes the donor contribution to the mismatch. Strains that lack the mismatch repair system show higher spontaneous mutation rates. The system apparently repairs DNA replication errors by recognizing base mismatches and removing the wrong base in the nascent strand. By analyzing reversion rates of mutations in the amylomaltase gene, the mismatch specificities of mutational correction and integration efficiency will be compared. Mismatch repair, as indicated by the occurrence of gene conversion, is widespread among living cells. The proficiency of this system could be a major factor in determining spontaneous mutation rates. The impact of DNA methylation on spontaneous mutation rates will also be ascertained. If aging is due to the accumulation of mutations, mismatch repair could be important for longevity and for the prevention of age-related diseases such as cancer and heart disease. An in vitro assay will make the sudy of mismatch repair accessible also in human cells.
Keywords: DNA; MUTAGENESIS; BIOLOGICAL REPAIR; DNA REPLICATION; ERRORS; BIOASSAY; METHYLATION; AGE DEPENDENCE; BIOLOGICAL MODELS.

30009 Toxic Algae in Marine and Fresh Water Environments. Siegelman, H.W.; Rapoport, H. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 81654. **Contract:** ES01547. **Supported by:** National Institutes of Health, Bethesda, MD (USA). **Funding:** NIH-$69,000.
R and D categories: Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

We are isolating and identifying the toxins produced by marine and freshwater algae with current emphasis on Gonyaulax excavata, the organism responsible for the northeast Atlantic toxic red tide. These studies will provide information on the toxins produced in marine and freshwaters which are hazardous to humans directly or following ingestion of the toxins by animals commonly used as human food resources. The laboratory culture of toxic algae provides information on the environmental factors responsible for toxic algal blooms. We have developed dependable large-scale culture facilities for growing marine and freshwater algae. The algae are grown under varied environmental conditions, and toxin production will be evaluated. We have obtained toxic algae from culture collections and by field collection. Toxin structures are determined by Dr. H. Rapoport (co-principal investigator), Department of Chemistry, University of California, Berkeley, CA. We will examine large and small molecules excreted by toxic algae.
Keywords: ALGAE; AQUATIC ECOSYSTEMS; TOXINS; HEALTH HAZARDS; FOOD CHAINS; CONTAMINATION; FOOD.

30010 National Library of Medicine: Toxicology Data Bank and Toxicology. Ulrikson, G.U. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA); National Library of Medicine, Washington, DC (USA). **Funding:** HEW-$952,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

In order to meet the needs of government agencies, industry, academia, and the public, the National Library of Medicine implemented the Toxicology Data Bank (TDB) and the Toxicology Information Response Center (TIRC). TDB is an on-line computerized data base containing detailed information on ultimately 4,000 to 6,000 potentially hazardous substances, particularly those compounds likely to reach a large segment of the population. Data include physical and chemical properties, lethal dose values, animal and human toxicity with available antidotes and treatment, mechanisms of pharmacologic and toxicologic action, chemical synergism, environmental accumulation and effects, and other items totaling almost 100 data elements. TIRC prepares and disseminates literature packages according to specific requests. TIRC's main mission is to deal with human and animal toxicity; however, the Center also responds to inquiries dealing with all aspects of environmental and industrial pollutants, chemistry, analytical methodology, and other subjects closely or peripherally related to toxicology. Aside from response activities TIRC prepares specialized bibliographies, annotated literature collections, and state-of-the-art reviews.
Keywords: INFORMATION CENTERS; TOXICITY; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; DATA COMPILATION; TOXIC MATERIALS; ECOLOGICAL CONCENTRATION.

32007 Development of a Fibrous Aerosol Monitor. Lilienfeld, P. (GCA/Technology Division, Burlington Road, Bedford, MA, 01730). **Project number:** VQU-E23-484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** HEW-$75,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of the project is to construct a portable prototype fibrous aerosol monitor capable of in-plant monitoring of asbestos and other fibrous dusts. The instrument utilizes a combination of light scattering and electrostatic alignment of the fibers for the exclusive detection of fibers. A prototype has been received and is being evaluated.
Keywords: ASBESTOS; AEROSOL MONITORING; AIR POLLUTION MONITORS; FIBERS; DESIGN; DUSTS.

32009 Recommended Standards for Coal Gasification Plants. Evans, J.M. (Enviro Control, Inc., 11300 Rockville Pike, Rockville, MD, 20852). **Supported by:** National Inst. for Occupational Safety and Health, Rockville, MD (USA). **Funding:** EPA-$131,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

Guidelines for good work practices and criteria for recommended occupational safety and health standards have been developed separately for coal gasification pilot plants and for commercial coal gasification facilities. Criteria and recommended occupational safety and health standards are based on available world-wide literature, data that have been generated by Federal agencies (EPA, DOE), and field data collected by NIOSH.
Keywords: COAL GASIFICATION PLANTS; COAL GASIFICATION; PILOT PLANTS; HEALTH HAZARDS; SAFETY; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; DUSTS; ORGANIC COMPOUNDS; NOISE POLLUTION; ENVIRONMENTAL EFFECTS; STANDARDS. .

32015 Mortality, Morbidity and IH Study of Oil Shale Workers. Costello, J. (National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** E773-CX-2. **Supported by:** Public Health Service, Washington, DC (USA). **Funding:** EPA-$93,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

This project is a study of approximately 320 persons who worked in a pilot oil shale operation in Rifle, Colorado, through a retrospective mortality study combined with a cross-sectional morbidity examination to evaluate the several morbidity aspects that may or may not be associated with oil shale occupations. Mortality due to several specific causes of death will be determined after an extensive follow-up effort and the obtaining of death certificates of those determined to be deceased. Observed deaths will be compared with expected deaths to uncover excess deaths due to a particular cause. Numerous indices of health will be assessed through the physical examinations and health questionnaires administered to the living members of the cohort. The Rifle, Colorado, study is currently underway. Further activities tentatively include environmental exposure and medical assessments of workers in a commercial sized operation.
Keywords: COLORADO; OIL SHALE PROCESSING PLANTS; HEALTH HAZARDS; PILOT PLANTS; MEDICAL SURVEILLANCE; PERSONNEL; MORTALITY.

32016 Medical Study of Divers--EPA (Accident Registry). Costello, J. (National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** E773-CZ-3. **Supported by:** Public Health Service, Washington, DC (USA). **Funding:** EPA-$111,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

While hyperbaric medical research has a history of over 100 years, the recent global energy crisis has added a note of urgency to the need for further research. Since 1954, ten million acres of sea floor have been leased for fossil fuel exploration. Plans are now underway to lease an equivalent amount of acreage in the next 1 to 3 years. This will require an increase in the number of divers. In addition, these new leases will approach 2000 feet in depth. Little is known about the medical and physical effects of diving at those depths. It was originally planned to do both a mortality and a morbidity study of deep sea divers. As an alternate, the establishment of an accident registry was suggested. All of these plans were terminated because of lack of cooperation of both labor and management, labor because of threatened job loss. NIOSH headquarters is presently investigating other approaches to this problem.
Keywords: DIVING OPERATIONS; PERSONNEL; ACCIDENTS; MEDICAL SURVEILLANCE; ENERGY SHORTAGES; HEALTH HAZARDS; BIOLOGICAL STRESS; LUNGS; RESPIRATION.

32018 Mortality and Industrial Hygiene Study of Clay Fiber Workers. Ness, G. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VMH-E21-577. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$69,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

Attapulgite, one constituent of a group of substances collectively known as Fuller's Earth, is a mineral fiber which has been discussed with chronic lung disease. A retrospective cohort mortality study, including an industrial hygiene evaluation, of a population with an occupational exposure to Attapulgite of approximately thiry (30) years since onset of exposure is being conducted by NIOSH. This will permit investigation of long term chronic health effects of exposures to small diameter, short mineral fibers by a study population with sufficient latency. A cohort of 4,800 workers was located and all procedures necessary to complete the mortality analyses have been finished, except for vital status ascertainment on about 95% of the cohort. The life table analyses will be complete in May 1978 with final results slated to be published in July 1978. The industrial hygiene data all have been collected and reported measurements ranged from 0.16 to 3.24 mg/M-cubed for total dust. Fiber size data indicated the fibers ranged from 0.1 to 2.5 microns in length and 0.02 to 0.1 microns in diameter, with the fibers having an affinity for fiber conglomeration into jagged particles that ranged in diameter from 0.5 to 5.0 microns. The industrial hygiene results will be incorporated into the mortality study final report.
Keywords: THERMAL INSULATION; OCCUPATIONAL DISEASES; HEALTH HAZARDS; PERSONNEL; FULLERS EARTH; FIBERS; INHALATION; BIOLOGICAL EFFECTS; CARCINOGENESIS; LUNGS; RESPIRATORY SYSTEM DISEASES; NEOPLASMS; EPIDEMIOLOGY; MORTALITY; PATHOLOGICAL CHANGES; RISK ASSESSMENT; LATENCY PERIOD.

32019 Mortality and Industrial Hygiene Study of Mineral Wool Workers. Ness, G. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VMH-E21-578. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$43,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

Since little is known of the health effects to man of respirable fibers other than asbestos, it is incumbent upon the National Institute for Occupational Safety and Health (NIOSH) to investigate epidemiologically the human health consequences of respirable fiber exposures and other insulation materials. This study will be approached through environmental surveys and retrospective cohort mortality studies designed to quantify the risk of exposure to mineral wool used as well as determine the presence of other substances that may promote the development of adverse health effects or act in a synergistic manner. Mineral wool is a generic term which includes three types of fibers: rock wool, slag wool, and fibrous glass wool. While toxicologic and epigemiologic research has been conducted on fibrous glass, the two other types of mineral wool--rock and slag wool--have remained virtually unstudied in spite of their widespread usage for over 50 years. The preliminary results of the retrospective cohort mortality study indicated that among all mineral wool plant employees no cause of death category was statistically increased at the time of this report. However, a closer examination by latency revealed that excess risks of possible biological significance existed in the greater than 30 year latency group for those diseases previously shown by other research to be related to asbestos and other fibrous exposure (i.e., digestive and respiratory cancer and non-malignant respiratory disease).
Keywords: THERMAL INSULATION; OCCUPATIONAL DISEASES; HEALTH HAZARDS; PERSONNEL; MINERAL WOOL; INHALATION; BIOLOGICAL EFFECTS; CARCINOGENESIS; LUNGS; RESPIRATORY SYSTEM DISEASES; NEOPLASMS; EPIDEMIOLOGY; MORTALITY; PATHOLOGICAL CHANGES; RISK ASSESSMENT.

32020 Mortality and Industrial Hygiene Study of Workers Exposed to Sulfuric Acid. Rinsky, R.A. (National Inst. for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VMH-E21-579. **Contract:** CDC-210-77-0102. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** EPA-$172,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The Environmental Protection Agency in its CHESS report (1970--1971) studied seven U.S. cities for community exposure to air contaminants. One community had a primary exposure to sulfur oxides and particulates. The findings of the CHESS report strongly suggest that occupational exposures to sulfur pollutants need further study in terms of exposure levels and morbidity and mortality. The Proceedings of the Computer-based Conference on Human Response to Sulfur Pollutants at Brookhaven Laboratory (1974) suggested that sulfates and sulfuric acid could have a possible carcinogenic and/or co-carcinogenic effect. The purpose of this project is to conduct a retrospective cohort mortality study, including industrial hygiene surveys, of a population occupationally exposed to sulfuric acid mist to evaluate the carcinogenesis hypothesis. Orginally, this project, as funded by EPA in July 1975, was to have included a retrospective cohort mortality and industrial hygiene study of workers exposed to sulfuric acid and sulfates. However, at the beginning of FY-77 (October 1976), it was decided that additional information was needed on sampling and analytical methods to support this study and the morbidity study being conducted by another NIOSH Division. Therefore, the funds for the mortality study were transferred for the sampling and analytical development and the mortality study was postponed. The industrial hygiene surveys for selection of cohort, however, were initiated.

Keywords: MORTALITY; PERSONNEL; AIR POLLUTION; HEALTH HAZARDS; SULFUR DIOXIDE; AEROSOLS; PARTICLES; PATHOLOGICAL CHANGES; DISEASES; SULFATES; SULFURIC ACID; CARCINOGENESIS; SAMPLING.

32021 Industrial Hygiene Study of Insulation Workers. Wallingford, K.M. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VMH-E22-582. **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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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. To date, a request for contract proposals has been issued and bids have been received. The evaluation of the proposals is in progress.
Keywords: THERMAL INSULATION; FIBERS; INHALATION; PERSONNEL; HEALTH HAZARDS; OCCUPATIONAL DISEASES; RISK ASSESSMENT; RESPIRATORY SYSTEM DISEASES; EPIDEMIOLOGY.

32022 Industrial Hygiene Study of Solar Energy Component Manufacture. Boeniger, M.F. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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 cells for direct conversion of solar light to electricity. While rapid technological developments are occurring in this field, the present view is that the silicon and cadmium sulfide type photovoltaic cells will dominate the future market. Though photovoltaic conversion of solar energy still plays a very minor role in the total energy supply it will probably make dramatic gains in the near future. For instance, at the close of 1975 approximately 10 kW are anticipated. Major declines in cost of these cells with moderate increases in efficiency are forseen and will further their acceptance. Corresponding manpower demands would also be expected. The production of the final solar collection panel is preceded by many refining steps. Potential health hazards exist, beginning with the initial mining and purification of phosgene, polishing the crystals with strong acids and caustics, to the installation of the crystals within collection panels. Employee exposures and environmental health aspects in all these refining processes should be evaluated while the industry is still in its infancy.
Keywords: SILICON SOLAR CELLS; CADMIUM SULFIDE SOLAR CELLS; MANUFACTURING; MINING; HEALTH HAZARDS; PHOSGENE; CRYSTALS; FABRICATION; ENVIRONMENTAL IMPACTS; COST.

32023 Industrial Hygiene Study of Petroleum Production. Cox, C. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VMH-E22-584. **Contract:** CDC-210-78-0082. **Supported by:** Department of Health, Education, and Welfare, Cincinnati, OH (USA). **Funding:** EPA-$272,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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. A request for contract proposals has been issued and bids have been received. The evaluation of the proposals is in progress.
Keywords: PETROLEUM REFINERIES; WORKING CONDITIONS; TOXIC MATERIALS; SAFETY; MONITORING; HEALTH HAZARDS; PERSONNEL; POLLUTION CONTROL.

32024 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: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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 for about 90% of them.
Keywords: GLASS INDUSTRY; PERSONNEL; INHALATION; FIBERGLASS; BIOLOGICAL EFFECTS; LUNGS; PATHOLOGICAL CHANGES; RESPIRATORY SYSTEM DISEASES; MORTALITY; CARCINOGENESIS; NEOPLASMS; EPIDEMIOLOGY; PARTICLE SIZE; OCCUPATIONAL DISEASES; RISK ASSESSMENT.

32025 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: solar(50); other advanced(50). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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). A publication entitled Criteria for a Recommended Standard...Ocupational Exposure to RF/Microwave Radiation is to be formally transmitted to the US Department of Labor for consideration for promulgation of standards.
Keywords: MICROWAVE RADIATION; OCCUPATIONS; STANDARDS; HEALTH HAZARDS; SAFETY STANDARDS; BIOLOGICAL EFFECTS; ELECTROMAGNETIC FIELDS; ELECTROMAGNETIC RADIATION.

32026 Criteria for Occupational Safety and Health Standards--Coal Liquefaction. Woods, G.R. (JRB Associates, 8400 Westpark Drive, McLean, VA, 22101). **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:** Operational safety; Characterization, measurement, and monitoring; Health effects.

Criteria for recommended occupational safety and health standards are being developed for coal liquefaction facilities based on available world-wide literature, data that have been generated by Federal agencies (EPA, DOE) and field data collected by NIOSH. A publication entitled Criteria for a Recommended Standard...Occupational Exposures in Coal Liquefaction Plants, is expected to be formally transmitted to the US Department of Labor for consideration for promulgation of standards.
Keywords: COAL LIQUEFACTION PLANTS; HEALTH HAZARDS; SAFETY; STANDARDS; ENVIRONMENTAL EFFECTS; RECOMMENDATIONS; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PARTICLES; ORGANIC COMPOUNDS.

32027 Assessment of Energy Industry Occupational Health Problems. Knowles, D.F. (National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** VKPE10204. **Supported by:** Public Health Service, Washington, DC (USA). **Funding:** HEW-$86,000.
Related energy source: fossil fuels(15); geothermal(10); solar(10); ocean thermal(5); biomass(5); wind(5); conservation(20); other advanced(30). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective of this project is to identify occupational health problems associated with the extraction, processing, and utilization of energy resources, and the conservation of energy. The approach was to utilize a Task Order contract with Stanford Research Institute for Quick Response Evaluations of Energy Related Occupational Safety and Health Programs. Specific problem areas were identified by Task Orders to the contractor. Task Orders required literature searches and technical report evaluations; walk through or detailed industrial hygiene/safety surveys; morbidity, mortality or epidemiologic studies; evaluations of suggested improvements in work practices and engineering controls; recommended criteria for health and safety standards; and preparation of reports on occupational safety and health conditions in energy industries. A continuing program for monitoring developments in energy industries in house is maintained through a survey of periodicals, publications, and by personal contacts and participation in symposiums and conferences.
Keywords: ENERGY SOURCE DEVELOPMENT; HEALTH HAZARDS; PERSONNEL; OCCUPATIONAL SAFETY; ENERGY CONSUMPTION; INDUSTRY; SAFETY; RESEARCH PROGRAMS; STANDARDS; EPIDEMIOLOGY; ENVIRONMENTAL ENGINEERING; MORTALITY; ENERGY CONSERVATION; EVALUATION; MEDICAL SURVEILLANCE; AEROSOLS; CARCINOGENS; BIOMASS; CHEMICAL EFFLUENTS.

32028 Morbidity and Industrial Hygiene Study of Workers Exposed to SOx and NOx. Gamble, J.F. (National Inst. for Occupational Safety and Health, Morgantown, WV, 26505). **Project number:** VKL E21—170. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$221,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objective is to determine the prevalence of respiratory disease and dose-response relations in workers exposed to sulfur and nitrogen oxides. Cross-sectional epidemiological studies of occupational groups exposed to the chemicals of interest will be administered respiratory questionnaires, chest x-ray, and before and after shift pulmonary function. Personal environmental measurements and work histories will also be collected. The final product will be a report giving the prevalence of respiratory symptoms, radiographic and functional findings by confounding variables (e.g., smoking, age) and exposure. Dose-response relations, both acute (before and after pulmonary function testing vs. exposure) and chronic (baseline pulmonary function vs. estimated exposure) will be presented. Data have been collected on salt miners exposed to diesel exhaust (primarily NOx and salt exposure) and battery acid workers exposed to sulfuric acid. We hope to study pulp mill workers exposed to SOx, and diesel locomotive mechanics exposed to NOx. The studies of workers exposed to diesel exhaust is an energy-related environmental problem because of the potential for increasing use of diesels for transportation, and because nitrogen oxides are formed wherever there is combustion. Sulfur oxides are pollutants formed whenever sulfur containing fossil fuels are burned, and sulfuric acid may be formed when catalytic converters are used on gasoline powered automobiles.
Keywords: SULFUR DIOXIDE; NITROGEN OXIDES; BIOLOGICAL EFFECTS; HEALTH HAZARDS; RESPIRATORY SYSTEM DISEASES; EPIDEMIOLOGY; DOSE-RESPONSE RELATIONSHIPS; ACUTE EXPOSURE; CHRONIC EXPOSURE; DIESEL ENGINES; EXHAUST GASES; PAPER INDUSTRY; COMBUSTION PRODUCTS; FOSSIL FUELS; CATALYTIC CONVERTERS; ENVIRONMENTAL IMPACTS; MEDICAL SURVEILLANCE; PERSONNEL.

32029 Industrial Hygiene Characterization of Coal Gasification Plants. Evans, J. (Enviro Control Inc., 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VKPE22215. **Contract:** 210-78-0040. **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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The purpose of this project is to perform a comprehensive research industrial hygiene characterization of worker environments (e.g., develop a catalog of worker exposure through estimations from area sampling, and time motion studies, or through personal sampling) in coal gasification plants. It is the purpose of this project to determine the composition of process streams, product and by-product streams, effluents and fugitive emissions. This effort will include the identification of potential exposure locations, such as waste removal, spent catalyst handling and other transfer points, and a determination of whether carcinogens are being concentrated in any process area. It is required that a thorough technical characterization of coal gasification on a unit process basis be an integral portion of the overall characterization study. Based on the technical and industrial hygiene findings, specific recommendations will be made identifying areas where control technology assessment studies are necessary. This information is to provide NIOSH, EPA, DOE and the scientific community with information necessary to identify areas where control technology assessment studies are needed. Knowledge relative to product and by-product compositions will be useful in evaluating potential hazards in secondary industry workers.
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.

32030 Study of Coal Liquefaction Processes. Evans, J. (Enviro Control Inc., 11300 Rockville Pike, Rockville, MD, 20852). **Project number:** VKP No. 22225. **Contract:** 210-78-0101. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). Appalachian Lab. for Occupational Safety and Health. **Funding:** HEW-$369,000.
Related energy source: fossil fuels(5); coal(80); oil and gas(10); oil shales and tar sands(5). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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. A contract to Enviro Control Inc. to perform the above described study of coal liquefaction processes has been awarded and work is underway.
Keywords: COAL LIQUEFACTION PLANTS; WORKING CONDITIONS; HEALTH HAZARDS; INDUSTRIAL MEDICINE; HYDROCARBONS; CARCINOGENS; MUTAGENS; EMISSION; PARTICLES; INHALATION; SAFETY; PERSONNEL.

32032 Control Technology for Energy Systems. Hughes, R.T. (National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VQCE31 417. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$701,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

Increased costs and sometimes availability of petroleum and natural gas derived energy has created an urgent need for coal derived energy as well as a need for energy conservation methods for all types of energy. The new technologies and methodologies resulting from this need creates a potential for worker health problems unless adequate control measures or procedures are taken. This project addresses three significant areas. Recirculation of exhaust air can be used as an energy conservation measure. Criteria for the design and operation of recirculation systems will be developed and validated in industrial situations. Control technology for diesel powered coal mine equipment and for coal liquefaction and gasification will be identified and documented. A contract to develop recirculation criteria was completed and a symposium has been held. Contracts to validate this criteria in actual industrial situations were let and validation work is in progress. A contract will be let for the coal liquefaction and gasification technology assessment by the end of FY78.
Keywords: WORKING CONDITIONS; INDUSTRY; ENERGY CONSERVATION; AIR CLEANING SYSTEMS; COAL LIQ-

UEFACTION PLANTS; COAL GASIFICATION PLANTS; RECYCLING; ENERGY CONSERVATION; MINING EQUIPMENT; COAL MINES; VENTILATION SYSTEMS.

32033 Evaluation of Passive Organic Vapor Monitors. Woebkenberg, M.L. (National Institute for Occupational Safety and Health, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VQU E23 484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** HEW-$70,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective is to evaluate commercially available passive organic monitors for precision over a range of concentrations and determine the effects of temperature, humidity and face velocity on the precision.
Keywords: AIR POLLUTION MONITORS; PERFORMANCE TESTING; COMPARATIVE EVALUATIONS; ORGANIC COMPOUNDS; VAPORS; HYDROCARBONS.

32034 Development of a Personal Dosimeter for Ultraviolet Radiation. Breuer, G.M. (National Institute of Occupational Safety and Health, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VQU E23 484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** HEW-$10,000.
Related energy source: all(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of this project is the development of a personal dosimeter for ultraviolet radiation. The development of a self-contained, integrating dosimeter for personal measurement of ultraviolet radiation conforming to the NIOSH recommended standard for workplace exposure is being investigated.
Keywords: ULTRAVIOLET RADIATION; PERSONNEL DOSIMETRY; DOSEMETERS; DESIGN.

32035 Development of an Automated Personal Sample Fiber Counter. Wertheimer, A. (Leeds and Northrup Company, Technical Center, M.D. 110, North Wales, PA, 19454). **Project number:** VQU-E23-484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** HEW-$134,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of the project is the development of an instrument capable of counting asbestos and other fibers collected on filters. A contract has been let to construct an instrument based on the unique light scattering properties of fibers. Construction of the prototype instrument is slated for completion 11-78.
Keywords: ASBESTOS; AEROSOL MONITORING; AIR POLLUTION MONITORS; DESIGN; FIBERS; DUSTS.

32036 Portable Microwave Spectrometric Analyzer for Chemical Contaminants in the Air: Design and Prototype Construction. Hrubesh, L. (Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA, 94550). **Project number:** VQU E23 484. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** HEW-$208,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective is to design and construct an air monitor capable of quantitatively measuring the concentration of 10 specific gases and vapors using microwave spectrometric detection. Various components to be used in the monitor including microwave source, detection cells and air sampling system will be investigated. An air monitor will be designed and constructed for 10 specific gases based on these investigations. The prototype instrument has been delivered to NIOSH and is being tested for applicability to industrial hygiene situations. A draft final report has been received.
Keywords: AIR POLLUTION MONITORS; GASES; MONITORING; DESIGN; CONSTRUCTION; MICROWAVE RADIATION; MICROWAVE SPECTRA.

32037 Mortality/Industrial Hygiene Study of Workers in Coal-Fired Power Plants, TVA. Simon, J.S.; Traver, D. (TVA, Division of Medical and Environmental Services, 406 Edney Building, Chattanooga, TN, 37401). **Project number:** FY 78 VKP E21 189. **Supported by:** National Inst. for Occupational Safety and Health, Morgantown, WV (USA). **Funding:** EPA-$634,000; TVA-$58,000.
Related energy source: coal(75); hydroelectric(25). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The purpose of the industrial hygiene portion of the study is to identify and measure contaminants in the occupational environments of employees at TVA coal fired power plants. Detailed cross-sectional industrial hygiene studies will be conducted on workers in approximately 10 selected occupations within the power plant. TVA will also review selected existing industrial hygiene data available on past exposures of the selected occupations along with any available information on control procedures and materials used, and will attempt to retrospectively estimate exposures. The purpose of the mortality study is to measure how much if any increases in death rates and pre-retirement age disability due to chronic pulmonary impairments are correlated with long-term exposures of coal dust, coal combustion gases and fly ash, asbestos fibers and other airborne respiratory hazards in TVA work environments. All regular male employees of the TVA employed sometime between 1 January 1955 and 31 December 1972 will be included, provided they have total work-histories at the TVA of 5+ years (N approximately 25,000). Employees not exposed to airborne hazards will be used as controls. Work-histories and needed demographic data will be assembled from TVA personnel records. The NIOSH will search for deaths among employees who resigned from the TVA retirement system while living. From the entire employee cohort specified categories of employees with long-term exposures to contaminants potentially linked to malignancies or disabling respiratory diseases will be selected, with matched not-exposed controls, for detailed follow-up regarding non-occupational exposures, non-TVA work exposures and development of malignancies and respiratory diseases.
Keywords: FOSSIL-FUEL POWER PLANTS; MORTALITY; PERSONNEL; HEALTH HAZARDS; FLY ASH; RESPIRATORY SYSTEM DISEASES; NEOPLASMS; DUSTS.

32038 Develop Sampler Performance Specifications--EPA. Smith, J.P. (National Institute for Occupational Safety and Health, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, OH, 45226). **Project number:** VQU E23 494. **Supported by:** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). **Funding:** NIOSH-$318,000.
Related energy source: all(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The evaluation of personal aerosol sampler bias as a function of design specifications is becoming more important as the airborne aerosol concentration of interest decreases and the number of commercially available samplers increases. Also, samplers designed to operate in one specified particulate regime could systematically bias results when used to sample in another regime. This project investigates the design specifications and sampling parameters as they effect the indicated concentration of hazardous, airborne substances. Theoretical analysis of the problem is completed, and the results are tabulated into a set of performance specifications for personal aerosol samplers. The specifications are then used for the laboratory evaluation and comparison of an ideal personal aerosol sampler and commercially available models.
Keywords: HAZARDOUS MATERIALS; AEROSOLS; SAMPLING; PERSONNEL; AIR SAMPLERS; AEROSOL MONITORING; SPECIFICATIONS.

33295 Chemical and Environmental Mutagen Studies Utilizing the Tradescantia Test System. Van't Hof, J. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C 06909. **Contract:** IAG 6/14/72. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$445,000.
Related energy source: fossil fuels(90); nuclear fission(10). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives of the project are to: monitor atmospheric levels of chemical pollutants at epidemiologically selected sites located throughout the continental United States; verify the Mendelian characteristic of the pink gene of Tradescantia whose mutation frequency is used as an indicator of atmospheric pollutants; compare somatic and gametic mutation frequencies of the pink gene; and determine the developmental, cellular, and molecular aspects that influence the frequency of somatic and gametic mutagenesis. The assay system is Tradescantia stamen hair cells that are heterozygous for pigmentation. A lesion in the dominate blue gene results in the expression of the recessive pink phenotype which, in turn, is visible in the cells of the stamen hair. Environmental atmospheric monitoring is done via a mobile laboratory unit that is transported throughout the USA. Basic biological studies are performmed in the laboratory at the cellular, molecular, and genetic levels. Results to date show that the system is a successful environmental monitor of atmospheric pollutants.
Keywords: CHEMICAL EFFLUENTS; EARTH ATMOSPHERE; AIR POLLUTION; MUTAGEN SCREENING; TRADESCANTIA; MUTATION FREQUENCY; STAMEN; PLANT CELLS; DNA; MUTAGENESIS; CARCINOGENESIS.

33296 Cytophysical Studies in Mutagenesis. Mendelsohn, M.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** MC-03768. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** HEW-$230,000.

R and D categories: Characterization, measurement, and monitoring; Health effects.

The objective is to develop methods to assay genetic damage in single, readily sampled mammalian cells. Three approaches are being followed: (1) counting the frequency among normal human red blood cells of the rare cells containing sickle hemoglobin using highly specific fluorescent antibody to hemoglobin S and detection by flow cytometry; (2) the development of cytochemical fluorescent methods for oxidoreductase assay such as lactic acid dehydrogenase, succinic acid dehydrogenase, monoamine oxidase, and cytochrome oxidase suitable for flow cytometric application to mammalian sperm; and (3) validation of flow cytometric measurement of sperm DNA content as a measure of abnormal chromosomal segregation using various mouse stains bearing chromosomal translocations. The success of these methods would contribute to the measurement of somatic and germinal mutation rate in man and animals, and might permit occupational and environmental surveillance.

Keywords: MUTAGENESIS; ANIMAL CELLS; BLOOD; ANEMIAS; BIOLOGICAL MODELS.

33301 Testing Compounds for Mutagenic Activity in a Meiotic Non-Disjunction Test in Neurospora crassa. Griffiths, A.J.F. (University of British Columbia, Botany Department, Vancouver, British Columbia, Canada, V6T 1W5). **Project number:** NIH-75-C-638 ADG. **Contract:** NIH-75-C-638. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$17,000.

Related energy source: fossil fuels(90); nuclear fuels(general)(10). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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.

33302 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: fossil fuels(90); nuclear fuels(general)(10). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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.

33311 Species-to-Species Carcinogenesis Extrapolation. Williams, G.M. (American Health Foundation, Naylor Dana Institute for Disease Prevention, 1 Dana Road, Valhalla, NY, 10595). **Project number:** N01-ES-6-2130-02 BB. **Contract:** N01-ES-6-2130-02. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$13,000.

R and D categories: Health effects.

The objectives are to create a data summary from published studies in the field of carcingenesis and to utilize this data summary to investigate various aspects of the quantification of species differences following exposure to specified carcinogenic agents. These differences will in turn be incorporated into the species-to-species extrapolation process whenever feasible. All relevant pharmacological and epidemiological literature on aflatoxin B1, vinyl chloride, dimethylnitrosamine, chlornaphazine, benzidine, and DES were reviewed and abstracted. The abstracted data was then analyzed with regard to a number of factors that could possibly contribute to the differences in cancer incidence rates observed across (and occasionally within) species. There are significant species differences in response to each of the carcinogens evaluated in well-controlled experiments. These differences cannot be reconciled by merely reworking the dose, i.e., by changing the units of measurement in which the dose or dose rate is expressed. Furthermore, for none of the species differences was a metabolic factor identified which could account for them. However, the activated metabolites are difficult or impossible to identify in most cases. Thus, the metabolism studies must be considered insufficient at this point. In addition, none of the metabolism studies was performed specifically to examine species differences in sensitivity. The quantitative data on human exposure is generally inaccurate or non-existent. For the various compounds considered the best data is that associated with DES exposure, and Aflatoxin B1 is acceptable. However, the data on benzidine, e.g., is considered inaccurate with regard to human exposure levels. Using the best available estimates of human exposure man was often found to have the same sensitivity within an order of magnitude as some experimental species for many of the compounds considered.

Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; DATA ACQUISITION; DATA COMPILATION; HYDROCARBONS; CARCINOGENS; METABOLISM; TOXICITY.

33312 Statistical Development of Multistage Carcinogenesis Models. Peentice, R.L.; Crump, K.S. (Fred Hutchinson Cancer Research Center, Seattle, WA, 98104). **Project number:** ERP-7.3 BB. **Contract:** RFP No. NIH-ES-77-22. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$150,000.

R and D categories: Health effects.

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.

33313 Statistical Analysis of Mutagenesis Testing Data. Margolin, B.H. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 40005-0133BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.

R and D categories: Health effects.

The primary objective of this project is to develop appropriate statistical techniques for the analysis of data arising from the Mutagenesis Testing Program. A large microbial experiment conducted by LEM served as the empirical base for this modeling effort. Existing models, such as the currently favored Poisson model, were

analyzed to see if they were consistent with the laboratory observations obtained by LEM. Considerations of stochastic variability in serial dilutions and in other experimental procedures led to new statistical techniques for the analysis of experiments of this type. The Poisson model frequently adopted for the modeling of certain microbial test data is contradicted by empirical evidence; it seriously underestimates the variability of the counts of revertants observed in the Ames test. A logarithmic transformation of the counts serves to stabilize variability and to permit employment of standard statistical procedures for the analysis of the transformed data.
Keywords: MUTAGENESIS; STATISTICAL MODELS; MICROORGANISMS; MUTAGEN SCREENING; REVERTANTS; MUTANTS; DATA ANALYSIS.

33314 Risk Assessment for Environmental Carcinogens. Hoel, D.G. (National Institute of Environmental Health Services, Research Triangle Park, NC, 27709). **Project number:** Z01 ES41001-04BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
R and D categories: Health effects.

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 synergistic effects in the framework of multistage models for carcinogenesis as well as the question of species-to-species extrapolation. The multistage theory for cancer initiation was used to derive mathematical models for independent and dependent effects of two agents. Then the standard statistical measures of synergism were evaluated in terms of these multistage models. Meselson's NAS estimates of human relative cancer risk--where relativity is expressed in terms of the most sensitive animal species tested--for a variety of known carcinogens were reexamined to determine the extent to which they depend on both the length of exposure and the unit of dosage quantification. The research into the assessment of the synergistic potential of two carcinogenic risk factors demonstrated that erroneous conclusions concerning effects on the mechanism of the carcinogenic process can be made if the traditional statistical measures are employed. Improved techniques for the design and analysis of multifactor carcinogenicity experiments were formulated as a result of this research. It was found that when relative lifespan and body surface area were introduced into the animal versus man risk calculations for the carcinogens considered by Meselson, the similarity between species was even stronger than he originally indicated. Other known human carcinogens are now being evaluated to determine if this trend persists.
Keywords: CARCINOGENESIS; STATISTICAL MODELS; CARCINOGENS; RISK ASSESSMENT; SYNERGISM; BIOLOGICAL MODELS.

33315 Low Dose Toxicoloqical Estimation (Low Dose Extrapolation in Non-Carcinogenic Toxicological Experiments). Feder, P.I. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 41003-01BB ERP-7.4. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$10,000; EPA-$50,000.
R and D categories: Health effects.

The focus of this research effort is on the generation of mathematical and statistical procedures applicable to the problem of low dose extrapolation in toxicological experiments involving endpoints other than carcinogenicity. The asymptotic properties of a procedure for detecting litter effects that is based on the beta binomial model (which allows the investigator to quantify the extent of little effects) was compared to nonparametric procedures based on the Chi square tests for homogeneity and goodness-of-fit, respectively. It was found that the beta binomial test performed nearly as well as the better of the two nonparametric techniques, i.e., the Chi-square test of homogeneity, even when the assumption of an underlying beta binomial distribution was violated. Current research is centered on attempts to demonstrate that different dose-response curves may fit high dose noncarcinogenic laboratory data about equally well yet result in extrapolated low dose risks differing by orders of magnitude. Extensions of this research will involve the derivation and fitting of dose-repsonse functions based on simple mechanistic models. Practical aspects of this research could influence the regulatory approach toward safety evaluation of potentially toxic substances, including various by-products of different energy strategies.
Keywords: TOXINS; TOXIC MATERIALS; HEALTH HAZARDS; DOSE-RESPONSE RELATIONSHIPS; BIOLOGICAL EFFECTS; METABOLISM; HUMAN POPULATIONS; STATISTICAL MODELS.

33316 Environmental Contaminants of Infants' Foodstuffs: Child Health Effects of PCB's. Rogan, W.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-43002-2BB ERP 7.5. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000; EPA-$367,000. **Related energy source:** fossil fuels(80); conservation(20). **R and D categories:** Health effects.

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 rcliable 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. The study is a prospective, or follow-up study. Field nurses are hired, trained in protocol administration, and then work at selected hospitals. Subjects are enrolled, informed consent is obtained, and a questionnaire administered to each mother at approximately the time of delivery. Samples of milk, formula, colostrum, placenta, and maternal blood are collected. The health effects of these low dose environmental pollutants are now well studied in children, and this project should allow identification and quantification of those that occur short term in this group. The methodology for studying such phenomenon is also of interest, and the development of a field efficient method for study of low level pollutants, such as PCB's, in humans is important.
Keywords: HEALTH HAZARDS; DIET; INFANTS; ORGANIC CHLORINE COMPOUNDS; AROMATICS; BIOLOGICAL PATHWAYS; RISK ASSESSMENT; BIOASSAY; CHRONIC EXPOSURE; NEONATES; MILK; MAMMARY GLANDS; BIOLOGICAL ACCUMULATION.

33317 Pharmacodynamic Dose-Response Relationships. Tuey, D.B.; Hoel, D.G. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 42003-01BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
R and D categories: Health effects.

The purpose of this project is to determine whether pharmacodynamic considerations can provide insights for improving the extrapolation of expermental dose-response data: (1) from high- to low-dose; (2) from animals to man; and (3) from one compound to another. Pharmacokinetic models of xenobiotic disposition in the body, and various biochemical mechanisms of metabolic activation and deactivation are examined in the context of their real or potential ability to alter probabilistic dose-response models derived from statistical methodology. Pharmacokinetic dose-response effects are highly dependent upon the relative metabolic activation and deactivation rates of the underlying biochemical processes. Biological steady-state levels are not identical to equilibrium results. For linear pharmacokinetic models the existence of a linear relationship between the external and internal steady-state dose rate depends on the connectivity of the system. This project will provide better understanding of the pharmacodynamic bases of dose-response curves needed to assess the validity of estimating low-dose human risk from high-dose animal experiments.
Keywords: DOSE-RESPONSE RELATIONSHIPS; BIOCHEMICAL REACTION KINETICS; METABOLISM; MATHEMATICAL MODELS; PHARMACOLOGY; DRUGS.

33318 Extrapolation of PCB Deposition. Sipes, I.G. (University of Arizona, Tucson, AZ). **Project number:** EPR-7.2 BB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$109,000.
Related energy source: all(100). **R and D categories:** Health effects.

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 /sup 14/C-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.

33331 Changes in Mammalian Pulmonary Function Produced by Inhaled Environmental Agents. Takezawa, J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80020-06 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$66,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The methods have been established to assess the changes in pulmonary function induced by environmental toxicants. The methods include single breath diffusing capacity for carbon monoxide in the lung (D/sub LCO/), neon dilution to measure lung volumes such as residual volume (RV), functional residual capacity (FRC), and total lung capacity (TLC), and Amdur method to measure dynamic compliance and resistance in small laboratory animals. D/sub LCO/ and lung volumes of normal mammals from hamsters to rabbits have been measured. Morpholine was selected as the first compound to evaluate the sensitivity of our method to detect the damage in the lung. Pulmonary function testing was often more sensitive than light microscopical examination for detecting lung effects of inhaled toxicants. We have found that acute (2000 ppM) and subacute (450 ppM) exposure of morpholine to male rats induced changes in pulmonary function which suggested obstructive lung defect. The interest now is in CO2 response curve of neonatal guinea pigs which have been exposed to 10% of oxygen in air post patrum. It is suspected that in a certain period neonates set down their threshold to hypoxemia and hypercapnia according to the ambient O2 and CO2 conditions. This mechanism could be of significance in infant sudden death syndrome. Since D/sub LCO/ and lung volumes of animals subjected to Paraquat administration have not been reported, this compound and related ones have been selected to clarify the physiological or clinical picture of intoxication by these compounds. The interest is also in assessing the changes in lung function in animals exposed to a highly alkaline vapor of similar pH to morpholine. Pulmonary function testing will be deleted from the program of the Inhalation Toxicology Section effective June, 1978.
Keywords: LUNGS; DYNAMIC FUNCTION STUDIES; INHALATION; CARBON MONOXIDE; HAMSTERS; RABBITS; TOXICITY; BIOASSAY; MORPHOLINES.

33332 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-30042-03. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$15,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objectives of this project are to assess the cardiac effects from exposure to various environmental agents. At the present time studies will be performed using isolated perfused small animal hearts. Compounds of current interest include low molecular weight halogenated alkanes such as anesthetics, fluorocarbons, and brominated compounds as well as some of the energy-related pollutants. In the future we would like to be able to compare in vitro vs. in vivo preparations using surgically implanted energy transducers and detectors. The function of isolated, perfused rabbit, rat, and guinea pig hearts will be monitored. Animals may be previously exposed to contaminants followed by excision and perfusion of hearts or the hearts may be exposed acutely in vitro. Myocardial mechanical, electrical, and metabolic activity may be monitored concurrently. Two model systems are employed: (1) the perfused, isolated, Landendorff heart preparation; and (2) the superfused isolated papillary muscle preparation. Mechanical activity in the whole heart is monitored using an intraventricular balloon connected to a pressure transducer, and in the papillary muscle using a force transducer. Electrical activity is assessed using surface electrograms or microelectrode recordings. Metabolic activity of the whole heart is determined by monitoring perfusate pH, PCO2, and PO2 as it enters the aorta and as it exits the coronary sinus.
Keywords: CARDIOVASCULAR SYSTEM; DYNAMIC FUNCTION STUDIES; ALKANES; ORGANIC FLUORINE COMPOUNDS; ORGANIC BROMINE COMPOUNDS; ANESTHETICS; ANESTHESIA; BIOLOGICAL EFFECTS; RABBITS; RATS; GUINEA PIGS; METABOLISM; HEART; PHYSIOLOGY.

33333 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-30045-02 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Data acquisition and feedback control theory have been used to develop an electronic calculator-based sampled data control system capable of regulating 9 chambers on a time multiplex basis. Since this system must regulate gases generated from compounds with different physical properties, it has been necessary to design a control system capable of measuring certain characteristics of each generating system and adapting the control equations to optimize responses for each particular compound. Because equipment calibration is a significant factor in system performance statistical procedures have been implemented to evaluate daily calibrations and long term system performance. In order to better define the exposure environment, temperature and humidity are monitored and animal excrement actively removed during the course of the exposure. Special purpose procedures and software necessary to handle unusual exposures and circumstances must be developed to bring this system to its full potential. The realization of maximum usefulness of this project requires detailed documentation of system hardware, software, and operating procedures. System performance must be documented through use.
Keywords: LABORATORY ANIMALS; LABORATORY EQUIPMENT; TOXICITY; INHALATION; BIOLOGICAL EFFECTS; DATA ACQUISITION SYSTEMS; OPTIMIZATION; MONITORING; BIOCHEMISTRY; AUTOMATION; INHALATION; EXPOSURE CHAMBERS.

33334 Chemical Conjugation of Specific 13C-Labeled Benzo[a]pyrene Oxides to Glutathione: Regiospecificity and Stereospecificity. Cox, R.H. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 30050 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$48,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Several benzo[a]pyrene derivatives of high purity and definition including two oxides, one dihydrodiol and one diol oxide, labeled at specific positions and known enrichments with nonradioactive 13C have been obtained. Studies with benzo[a]pyrene-4,5-oxide-4,5-13C2 have been initiated to determine the preferred position of attack on the arene oxide by glutathione S-transferase enzyme system previously shown to covalently bind certain epoxides. Studies with styrene oxide have shown that both positional isomers (attachment of sulfur of glutathione to the epoxide) are produced in approximately equal amounts, with little difference in the isomer ratio between the enzymatic and non-enzymatic reactions. High-pressure liquid chromatographic (HPLC) techniques have been developed to separate the isomers produced. Future studies should include competition experiments to determine which biological nucleophiles are most reactive and the enzymatic versus non-enzymatic nature of the ring opening process and, if possible, elucidation of the required microenvironment for the covalent binding of such arene oxides. 13C-NMR spectra of the various oxygenated derivatives will be recorded routinely for reference purposes.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; ORGANIC OXYGEN COMPOUNDS; GLUTATHIONE; BIOCHEMICAL REACTION KINETICS; LABELLED COMPOUNDS; CARBON 13; STEREOCHEMISTRY; ISOMERS; NUCLEAR MAGNETIC RESONANCE; ENZYMES; CARCINOGENESIS; METABOLISM; MUTAGENESIS; TOXICITY; SPECTROSCOPY; TRANSFERASES; ADDUCTS.

33335 Field Desorption Mass Spectrometry Studies Analysis of Small Polynucleotide--Carcinogen Adducts. Hass, J.R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 30064 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Finding mass spectrometric methods for the analysis of small polynucleotide carcinogen adducts will permit a rapid method for identification of these compounds, permitting studies of the effects of neighboring groups upon the reactivity of the site attacked. Such studies should illuminate the microevironments important in environmental chemical carcinogenesis. The major adduct products from reaction of N-acetoxy-2-acetamidofluorene (NA-AAF) with phosphodinucleotides and small polynucleotides in citrate buffer were separated and isolated. As soon as the field desorption capability of the ZAB-2F mass spectrometer is routinely operational, these adducts will be used as models to find appropriate conditions for obtaining the field desorption mass spectra of small polynucleotide NA-AAF adducts. Four adducts of 9-bromomethylbenz(a)anthracene with nucleosides have been obtained from Professor Robert Shapiro (New York University) and phos-

phodinucleotide adducts of benzo(a)pyrene epoxydiol will be prepared following successful analysis of the NA-AAF adducts.
Keywords: NUCLEOTIDES; CARCINOGENS; ADDUCTS; MASS SPECTROSCOPY; CHEMICAL REACTIONS; DNA; HYDROCARBONS; MUTAGENESIS; BIOCHEMICAL REACTION KINETICS.

33336 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 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

There is increasing evidence that certain heavy metals produced as energy by-products may accumulate in body tissue and fluid and present serious health effects. Binding propensity of the heavy metals and toxicity and accumulation may be correlatable. An understanding of the specific molecular level interactions involved in binding may permit one to predict, prevent, or reverse them. There is an increasing body of evidence that the transport and accumulation of heavy metals in body tissue and fluids is related to the binding of the metals in biological systems. Studies to date have shown that 207-Pb NMR offers a very sensitive probe into the binding of lead. Future studies should include binding of lead to various biological systems with an attempt to correlate binding propensity with toxicity. In addition, NMR methods should be developed for investigating the binding of other heavy metals.
Keywords: LEAD; METALS; CHEMICAL EFFLUENTS; HEALTH HAZARDS; TOXICITY; CHEMICAL BONDS; BIOCHEMICAL REACTION KINETICS; METABOLISM; NUCLEAR MAGNETIC RESONANCE; LEAD 207.

33337 Effects of Chronic Low Level Lead Exposure in Rats: Immune Alterations. Luster, M.I. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-30068 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$6,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

Studies were performed to investigate the effects of chronic, low level pre- and post-natal lead exposure on immune functions in rats. Weanling female rats were exposed to lead (as lead acetate) in their drinking water at 0, 25, and 50 ppM for 7 weeks. At the end of 7 weeks they were mated with untreated males and continued on the same dosage throughout gestation and lactation. The offspring of these females were weaned at 21 days of age and continued on the same lead exposure regimen as their mothers. These offspring were used in immune surveillance procedures between 35 and 45 days of age. Lead exposure at the levels employed had no statistically significant effect on growth and did not result in overt signs of toxicity. Thymic weights were significantly decreased in both males and females of the two lead dosage groups. Furthermore, lead exposure resulted in suppression of responsiveness of lymphocytes to mitogen stimulation and in reduced delayed hypersensitivity responsiveness. A marked depression in the antibody response to sheep red blood cells (SRBC) as well as decreased serum IgG levels were observed. Serum IgM and IgA levels were normal.
Keywords: LEAD; METABOLISM; CHRONIC EXPOSURE; IMMUNOLOGY; EMBRYOS; FETUSES; NEONATES; MALES; FEMALES; PATHOLOGICAL CHANGES; TOXICITY; IMMUNE SERUMS; ANTIBODIES; BLOOD SERUM; DYNAMIC FUNCTION STUDIES; INGESTION.

33338 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-30085-01 EBCB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective of this project is to search for evidence of early toxic lung injury that may shed light on subsequent events. Animals will be exposed to gases and fibers that may be found as environmental contaminants. Exposures are carried out in dynamic flow through chambers of two types. One type provides whole body exposure and the other is a nose exposure unit. Pulmonary lavages are obtained and the cellular, lipoprotein and lipid components are isolated by differential centrifugation. The 125-I Wheat Germ agglutinin binding to alveolar macrophages will be used as a probe of alteration in alveolar macrophage membrane structure. The lipids (those associated with surfactants and those that are free) will be separated into classes by T.L.C. and column chromatography and their fatty acid composition determined by G.L.C.
Keywords: LUNGS; BIOLOGICAL STRESS; BIOASSAY; TOXICITY; GASES; FIBERS; BIOLOGICAL EFFECTS.

33351 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-20003-05 OHHA. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$72,000.
Related energy source: fossil fuels(50); biomass(50). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The project develops and uses preventive surveillance appropriate to NIEHS. The information relates to the compounds or physical agents considered, and then as much as possible to related chemical, physical, or biological systems. Methanol is still mentioned for possible use as a fuel alone or with gasoline. Communications are maintained with appropriate individuals world-wide. Ethanol is gaining acceptance over methanol in Brazil and Australia. Also, the catalytic conversion of methanol to a mixture of hydrocarbons similar to gasoline may be economically feasible in the future. Use of methanol in sealed system, large-scale applications would be less hazardous because then it would not be inhaled, absorbed through the skin or ingested in drink. The principal investigator assisted the Working Group on a National Ambient Air Quality Standard for Lead and reviewed their documents. Participation in considerations of stratospheric pollution is also being continued.
Keywords: CHEMICAL EFFLUENTS; TOXICITY; BIOASSAY; BIOLOGICAL INDICATORS; METHANOL; ETHANOL; HYDROCARBONS; LEAD; HEALTH HAZARDS.

33352 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-20004-04 OHHA. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Health effects.

The objectives are: (1) to determine whether exposure to a large variety of chemical agents from both existing and developing technologies may result in long-term neurological and behavioral consequences; (2) to assess the availability, validity, and utility of animal test systems which are used to reveal such neurobehavioral toxicity; (3) to evaluate methods for monitoring neurobehavorial effects in exposed humans; and (4) to suggest research programs necessary to establish a firm scientific basis for using neurophysiological and behavorial tests as early warning indicators of toxicity. A literature review aimed at integrating the available information on neurobehavioral toxicity will be conducted, and attendance at meetings and membership on committees concerned with the neurological and behavioral effects of various agents will be instigated. Reviews of documents and manuscripts; preparation of reports; and consultations with scientists from other Government agencies, industry, and academia will be undertaken.
Keywords: NEUROLOGY; BEHAVIOR; TOXICITY; CHEMICAL EFFLUENTS; RESEARCH PROGRAMS; RECOMMENDATIONS; HUMAN POPULATIONS; BIOLOGICAL INDICATORS; DATA ACQUISITION; BIOASSAY; DATA ACQUISITION SYSTEMS; RISK ASSESSMENT; HEALTH HAZARDS.

33353 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-20007-01 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:** Characterization, measurement, and monitoring; Health effects.

An evaluation of the potential impact of increased coal production on cancer incidence in coal miners and of increased coal combustion on cancer incidence in the general population was completed in response to a request from the President's Task Force.
Keywords: CHEMICAL EFFLUENTS; HEALTH HAZARDS; CARCINOGENS; COAL INDUSTRY; NEOPLASMS; COAL MINERS; HUMAN POPULATIONS; RISK ASSESSMENT; AIR POLLUTION; WATER POLLUTION.

33361 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.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment; Health effects.

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 Hbb-A to mutate to Hbbs 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.

33362 Electrophoresis of Mouse Tissue. Zweidinger, R. (Research Triangle Institute, Chemistry and Life Sciences Division, Research Triangle Park, NC, 27709). **Project number:** ERP-1.1 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$246,000.

R and D categories: Health effects.

This is one of several projects serving an experimental program which has as its purposes (1) investigation of potential means to detect germinal gene mutations in the mammalian organism, (2) investigation of environmental agents for their capacity to induce germinal mutations in mammals, and (3) investigation of health impact associated with increased mutation rates. This project is concerned with evaluating electrophoretic methods and enzyme activity characteristics as indicators of mutational events. Male mice are exposed to a model mutagen, mated with females and the F1 offspring examined for electrophoretically and kineticaly altered enzymes. Untreated males are also used for control purposes and similar analyses are performed on all parents and offspring. Presumptive mutants are verified by genetic analysis. This is possible because tissue samples are used which do not require sacrifice of the animals. The metabolic consequences of the detected and verified mutants will be investigated.

Keywords: MICE; TISSUES; ELECTROPHORESIS; MUTAGENESIS; BIOASSAY; MUTAGEN SCREENING; TOXINS; GENETIC EFFECTS; HEALTH HAZARDS; BIOLOGICAL EFFECTS.

33363 Environmental Mutagen Information Center. Wassom, J.S. (Oak Ridge National Laboratory, Environmental Mutagen Information Center, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** ERP-1.2 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$269,000; EPA-$31,000.

Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

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.

33364 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.

R and D categories: Characterization, measurement, and monitoring; Integrated assessment; Health effects.

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.

33365 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.

R and D categories: Health effects.

This is one of several projects serving an experimental program which has as its objectives (1) investigation of potential means to detect germinal gene mutations in the mammalian organism, (2) investigation of environmental agents for their capacity to induce germinal mutations in mammals, and (3) investigation of health impact associated with increased mutation rates. This project is an effort to explore the potential of several quantitative (polygenic) characteristics as indicator of mutagenic activity. Traits determined by several genes may offer advantages in sensitivity if mutation at any one of the several genes alters the trait perceptively. Characteristics involved in the study include (1) age of development of righting response, (2) body weight at weaning, (3) defectation portion of the open field test, (4) tail length at seven weeks, (5) hematocrit at seven weeks, and (6) brain weight at maturity. In addition several productivity traits are employed: (1) percent dead implantation scars, (2) total implantation scars, (3) percent females born, (4) total born, (5) percent females weaned, and (6) total weaned.

Keywords: BIOASSAY; MUTAGENESIS; MICE; MUTATIONS; BIOLOGICAL MODELS; BIOLOGICAL INDICATORS.

33366 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 LBG. **Contract:** NIH-N01-ES-5-2159. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.

R and D categories: Health effects.

This is one of several projects serving an experimental program which has as its objectives (1) investigation of potential means to detect germinal gene mutations in the mammalian organism, (2) investigation of environmental agents for their capacity to induce germinal mutations in mammals, and (3) investigation of health impact associated with increased mutation rates. This project is concerned with the construction of special strains of mice having genetic characteristics particularly suitable to the detection of newly arisen mutant genes. When two strains having different alleles homozygous at common loci between items are used in the experimental induction of mutation, there is sometimes the possibility of recognizing both parental gene products in the offspring. If one is altered by mutation, then by the presence of the one which is normal in the offspring, mutation can be reliably attributed to one or the other parent and thus to the mutagen treated or untreated gene. The more such loci there are differing between the strains, the more sensitivity there is in detecting mutation. This work is an effort to expand the number of genetic differences between two commonly used mouse strains by genetically incorporating potentially useful workers from other strains into one of them.

Keywords: MICE; MUTANTS; BIOASSAY; MUTAGEN SCREENING; LABORATORY ANIMALS; GENETIC VARIABILITY; MUTAGENESIS; BIOLOGICAL MODELS; HEALTH HAZARDS.

33367 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 56002-01 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
R and D categories: Characterization, measurement, and monitoring; Health effects.

The objective is to develop methodology for studying mutation in mammals in vivo utilizing monospecific antibodies against hemoglobins. Antibodies are raised against various variants of mouse hemoglobins. These antibodies are then rendered monospecific through several absorptions. The monospecific antibodies are used in fluorescence antibody technique for the detection of mutations. Several antisera against DBA/2 (D2) and C57BL/6 (C57) hemoblobin (Hb) have been raised in horses and rabbits. Different pools of the antisera were found to contain 0.2 to 2.2 mg precipitating antibody/ml of serum when titrated with homologous (immunizing) Hb. Sharp precipitin bands were observed with homologous as well as heterologous hemoglobins in gel diffusion. Purification of monospecific antibody from these sera is in progress. This involves absorbing the serum with the heterologous Hb-immunoabsorbent to remove the cross reacting antibodies; the absorbed serum is then passed through a homologous Hb immunoabsorbent column. The bound antibody is eluted with an acidic pH buffer. This last step results in the elution of significant amounts of Hb along with the antibody. Experiments are being carried out to find an efficient way of removing the contaminating Hb without losing too much antibody. Red blood cells from D2 and C57 mice could be successfully labeled with FITC-conjugated purified anti-Hb antibodies. However, this technique required FITC labeling of each antibody preparation which results in significant loss of the purified antibody. A sandwich immunofluorescent technique has been developed that utilizes FITC-labeled goat anti-horse IgG. This technique precludes the need for FITC-labeling of the anti Hb antibody and is also more sensitive than the direct method.
Keywords: MUTAGENESIS; BIOLOGICAL MODELS; ANTIBODIES; HEMOGLOBIN; BIOLOGICAL VARIABILITY; HORSES; RABBITS; GOATS.

33368 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 60019-05 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
R and D categories: Characterization, measurement, and monitoring; Health effects.

The aim of this project is to develop systems for measuring the frequency of point mutations and DNA change in male germinal tissue. These systems would have the advantage of testing the human population by means of readily available samples, i.e., spermatozoa. Some enzymes in sperm can be detected readily by histochemical methods. The enzymes under study in this laboratory are alpha-glycerophosphate dehydrogenase and succinate dehydrogenase. The principle of these studies is that, with the use of standardized staining procedures and use of thermodenaturation, it should be feasible to detect thermoresistant mutations in the spermatozoal enzymes. These mutations will be estimated by counting stained and unstained cells with the aid of a Zeiss Axiomat microscope connected to a PDP-12 computer and a teleprinter output. At present, it has been possible to standardize the staining technique to the extent that it is reproducible after repeated experimentation. The characteristics of the thermodenaturation of alpha-glycerophosphate dehydrogenase and succinyl dehydrogenase has been established in situ. Similar studies will be carried out with the enzymes in vitro. Ten to twenty different mouse strains will be screened for natural variation in the thermosensitivity of these two enzymes.
Keywords: SPERMATOZOA; MALES; DNA; MUTATIONS; MUTAGEN SCREENING; HUMAN POPULATIONS; ENZYMES; STANDARDIZATION.

33369 Immunological Comparison of Mouse Hemoglobins. Ansari, A.A. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 65001-01 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$24,000.
R and D categories: Characterization, measurement, and monitoring; Health effects.

Mouse hemoglobins are being used in this laboratory to develop immunological methods for the study of mutation in mammals in vivo. An immunological comparison of these hemoglobins was, therefore, essential. Different hemoglobin variants were compared in radioimmunoassay and the immunological differences among them were found to correlate with amino acid sequence differences. A solid phase radioimmunoassay, utilizing 125-I labeled hemoglobin and Sepharose-bound anti-hemoglobin antibody, was used to compare the immunological properties of different mouse hemoglobins. Immunological properties of several mice hemoglobins bearing alpha-chains 1 or 4, and beta-chains, d/sub maj/ or p/sub min/ were compared using radioimmunoassays that involved inhibition by these hemoglobins of a reaction between 125-I labeled C57BL/6 hemoglobin (alpha-chain 1, beta-chain s) and horse antibody against C57BL/6 hemoglobin. SJL hemoglobin (alpha-chains 1 and 4, beta-chain s) and C57BL/6 hemoglobin were found to have identical relative association constants, K/sub 0(rel)/. The d/sub maj/ hemoglobins from DBA/2 and AU/Ss mice (alpha-chain 1, beta-chain d/sub maj/) were 3.3 to 3.6 times less reactive while the p/sub min/ hemoglobin from AU/Ss mice was found to be 17 times weaker than C57BL/6 hemoglobin. These immunological differences correlate with the amino acid sequence differences in the beta-chains.
Keywords: MICE; IMMUNOLOGY; HEMOGLOBIN; RADIOIMMUNOASSAY; MUTAGENESIS; BIOLOGICAL MODELS; BIOLOGICAL VARIABILITY; IODINE 125; HOSES; PROTEINS.

33370 Comparison of Double Antibody and Solid-Phase Radioimmunoassay. Ansari, A.A. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-65006-01 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

We are developing radioimmunoassays (RIA) for the study of mutation in hemoglobins. This project was undertaken to compare two RIA procedures, namely, double antibody RIA and solid phase RIA. The former method was found to be more sensitive than the solid phase RIA. Solid phase RIA was done using hemoglobin covalently bound to CNBr-activated Sepharose. Double antibody RIA was carried out using goat anti-horse IgG and 5% polyethylene glycol for precipitating the primary immune complexes. These two methods were compared under similar conditions using the same reagents. Two commonly used radioimmunoassay (RIA) procedures, double antibody assay and solid phase assay, have been compared using the same reagents and conditions. Mouse hemoglobin-horse anti-mouse hemoglobin system was chosen for this study. The antibody was found to have more binding capacity in soluble form than in the Sepharose-bound form. The inhibition curves in both the assay systems were shifted to higher inhibitor concentration at higher control binding levels. At 40% control binding level, the double antibody RIA was found to be 2.7 times more sensitive than the solid phase RIA. The reason for this most probably lies in the lower binding capacity of the Sepharose-bound antibody which necessitates the use of higher amounts of the antibody to reach 40% control binding.
Keywords: RADIOIMMUNOASSAY; HEMOGLOBIN; MUTATIONS; ANTIBODIES.

33371 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-65007-01 LBG. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
R and D categories: Characterization, measurement, and monitoring; Health effects.

This project is designed to study mutagenesis using monospecific antibodies against the sperm specific enzyme, lactic dehydrogenase-X. The antiserum against mouse LDH-X has been characterized and its cross reaction with rat LDH-X has been studied. An immunofluorescent technique has been developed to label the mouse and rat sperm using the horse anti-LDH-X antibody and FITC-labeled goat anti-horse IgG antibody.
Keywords: SPERMATOZOA; MUTANTS; ENZYMES; MICE; RATS; MUTAGENESIS; BIOLOGICAL MODELS; PROTEINS; IMMUNOLOGY.

33381 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 90000-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
R and D categories: Health effects.

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. Rats were dosed in drinking water for a total of 12 weeks with

silver (1000 ppM of elemental slver as silver nitrate), selenium (10 ppM of elemental selenium as sodium selenate) or a mixture of these two solutions. Body weights and gross food and water consumptions were taken weekly. Neurobehavioral measures were taken biweekly. Body weights for the selenium alone group were depressed from the third week of dosing on, although food consumption (g food/g body weight/day) was elevated for those animals. Food consumption for the silver/selenium group was also typically elevated though not as markedly. Water consumption (ml water/g body weight/day) 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, although when (transient) differences from controls occurred they were more likely to be in the selenium alone group than any other.
Keywords: SELENIUM; SYNERGISM; SILVER; TOXICITY; RATS; BEHAVIOR; NEUROLOGY.

33382 Effects of Acrylamide on Food, Kaolin, 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 90001-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$15,000.
R and D categories: Health effects.

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 the changes in each behavioral variable as a function of dose and length of exposure and to associate behavioral dysfunction with neurophysiological and neurochemical measures. Adult male, Fischer strain rats are housed individually in stainless steel home cages. Measures of food, kaolin, and water ingestion, as well as home cage crossings, are obtained on-line using a laboratory computer system. The effects of acrylamide given orally 3 times per week on baseline domiciliary behaviors are currently being studied. The time and cumulative dose required to observe behavioral toxicity are being assessed. Eventually, studies to evaluate the effects of acrylamide on nerve conduction velocities, amplitude, and duration of axonal firing and muscle strength will be studied in behaviorally affected rats. In addition, the effects of acrylamide on the turnover and disposition of brain neurotransmitters, such as dopamine and norepinephrine, in various regions of the nervous system will be determined.
Keywords: ACRYLAMIDE; METABOLISM; FOOD; WATER; DIET; BEHAVIOR; BIOLOGICAL EFFECTS; TOXICITY; KAOLIN; CONSUMPTION RATES; RATS; NEUROLOGY.

33383 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 90003-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$6,000.
R and D categories: Health effects.

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. Pregnant mice are given 3,4,3',4'-tetrachlorobiphenyl by gavage on days 6 to 13 of gestation. The PCB-exposed offspring are assessed for the presence or absence of rapid circular movements or spinning at a time prior to weaning. At 21 days of age, spinning and non-spinning mice are selected with control mice for evaluation in a longitudinal behavioral study. The measures include: exploratory activity, rectal temperature, forelimb grip strength, visual placement, ability to balance on a wire, acquisition of one-way avoidance response, and body weights. Tests are conducted at 1, 2, 6, and 12 months of age. In addition, diurnal activity of mice housed in groups of four is assessed over a 4 or 5 day period following each neurobehavioral assessment. These experiments are still underway. In addition to the above neurobehavioral profile, future studies will include measures of food and water consumption, a systematic study of environmental factors that elicit spinning behavior, and psychopharmacological studies of possible homeostatic changes in catecholaminergic and cholinergic functioning in the central nervous system.
Keywords: AROMATICS; ORGANIC CHLORINE COMPOUNDS; TOXICITY; MICE; BEHAVIOR; NEUROLOGY; EMBRYOS; CENTRAL NERVOUS SYSTEM.

33384 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 90004-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$9,000.
R and D categories: Health effects.

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. Male, albino rats of the Fischer strain are exposed to 2 mg/l of carbon disulfide (CS2) by inhalation 4 hours per day, 5 days per week for 6 consecutive weeks. At weeks 3 and 6 during dosing and at 1 and 3 weeks after cessation of dosing, rats are assessed for neurobehavioral functioning using the following measures: exploratory motor activity, startle responsiveness, rectal temperature, performance on an inclined screen, forelimb grip strength, hind limb extensor response, visual placement responses, and gross behavioral observations of sensory/motor functioning. Body weights are taken weekly during the course of the experiment. Some rats will be tested after 6 weeks of dosing and 3 weeks after cessation of dosing for changes in the sensitivity of catecholaminoergic functioning. Spontaneous motor activity, startle responsiveness, and stereotypic motor responses following systemic administration of d-amphetamine and/or apomorphine will be assessed.
Keywords: RATS; CENTRAL NERVOUS SYSTEM; BEHAVIOR; CARBON SULFIDES; TOXICITY; BIOLOGICAL MODELS; NEUROLOGY.

33385 Neurobehavioral Effects of Chronic 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 90010-01 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$24,000.
R and D categories: Health effects.

The present work is intended to assess neurobehavioral consequences of chronic (six month) exposure to a commercial mixture of PBB (Firemaster FF-1). Rats receive 0.3, 1.0, or 3.0 mg/kg body weight of FF-1 or corn oil vehicle. Mice receive 1.0, 3.0, or 10.0 mg/kg body weight of FF-1, or vehicle. Both male and females rats and mice are to be tested in a battery designed to screen for neurobehavioral dysfunction. Tests for rats include: body weight, motor activity, sensorimotor reflexes or orientation, visual placement, forelimb grip strength, inclined screen, hind limb strength, startle to air puff, and rectal temperature. Shock escape latencies and acquisition of shock avoidance are tested at the end of one month's dosing and retention is tested at 2 and 6 months. Mice receive the same tests except for hind limb strength, inclined screen, startle, and lateral hop. Autonomic/general health observations and food consumption measures are taken on all animals. At the end of the dosing period, some subjects will be tested in a neurophysiological battery consisting of measures of nerve induction speed, maximal firing rates, and duration of maximal rates. Attempts to measure the strength of the hind limb reflex will also be made.
Keywords: NEUROLOGY; BEHAVIOR; RATS; MICE; CENTRAL NERVOUS SYSTEM; ORGANIC BROMINE COMPOUNDS; TOXICITY; RODENTS; BIOLOGICAL MODELS.

33386 Neurobehavioral Toxicity of Developmental Exposure to Lead. Kimmel, C.A. (National Institute of Environmental Health Sciences, National Center for Toxicological Research, Teratology Division, Jefferson, AR, 72079). **Project number:** Z01 ES 70220-05 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$120,000.
R and D categories: Health effects.

The effects of lead on the behavior and development of offspring exposed chronically before and after birth are being studied. A broad battery of observations of physical developmental milestones, reflex ontogeny, and behavioral functions is being employed to determine the full range of neurotoxic potential of lead. These observations are being related to the teratogenic activity and body burden of lead as estimated from levels found in blood, brain, and bone at various times throughout the exposure period and to neurochemical parameters which indicate changes in developing brain chemistry. Lead doses of 50 and 250 ppM produce overt toxic effects on body weight, physical and behavioral development, and biochemical and morphologic parameters. At 25 ppM, there is an effect on time of vaginal opening in parent and F1 females and in the immunologic competence. Behavioral testing of animals exposed to 250 ppM of lead up to 6 to 9 months of age indicated impaired surface righting responses and slightly delayed maturation of locomotor response patterns. Significant delays in the development of sensorimotor reflexes were not noted. Acquisition of a two-way shuttle box avoidance task was generally impaired in animals receiving 5 to 50 ppM of lead and the effect may have been dependent upon the age the subject at the time of testing.
Keywords: LEAD; TOXICITY; EMBRYOS; NEONATES; CENTRAL NERVOUS SYSTEM; BEHAVIOR; NEUROLOGY; BRAIN; BIOLOGICAL MODELS; ANIMALS.

33387 Neurochemical Correlates of Behavioral Toxicology. Wilson, W.E. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-70800-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$138,000.
R and D categories: Health effects.

In order to obtain a better understanding of the neurochemical bases for behavior modification resulting from environmental stresses, we have undertaken studies concerned with: (a) alterations in levels and characteristics of enzymes which, because they are rate limiting, may provide critical regulation of neurotransmitter levels (e.g., monoamine oxidase, tyrosine hydroxylase, etc.); and (b) the extent to which neurotransmitter concentrations may be modulated or altered in those parts of the central nervous system which are thought to be involved in behavior regulation. We are now focusing our attention on some of the consequences of modulation of gonadal steroid production in the neonate with respect to sexual differentiation in rodent (rat) brain. Monoamine oxidase (MAO) levels and turnover rates will be used as one criterion for reflection of sex steroid modulation, while other criteria will include estimations of serotonin and catecholamine levels and turnover rates in various parts of the brain. It was observed that castration of newborn rats on postnatal day 1 led to the following situation on day 63: whole brain homogenate levels of MAO types A and B were diminished relative to control values, whereas the activities of MAO and of 5 of 6 other enzymes in liver homogenates of the treated animals did not differ from control values.
Keywords: CENTRAL NERVOUS SYSTEM; NEUROLOGY; BIOCHEMISTRY; BEHAVIOR; RATS; ENZYMES; BRAIN; SPERMATOZOA; BIOLOGICAL STRESS.

33388 Etiology of Pica in the Rat. Squibb, R.E. (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.70805-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
R and D categories: Health effects.

A continuing series of experiments seeks to validate the functional utility of pica (geophagia) as a behavioral assay of toxicosis in the rat. The present studies sought to demonstrate the effects of orally administered lithium chloride, apomorphine, and acrylamide on the kaolin consumption of Fischer strain albino rats. Male rats of the Charles River CDF 344 strain are individually housed with a 12 hour light-dark cycle and provided food (NIH No. 31 diet), water, and kaolin ad libitum. Baseline data for body weights, food, water, and kaolin consumption are collected daily for at least 10 days. It has been determined that Charles River CDF 344 rats dosed with 127.2 mg/kg of lithium chloride at dose volumes of 1 ml/kg and 20 ml/kg body weight administered either intraperitoneally or by gavage engaged in geophagia after the second dose. Rats with the 10 ml/kg volume and ip mode of administration, however, did not. In this study, increased water consumption seemed to be the more sensitive indicator of lithium toxicosis. In a comparable study in which 0, 0.25, 0.50, and 1.0 mg/kg of apomorphine was administered ip at a volume of 1 ml/kg on four consecutive occasions, there was no evidence of geophagia across treatment groups.
Keywords: TOXICITY; BEHAVIOR; BIOASSAY; LITHIUM CHLORIDES; KAOLIN; DRUGS; RATS; GENETIC VARIABILITY; CENTRAL NERVOUS SYSTEM.

33389 Neurotoxicological Effects of Polybrominated Biphenyls in Rats and Mice. Tilson, H.A. (National Institute of Environmental Health Sciences, Laboratory of Behavioral and Neurological Toxicology, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 70805-02 LBNT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
R and D categories: Health effects.

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.

33401 Effects of 60 Hz Fields on the Mammalian Central Nervous System. Adey, W.R. (University of California at Los Angeles, Brain Inst., Los Angeles, CA, 90024). **Project number:** NR-201-219(ERR-4.75.23) LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

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. Exposure of rats to 60 Hz electric fields at 50, 500, and 1000 volts/meter (V/m) have been completed. Preliminary results indicate a possible increase in movement in the first 7 days of exposure in the 500 V/m exposed group and the first 3 days of the 1000 V/m group with a return toward sham levels after these periods. Urine output was higher for animals in 500 and 1000 V/m and 500 V/, groups, and a decrease in the 1000 V/m group. Average weight of wet adrena tissue was higher (57.8 mg) for 500 V/m group and for 1000 V/m (50.8) than in the no-field group (43.1 mg). No differences were detected in averaged wet thyroid tissue weights. No changes in any of the examined hematological parameters were measured.
Keywords: CENTRAL NERVOUS SYSTEM; BIOLOGICAL STRESS; POWER TRANSMISSION LINES; NEUROLOGY; ENDOCRINE GLANDS; RATS; MAGNETIC FIELDS; ELECTROMAGNETIC RADIATION; BIOLOGICAL EFFECTS; DAILY VARIATIONS.

33402 Shale Oil Bioeffects. Chignell, C.F. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 50036-01;ERP-5.2-LEB;Z01 ES 50032-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$80,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.

The objectives of this project are to: (1) study the role of free radical intermediates formed during the metabolism of polynuclear hydrocarbons in the toxicity of these agents; (2) study the mechanisms by which light (uv and visible) synergizes the tumorigenicity of polynuclear hydrocarbons on skin; and (3) study the effect of binding of heavy metal ions to plasma and tissue proteins on the body distribution of the metal ions. The formation and characterization of free radical intermediates will be done using electron spin resonance (ESR) spectroscopy. ESR spectroscopy can detect unpaired electrons present both in free radicals (organic or inorganic) and in paramagnetic metals. In some cases, spin trapping techniques will be used to transform reactive free radical intermediates to form stable radicals which can then be identified.
Keywords: SHALE OIL; POLYCYCLIC AROMATIC HYDROCARBONS; TOXICITY; RADICALS; VISIBLE RADIATION; VISIBLE RADIATION; ULTRAVIOLET RADIATION; SYNERGISM; PHOTOREACTIVATION; METALS; ELECTRON SPIN RESONANCE; BLOOD PLASMA; SKIN; METABOLISM; PROTEINS; BIOLOGICAL EFFECTS.

33403 Effect of NOx on Membrane. Chignell, C.F. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ERP-5.3 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$20,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective of this project is to examine the effects of N02 on model membranes, e.g., liposomes or lecithin multilayers; biological membranes, e.g., those from alveolar macrophages or erthocytes; and the lung surfactant lipoprotein. The electron spin resonance (ESR) spectrometer will be used to detect free radical intermediates formed as a result of reactions with NO2. If such intermediates are not detected, the effect of NO2 on membrane structure would be ascertained with the aid of spin-labeled analogs of steroids, fatty acids and phospholipids.
Keywords: NITROGEN OXIDES; CELL MEMBRANES; BIOLOGICAL EFFECTS; DYNAMIC FUNCTION STUDIES.

33404 Effects of Microwave Radiation on the Nervous System. Lovely, R.H.; Guy, A.W. (University of Washington, University Hospital, Department of Rehabilitation Medicine, Seattle, WA, 98195). **Project number:** ERR-5.9 LEB. **Supported by:** National Inst.

of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$39,000.
Related energy source: solar(30); conservation(30); other advanced(40). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective of this project is to determine the effects of long-term, low-level, exposure to 2450 MHz microwave radiation on the central nervous system and behavior. Rats will be exposed to 2450 MHz plane wave microwave fields at a power density of 500 mu-W/sq cm. The exposures will be for 7 hours per day for 3 months. The following indicators of biological effects will be made: (1) serum content for sodium, calcium, phosphorus, PTH, SH groups and cholorinesterase activity of the blood and 17-ketosteroids in urine will be measured; (2) animals will be evaluated for free-operant and free-repertoire behavior; and (3) EEG recordings will be made on the animals following the four month irradiation period. Blood cholinesterase and sulfa-hydral (glutathione) activity revealed significant initial decrements in the exposed animals relative to the controls followed subsequently by no differences between groups at the end of months 2 and 3. Evaluation of serum electrolytes, CO2 and BUN at the end of the three-month exposure protocol revealed significant differences in Na+, K+, CO2, and ion gap. Behavioral testing of shock sensitivity and tests of open field activity and shuttlebox avoidance responding also revealed significant differences between the groups.
Keywords: MICROWAVE RADIATION; CENTRAL NERVOUS SYSTEM; BIOCHEMISTRY; BIOLOGICAL EFFECTS; BEHAVIOR; RODENTS; CHRONIC EXPOSURE.

33405 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: solar(30); conservation(30); other advanced(40). **R and D categories:** Health effects; Ecological/biological processes and effects.

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.

33406 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-50014-08 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$45,000.
Related energy source: solar(30); conservation(30); other advanced(40). **R and D categories:** Health effects; Ecological/biological processes and effects.

It is the objective of this project to develop exposure systems for bioeffects research and to develop and test techniques for measuring energy absorption. During the past year components have been obtained to develop waveguide exposure systems which will be used to expose cell systems and isolated neurons. The pressure transducer-capillary temperature detector was tested. The detector did not have the necessary stability at the desired sensitivity range. The response tie of the instrument was slower than desired. As a result of these studies, this detector proved unsatisfactory for microwave energy absorption measurements at the levels associated with microwave hazards. A liquid crystal-optic fiber (LCOF) temperature measurement probe was obtained from the Office of Naval Research. This probe does not interact with the microwave field and provides a technique for measuring energy absorption. We used the probe to test the thermistor which we have been using for energy absorption measurements. Excellent agreement between the two detectors was obtained and verifies our techniques as being accurate. The system for exposing isolated neurons has been fabricated and calibrated. The absorbed energy by the isolated nerves have been measured using both the small thermistor probes and liquid crystal-optic fiber probe.
Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; NEUROLOGY; BIOASSAY; BEHAVIOR; NERVE CELLS; EQUIPMENT; CENTRAL NERVOUS SYSTEM.

33407 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-50015-04 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: solar(30); conservation(30); other advanced(40). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective of this project is to determine the effect of microwave radiation on neurological response. Isolated neurons such as the abdominal ganglion of the Aplysia, the sciatic nerves of frogs and the saphenous nerves of cats will be exposed to CW and modulated microwave radiation in the power density range of 1 to 10 Mw/square centimeter. A waveguide system will be used to expose isolated nerves at various power densities in order to determine dose-response effects. The exposed nerves will be cooled in order to eliminate gross heating as a causal effect. Experiments to determine the effects of 2450 MHz CW microwaves on nerve vitality or fatigue under rapid stimulation has been completed. The exposed nerves fatigued faster than the control at specific absorption rates of 10 Mw/g and above. No difference in fatigue rates were measured at 5 Mw/g.
Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; NEUROLOGY; BEHAVIOR; FROGS; CATS; BIOLOGICAL STRESS.

33408 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-50017-04 LEB. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: solar(30); conservation(30); other advanced(40). **R and D categories:** Health effects; Ecological/biological processes and effects.

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.

33421 Genetic Tests to Characterize Specific Locus Mutants in Neurospora Crassa. Colbourn, J.L. (Miles Laboratory, Inc., Elkhart, IN, 46514). **Project number:** NCI-ES-3-2113 LEM. **Contract:** NIH-N01-ES-3-2113. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$70,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The primary objective of this contract is the genetic characterization of presumptive adenine-3 (ad-3) mutants of Neurospora crassa derived from forward-mutation experiments at the Institute and at Illinois State University (under contract with the Institute) with various environmental chemicals as well as various chemical carcinogens. Stock cultures of presumptive ad-3 mutants are analyzed by a series of heterokaryon tests with various standard tester sets which determine the genotypes of the mutants, determine the complementation pattern of ad-3B mutants showing allelic complementation, and also distinguish point mutations from chromosome deletions. Mutants which have been successfully characterized include those induced by ICR-170 in haploid wild-type and in six

different haploid uv-sensitive strains and those induced by various chemical carcinogens in two-component heterokaryons.
Keywords: NEUROSPORA; MUTANTS; BIOASSAY; BIOLOGICAL INDICATORS; CHEMICAL EFFLUENTS; CHROMOSOMAL ABERRATIONS.

33422 Development of a System for Detecting Lethal Mutations in Mice. Roderick, T.H. (Jackson Laboratory, Bar Harbor, ME, 04609). **Project number:** 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: all(100). **R and D categories:** Health effects.

The aim of the contract is to develop strains of mice, carrying marked inversions, 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, 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, decision is made as to the utility of the inversion and appropriate marker genes are induced into the stock.
Keywords: RECESSIVE MUTATIONS; BIOLOGICAL INDICATORS; MICE; CHROMOSOMAL ABERRATIONS; BIOASSAY; STRAND BREAKS.

33423 Tier One Microsomal Assay for Mutagenesis. Rosenkranz, H.S. (New York Medical College, Valhalla, NY, 10595). **Project number:** NIH-ES-6-2124 LEM. **Contract:** N01-ES-6-2124. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$186,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This contract is designed for testing chemicals of interest to the NIEHS. Suspension and plate test procedures are being compared to determine the relative efficiency of each for screening purposes. In addition this laboratory will serve as a pilot laboratory for design and implementation of an interactive computerized system for the collection, storage and analysis of microbial mutagenicity data.
Keywords: MUTAGENESIS; OPTIMIZATION; MUTAGEN SCREENING; BIOASSAY; CHEMICAL EFFLUENTS; INFORMATION SYSTEMS; MICROSOMES; RNA.

33424 Development of Simple Mutagen Test Systems in Neurospora Crassa. Ong, T.M. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60004 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Development of spot plate and suspension tests will provide a simple, economical and quick system in eukaryotes for the detection and evaluation of the mutagenic activity of chemical carcinogens and environmental agents. N23 and N24, selected from hundreds of ad-3 mutants, have been used as testers for the spot, plate, and suspension tests in Neurospora crassa. These two testers are highly sensitive to mutagens and are revertible by specific groups of chemicals. N23 can be reverted from adenine-dependence to adenine-independence by agents which cause base-pair substitutions, whereas N24 can be reverted by frameshift mutagens. Spot, plate, and suspension tests using testers N23 and N24 are satisfactory substitutes for the ad-3 forward mutation system for screening the mutagenic activity of environmental agents and chemical carcinogens in N. crassa. Further studies will be conducted to validate these test systems and to determine whether the sensitivities of these testers to chemicals can be enhanced by incorporation of uv sensitivity and Osmotic markers into these tester strains.
Keywords: MUTAGEN SCREENING; OPTIMIZATION; BIOASSAY; MUTAGENESIS; NEUROSPORA; CHEMICAL EFFLUENTS; METABOLISM; CARCINOGENS.

33425 Comparative Sensitivities of Different Mouse Strains to Mutagenic Agents. Sheridan, W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60026-4 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$6,000.
Related energy source: all(100). **R and D categories:** Health effects.

Earlier studies, utilizing irradiation as the mutagenic source, have shown that the genome of the test organism is a major factor in the determination of its susceptibility to genetic damage. It is our purpose to investigate to what extent such genetically caused differences in sensitivity pertain to other mutagenic agents. We also want to know if the relative level of sensitivity of a defined genome to induction of mutations is constant for all agents or variable depending on the mutagen used. Preliminary screening of five inbred strains using chemical mutagens indicates the existence of strain differences among these strains of mice.
Keywords: MICE; RADIOSENSITIVITY; MUTAGENS; MUTAGENESIS; GENETIC VARIABILITY; IONIZING RADIATIONS; RADIOINDUCTION; MUTAGEN SCREENING; OPTIMIZATION; COMPARATIVE EVALUATIONS.

33426 Comparisons of Effects of Chemical Mutagens on Somatic and Germ Cells of Mice. Sheridan, W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60027-04 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
Related energy source: all(100). **R and D categories:** Health effects.

This project is designed to explore the feasibility of using somatic cells to screen for chemically induced chromosomal aberrations. The use of somatic cells for screening purposes would allow for rapid screening of large numbers of animals provided such techniques are reliable in the detection of aberrations. Included in this project are comparisons with respect to the efficiency of detection of chromosome aberrations in germ cells (testicular preparations and sperm morphology), cultured lymphocytes and bone marrow preparations. In the studies conducted thus far, chromosome preparations from cultured lymphocytes or bone marrow seem to be less reliable for use in the detection of aberrations than chromosomes prepared from testicular tissues.
Keywords: CHEMICAL EFFLUENTS; MUTAGENS; GERM CELLS; SOMATIC CELLS; CHROMOSOMAL ABERRATIONS; MUTAGEN SCREENING; BONE MARROW; LYMPHOCYTES; CELL CULTURES; BIOASSAY; MICE.

33427 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-60042-02 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
Related energy source: all(100). **R and D categories:** Health effects.

Studies are being conducted of the induction of recessive lethal mutations in mice by chemical mutagens. Backcross progeny between F1 offspring of chemical mutagen treated parents and their F2 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 irradiation has previously been demonstrated in the mouse. No adequate study of this class of mutation has been conducted in mice following treatment with chemical mutagens. It is our purpose to investigate whether chemicals will induce recessive lethals in mice and what might be the mode of action and long-term effects of such mutations on mammals. Preliminary analyses of the data indicates that a high frequency of the F1 males studied are bearers of recessive lethals.
Keywords: MICE; CHEMICAL EFFLUENTS; MUTATIONS; INDUCTION; FETUSES; RECESSIVE MUTATIONS; MUTAGEN SCREENING; DNA; BIOLOGICAL MODELS.

33428 Role of Enzyme Induction in the Metabolism of Mutagens. Zeiger, E. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ES-60049-LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$24,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Arochlor-induced rat liver S-9 is widely used for metabolic activation of chemicals tested for mutagenicity. This study is designed to define the enzymic properties of Arochlor-induced S-9 and also to evaluate the suitability of induced versus uninduced S-9 for mutagenic studies. Arochlor induction significantly increased levels of enzymes studied, and protein/gm liver was unchanged. BaP mutagenesis was enhanced and 2-AA mutagenesis was depressed by S-9 from induced animals. There was a positive correlation with BaP mutagenicity as a function of AHH or cytochrome concentration. Additional studies will be performed to determine if the enzyme induction and mutagenic responses are also present in extrahepatic tissues and other animal species, and whether the depression of mutagenicity seen with 2-AA is also seen with other aromatic primary amines.

Keywords: ENZYMES; METABOLISM; MUTAGENS; BENZOPYRENE; BIOCHEMICAL REACTION KINETICS; MUTAGENESIS; RATS; LIVER; PESTICIDES.

33429 Evaluation of Metabolic Activation Techniques for Mutagens for Yeast, Using Yeast. Zeiger, E. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** ES 60050 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The intrasanguineous host mediated assay may be a valuable technique for studying the in vivo distribution of genetically active substances in mice and rats. This study provides information on the organ and tissue distribution of the yeast, the time course of this distribution, and organ-specific metabolism. This work also demonstrates the feasibility of using perfused whole organs and organ homogenates in combination with yeast for metabolism of mutagens.
Keywords: YEASTS; MUTAGEN SCREENING; METABOLISM; OPTIMIZATION.

33430 Mutagenesis Testing Program. Zeiger, E. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ES-60052 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$162,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The primary objective of this effort is to develop a program which will have the ultimate capability of testing 1000 chemicals per year using microbial systems, and as-yet-undetermined smaller numbers of chemicals in higher in vitro and in vivo test systems. With this level of testing, it will be necessary to develop the ability for chemical management and analyses of compounds tested. A computerized system for data handling and statistical analysis will also be developed. Substances which are mutagenic in the microbial tests will be tested further using higher systems which serve to affirm or refute the microbial data and more precisely define the types of mutagenic events induced. This program will develop an efficient coordinated system for mutagenesis testing and should serve as a model system. The data obtained from this program will be useful for decisionmaking on the safety of various classes of chemicals to which man is exposed.
Keywords: MUTAGENESIS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; MUTAGEN SCREENING; OPTIMIZATION; BIOLOGICAL EFFECTS; MICROORGANISMS; INFORMATION SYSTEMS.

33431 Amount and Effect of Null Allozymic Variation in Natural Populations. Langley, C.H. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** ES-60058-LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$222,000.
R and D categories: Integrated assessment; Health effects.

Virtually nothing is known about the frequency of null allozyme alleles (alleles which code for the production of no enzyme activity) in natural populations or their importance to the wellbeing of the individuals who carry such alleles. This study seeks to answer these questions for several natural populations of Drosophila melanogaster. Partial analysis of a sample from the Raleigh, North Carolina, population of Drosophila melanogaster suggests that the frequency of null allozyme alleles is less than one percent per locus and varies considerably among loci. The techniques utilized to screen for null alleles are from routine Drosophila biochemical genetics. The various nulls recovered will be analyzed to the extent that is feasible utilizing genetic, cytogenetic and molecular techniques.
Keywords: DROSOPHILA; GENETICS; ENZYMES; BIOCHEMICAL REACTION KINETICS.

33432 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-60059-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: all(100). **R and D categories:** Health effects.

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. Known translocation-bearing mice are mated and the F1 sons studied to determine the frequency of translocation heterozygotes. In other matings the females are euthanized shortly after fertilization, and two cell embryos are retrieved from the oviducts and established in culture. Stage of development arrest is determined.
Keywords: CHROMOSOMAL ABERRATIONS; FETUSES; MORTALITY; EMBRYOS; MICE; BIOLOGICAL EFFECTS; TERATOGENESIS; ONTOGENESIS; CHEMICAL EFFLUENTS.

33433 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-60062-02 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$120,000.
Related energy source: coal(30); oil and gas(30); nuclear fission(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Various isozymes and mutant enzymes in mouse are detected by difference in electrophoretic mobility and/or kinetic parameters in a biochemical specific locus mutation system. Molecular characterization of these mutant proteins will elucidate the nature of genetic mutations in mammals. Various dehydrogenases are purified from mouse by AMP-sepharose affinity column. Tryptic peptides of these proteins will be analyzed on thin-layer and paper by chromatography and electrophoresis. Some of peptides will be eluted, and then amino acid composition and sequences will be determined. Primary structure characterization of various lactate dehydrogenases isozymes indicates the evolutionary relationship of different LDH genes. Molecular analyses of mutant proteins will elucidate the nature of genetic mutations in mammals.
Keywords: MICE; ENZYMES; MUTATIONS; DEHYDROGENASES; PEPTIDES; AMINO ACIDS; MUTAGENESIS; BIOCHEMICAL REACTION KINETICS.

33434 Amino Acid Sequence of Mouse Sperm Lactate Dehydrogenase. Marciniszyn, J.P. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60063-02 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$168,000.
Related energy source: coal(30); oil and gas(30); nuclear fuels(general)(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The amino acid sequence differences among different isozymes of lactate dehydrogenases will be correlated with their antigenic determinants. This information is essential for mutation monitoring program using monospecific antibodies against this enzyme. Sperm-specific lactate dehydrogenase from mouse are purified by AMP-sepharose column. The protein will be cleaved into peptides with trypsin and ONBr, and these peptides will be purified by gel filtration and ion-exchange chromatography. Amino acid sequences of pure peptides will be determined by automatic Edman. Elucidation of the primary structure of this enzyme is essential for studies of the antigenic properties of lactate dehydrogenases. This sperm-specific enzyme will be used for monitoring of mutations caused by environmental mutagens in human populations.
Keywords: LACTATE DEHYDROGENASE; AMINO ACIDS; MUTATIONS; MICE; PEPTIDES; MUTAGENESIS; ENZYMES; BIOCHEMICAL REACTION KINETICS.

33435 Primary Structure Characterization of Mouse Muscular Lactate Dehydrogenase. Natashima, Y. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-60064-02 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78.000.
Related energy source: coal(30); oil and gas(30); nuclear fuels(general)(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Amino acid sequence differences among different isozymes of lactate dehydrogenases from mouse will be correlated with their antigenic properties. This is a part of the program to evaluate the molecular events which result in mutations in mammals. Muscular lactate dehydrogenase from mouse is purified by affinity chromatography. Peptides of this protein derived from enzymatic and chemical cleavage will be purified by gel filtration and ion-exchange chromatography. Amino acid sequences of these peptides will be determined by automatic Edman degradation. The amino acid sequence differences among various isozymes of lactate dehydrogen-

ases will be correlated with their antigenic properties. This information is essential for a genetic monitoring program using monospecific antibodies of the sperm-specific enzyme as a mutation marker.
Keywords: LACTATE DEHYDROGENASE; MICE, MUTAGENESIS, MUTATIONS; PEPTIDES; BIOCHEMICAL REACTION KINETICS.

33436 Development of a Forward Mutation Assay in Bacteria. Pueyo, C. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ES 60067-LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This new strain, SV3, is sensitive to mutagens causing base-pair changes, frameshift mutations and deletions. Three new strains have been selected from strain SV3 which are deficient for the excision-repair system, the lipopolysaccharide barrier, or both. These additional mutations do not affect the assay's freedom from experimental artifacts, and they produce increased sensitivity to certain chemicals. Strain SV3 shows high inducible levels of L-arabinose isomerase and kinase but lacks epimerase, the third enzyme of the L-arabinose operon. The L-arabinose-resistant mutants selected from SV3 have additional mutations in the other genes involved in the L-arabinose pathway.
Keywords: MUTAGEN SCREENING; OPTIMIZATION; BIOASSAY; BACTERIA; MUTAGENS; SENSITIVITY; ENZYMES; ISOMERASES; BIOCHEMICAL REACTION KINETICS.

33437 Evaluation of Metabolic Activation Systems in Salmonella. Zeiger, E. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** ES 60068 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$21,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Foward mutation assays are valuable tools for mutagen testing programs since they are theoretically capable of responding to a broad range of mutagens. A new, arabinose-sensitive strain (SR-3) is capable of being used in a variety of in vivo and in vitro metabolic assay systems and therefore can be a useful new system for assaying chemicals for mutagenicity. The arabinose-resistance forward mutagen assay is remarkably well adapted to detect mutagens in body fluids and mammalian tissues. In the host-mediated assay, the bacteria are recovered from lungs, liver, kidneys and blood in proportions higher than have been reported with other bacterial systems. When DMN is used as the mutagen a higher mutagenic response is found with mice compared to rats, with liver and kidneys compared to lungs, and in vivo compared to in vitro microsomal activation.
Keywords: SALMONELLA; METABOLISM; MUTAGENESIS; MUTAGEN SCREENING; SENSITIVITY; OPTIMIZATION; RATS; MICE; LIVER; KIDNEYS; LUNGS.

33438 Metabolic Activation by S-9 Fractions from Liver Homogenates of Induced Rats. Ong, T.M. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60069 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Nine-thousand Xg supernatant (S-9) of liver homogenates from mammals is commonly used in the in vitro activation system to study the mutagenicity of chemical carcinogens which require metabolic activation for their biological activities. Several studies have shown that the mutagenic activity of these compounds can be enhanced if S-9 is from animals pretreated with enzyme inducers such as phenobarbital (PB), 3-methylcholanthrene (3-MC), or Arochlor 1254. Among these inducers, Arochlor 1254 appears to be less specific and can enhance a variety of enzyme activities. It has been shown, however, that Arochlor is carcinogenic. Studies using the Salmonella plate incorporation test system strains TA98 and TA1535 are being conducted to determine whether combined injection of naphthoflavone and PB can be used as a safe substitute for Arochlor as inducers in the in vitro activation system. The overall results seem to indicate that PCB is a better inducer for the induction of enzyme activities and the conversion of chemicals to metabolites mutagenic in bacteria.
Keywords: METABOLISM; RATS; LIVER; CHEMICAL EFFLUENTS; MUTAGENESIS; BIOLOGICAL MODELS; PHENOBARBITAL; CARCINOGENS; PESTICIDES; ORGANIC CHLORINE COMPOUNDS; AROMATICS; ENZYMES.

33439 Activation of Carcinogens to Mutagens in Salmonella by Rats Hepatocytes. Ong, T.M. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60071 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$6,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Some chemical carcinogens which can be activated to metabolites mutagenic to Salmonella typhimurium by 9000 Xg supernatant of liver homogenates from different mammalian species are carcinogenic only in certain species. Some other chemical carcinogens are not mutagenic in S. typhimurium with or without in vitro S-9 activation systems. Studies using S. typhimurium tester strains, TA98 and/or TA1535 are conducted to determine whether those false-negative compounds in bacteria mutagenesis test systems can be activated to mutagenic metabolites by hepatocytes from these species. Bacterial cells are treated with carcinogens and hepatocytes in suspension for 2 to 24 hours. After treatment bacteria are washed and plated both in minimal media and minimal medium supplemented with histidine. Revertants and survival colonies are scored after 2 days incubation at 37 degrees C. The preliminary studies indicate that rat hepatocytes can activate BP and 2AAF to metabolites mutagenic to TA98 of S. typhimurium. A standard protocol needs to be defined in future studies. Other chemical carcinogens and hepatocytes from other animal species should also be used in the future work.
Keywords: CARCINOGENS; MUTAGENS; SALMONELLA TYPHIMURIUM; RATS; METABOLISM; CHEMICAL EFFLUENTS; BENZOPYRENE; MUTAGENESIS; BIOLOGICAL MODELS.

33440 Mutagen Specificity in Saccharomyces cerevisiae. Harvey, R.G. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** ES 60073 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.
R and D categories: Operational safety; Integrated assessment; Health effects; Ecological/biological processes and effects.
Keywords: SACCHAROMYCES CEREVISIAE; MUTAGENESIS; MUTAGEN SCREENING; OPTIMIZATION; SENSITIVITY.

33441 Genetic Effects of Selected Substances in Yeast. Bronzetti, G. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** ES 60074 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

Saccharomyces is a eukaryotic microorganism in which it is possible to measure mitotic effects--such as gene conversion and recombination--in addition to mutation. There has been very little systematic work done with yeast using mutagen assays compared with bacteria. This study will attempt to evaluate the suitability of yeast for mutagen assays with regard to range of chemical classes to which it will respond and dose sensitivity as compared to a bacterial system. This will determine the future role of yeast in mutagen screening programs.
Keywords: YEASTS; GENETIC EFFECTS; SACCHAROMYCES; BIOASSAY; MUTAGEN SCREENING; SENSITIVITY; OPTIMIZATION; HYDROCARBONS.

33442 Genetic Effects of 1,2,7,8-Diepoxyoctane in Chinese Hamster Lung Cells. Huang, S.L. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60076-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
R and D categories: Health effects; Ecological/biological processes and effects.

The Lesch-Nyhan syndrome is a hereditary disorder of prime metabolism in man. The responsible gene is a sex-linked recessive. Chromosome aberrations are also known to cause human genetic defects. A mutagen test system using this locus and also scoring chromosome aberrations can be employed to monitor the induction of mutations by environmental agents. The mutagenicity of 1,2,7,8-diepoxyoctane (DEO) was investigated using Chinese hamster lung cells. 6-thioguanine resistance and chromosome aberration were induced. DEO was found to readily form adducts with radiolabeled nucleotides, as demonstrated through thin-layer chromatography in DEO/nucleotides mixtures. The mutagenic specificity of DEO is apparently related to the compound's ability to bind DNA.

Keywords: HAMSTERS; LUNGS; GENETIC EFFECTS; MUTAGENESIS; CELL CULTURES; DNA; MUTAGEN SCREENING; CHROMOSOMAL ABERRATIONS; OPTIMIZATION; HYDROCARBONS; METABOLISM.

33443 Biochemical Studies of Mouse Enzymes, I: IDH. Lee, C.Y. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60086-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$24,000.

Two isozymes of NADP+ dependent isocitrate dehydrogenase (IDH) are preferentially localized in cytoplasm and mitochondria, respectively, of various tissues. Genetic variants of the cytoplasmic isozyme have been identified in DBA/2J and in C57BL/6J mice. The purpose of this study is: (1) to provide a simple purification procedure for the isolation of these two isozymes; (2) to compare their structural and biochemical properties in order to correlate their differential distribution in the tissues or their subcellular localization; and (3) to compare biochemically the two cytoplasmic IDH variants from DBA/2J and C57BL/6J mice.**Keywords:** MICE; ENZYMES; BIOCHEMICAL REACTION KINETICS; DEHYDROGENASES.

33444 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 60087-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.

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.

33445 Biochemical Studies of Mouse Enzymes, III: Immunology of PGK. Lee, C.Y. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60088-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.

Rabbit antisera were raised respectively against two 3-phosphoglycerate kinase (PGK) isozymes from DBA/2J mice. The purpose of this study is (1) the characterization of the immunological properties of the two PGK isozymes and (2) the comparative immunological study of genetic variants of PGK-B.**Keywords:** PHOSPHOTRANSFERASES; BIOCHEMICAL REACTION KINETICS; MICE; IMMUNOLOGY; GENETIC VARIABILITY.

33446 Biochemical Studies of Mouse Enzymes, IV: Isoelectric Focusing. Lopez-Barea, J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60089-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$18,000.

Isoelectric points of about 16 mouse enzymes from various tissues were determined by preparative isoelectric focusing column. Strain variations of isoelectric points of some mouse enzymes were detected. We attempted to use isoelectric point determinations as a means to detect new genetic variants in mice that were not identified previously by electrophoresis.**Keywords:** MICE; ENZYMES; BIOCHEMICAL REACTION KINETICS; GENETIC VARIABILITY; MUTANTS.

33447 Biochemical Studies of Mouse Enzymes, V: Glutathione Reductase. Lopez-Barea, J. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z01 ES-60090-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.

Glutathione reductase from livers of DBA/2J mice was purified to homogeneity by affinity chromatography. It is a dimeric enzyme of molecular weight 107,000 daltons with a sedimentation coefficient 6.13S, stoke radius 41.8 degree A and PI = 6.91. Kinetic studies revealed a ping-pong mechanism. The substrate protects the enzyme against thermal inactivation.**Keywords:** MICE; ENZYMES; LIVER; BIOCHEMICAL REACTION KINETICS; GLUTATHIONE.

33448 Biochemical Studies of Mouse Enzymes, VI: Phosphoglucose Isomerance. Charles, D. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60091-01 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$54,000.

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.

33449 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:** ES-60092 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Integrated assessment; Health effects.

The purpose of this research is to evaluate the nature of mutations induced in Drosophila genes by chronic irradiation. A strain of Drosophila melanogaster (SM1/+1) was replicated into 1000 lines and exposed to chronic low-dose-rate gamma-radiation (7 rads/hours) for 14 generations (a cumulative dose of 33,552 rads). After scoring electrophoretically for mutants at the 7 soluble enzyme loci Got-2, alpha Gpdh, c-Mdh, Adh, Dip-A, Hex-C, and alpha Amy, 10 independent mutants were found: 5 at the alpha Gdph loci, 1 at Hex-C, 2 at c-MDH, 1 at Got-2, and 1 at Adh. Analysis of the salivary gland chromosomes showed that of these 10 mutants, only 1 (alpha Gdph) is associated with chromosome aberrations. The analysis of the various mutants and comparison with recessive lethals and previously published data suggests that the per rad mutation rates are comparable over end points and dose rates. It may also be concluded that a substantial proportion of irradiatin induced mutants are true point mutations as opposed to small intergenic deletion. **Keywords:** GENETICS; MUTAGENESIS; DROSOPHILA; CHROMOSOMAL ABERRATIONS; MUTANTS; GENETIC RADIATION EFFECTS; GAMMA RADIATION; LOW DOSE IRRADIATION; CHRONIC IRRADIATION.

33450 Tissue Specificity of Sister Chromatid Exchange (SCE) Formation. Allen, J.W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60094 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
R and D categories: Health effects.

Project objectives are to detect and investigate possible tissue-specific differences in sister-chromatid exchange responsiveness in experimental animals exposed to various chemical mutagens. 5-bromodeoxyuridine dye cytogenetic techniques will be utilized to monitor these chromosome effects. An increased understanding of somatic and germ cell sensitivities to genetic alteration by specific chemical mutagens should result.
Keywords: SISTER CHROMATID EXCHANGES; MUTAGENESIS; BIOLOGICAL MODELS; DNA; GENETIC EFFECTS; CHEMICAL EFFLUENTS.

33451 Sister Chromatid Exchange Studies in Rodent Pre- and Post- Implantation Embryonic Tissues. Allen, J.W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60095-LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$54,000.
R and D categories: Health effects.

The project objectives are to evaluate alterations in embryo chromosomes and cell replication patterns following exposure to known or suspected chemical mutagens and/or teratogens. 5-Bromodeoxyuridine-dye cytogenetic techniques will be utilized to assess induction of sister chromatid exchange, as well as replication kinetics. An increased understanding of specific embryo susceptibilities and effects, of a mutagenic-teratogenic nature, relating to selected compound exposures should result.
Keywords: SISTER CHROMATID EXCHANGES; RODENTS; TRANSPLANTS; EMBRYOS; TISSUES; CHROMOSOMAL ABERRATIONS; MUTAGENESIS; DNA REPLICATION; CHEMICAL EFFLUENTS; TERATOGENESIS; BIOLOGICAL MODELS.

33452 Comparison of Rates of Point Mutations and Chromosome Aberrations in Cultured Cells. Sheridan, W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01 ES 60096 LEM. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$12,000.
R and D categories: Health effects.

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. Analysis to date indicates that there is a correlation between the induction of point mutations and the induction of chromosomal aberrations.
Keywords: CELL CULTURES; CHROMOSOMAL ABERRATIONS; MUTATIONS; MUTAGEN SCREENING; MICE; MUTAGENS; MUTATION FREQUENCY; MUTAGENESIS; BIOLOGICAL MODELS.

33471 Teratogenic Potential of Environmental Agents. Marks, T.A. (Research Triangle Institute, Chemistry and Life Sciences Division, Research Triangle Park, NC, 27709). **Project number:** N01-ES-6-2127 LET. **Contract:** N01-ES-6-2127. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$255,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective is to determine the teratogenic potential in animals of environmental agents. Pregnant mice were gavaged with isomers of polychorinated biphenyls, formaldehyde, n-hexane, phencyclidine, and epichlorhydrin during the period of major organogenesis at the dose maximally tolerated by the dam.
Keywords: TERATOGENESIS; BIOLOGICAL MODELS; ANIMALS; MICE; ORGANIC CHLORINE COMPOUNDS; AROMATICS; FORMALDEHYDE; HEXANE; DRINKING WATER; BIOLOGICAL EFFECTS.

33472 Effect of Environmental Components on Reproduction and Ontogenesis. Murray, F.J. (Dow Chemical Company, Toxicology Research Laboratory, Health and Environmental Research, Midland, MI, 48640). **Project number:** NIH-NIEHS-73-2102 LET. **Contract:** NIH-NIEHS-73-2102. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.
R and D categories: Health effects.

The objectives are: (1) to determine the teratogenic potential in animals of environmental components when administered singly or in combination; (2) to determine species differences in response to teratogens and to study the etiology of such differences; and (3) to investigate the mechanisms of action of teratogens and to improve experimental testing and extrapolation to man. In general, the screening approach outlined by the World Health Organization (Technical Report No. 364, 1967) is being followed with certain modifications to alleviate some of the problems encountered by private industry during the testing of potential therapeutic agents. Agents studied to date include: pesticides, chloroform, epichlorhydrin, tetrachloroacetone, and hexachlorocyclopentzdiene.
Keywords: CHEMICAL EFFLUENTS; SYNERGISM; BIOLOGICAL VARIABILITY; MUTAGEN SCREENING; OPTIMIZATION; TERATOGENESIS; MUTAGENESIS; BIOLOGICAL MODELS; PESTICIDES; CHLOROFORM.

33473 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: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

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.

33474 Effects of Environmental Components on Reproduction and Ontogenesis. Murray, F.J. (Dow Chemical Co., Toxicology Research Lab., Health and Environmental Research, Midland, MI, 48640). **Project number:** NIH-NIEHS-73-2102 LET. **Contract:** NIH-NIEHS-73-2102. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$300,000.
Related energy source: coal(75); oil and gas(10); oil shales and tar sands(15). **R and D categories:** Integrated assessment; Health effects.

Pregnant mice and rabbits were exposed in inhalation chambers to sulfur dioxide, sulfur dioxide plus carbon monoxide, and sulfuric acid aerosol to determine the effects of these pollutants on development of the conceptus. The offspring were examined just before birth for the presence of external and internal structural alterations. SO2 was administered at slightly toxic doses (mice, 25 ppM; rabbits, 70 ppM) alone or in combination with 250 ppM CO for 7 hr/day through the period of major organogenesis. H2SO4 aerosol was administered similarily to both species at 5 or 20 mg/m-3. Teratogenicity was not observed in either species, but exposure of mice to SO2 resulted in significantly smaller fetuses.
Keywords: REPRODUCTION; SULFUR DIOXIDE; CARBON MONOXIDE; SULFURIC ACID; AEROSOLS; TOXICITY; MICE; RABBITS; SYNERGISM; TERATOGENESIS; INHALATION.

33475 Developmental Toxicity Indicators. Dixon, R.L. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ERP-2.3 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$70,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The objective of the project is to assess the postnatal toxic effects of gestational chemical exposure using energy-related compounds, such as trace metals and polycylic aromatic hydrocarbons, as well as other environmental chemicals. In this investigation, emphasis will be placed on physiological and biochemical functions associated with the various organs and tissues of gestationally exposed rodent offspring. Systems (or functions) which will be studied include the following: bone marrow and blood; motor and sensory function of the nervous system (including pain, taste, olefaction, audition, and vision); behavior and memory; cardiovascular responses; respiration; renal function and body fluid balance; digestive system; metabolism (energy exchange); endocrinology; reproduction; immunologic capacity; and pathologic lesions. Tests of overall homeostatis, physical endurance, and adaption to stress are also planned. This contract has not been let.
Keywords: TOXICITY; BIOLOGICAL INDICATORS; PREGNANCY; CHEMICAL EFFLUENTS; METALS; POLYCYCLIC AROMATIC HYDROCARBONS; RODENTS; DYNAMIC FUNCTION STUDIES; BIOLOGICAL ADAPTATION; BIOCHEMISTRY; PHYSIOLOGY; BIOLOGICAL EFFECTS.

33476 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; EPA-$130,000.
Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

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) to 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 on-line 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.

33477 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 ERP-8.1 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$80,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

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. Large numbers of shellfish will be exposed to these elements for subsequent incorporation of freeze-dried shellfish meats into rat diets for evaluation of pharmacokinetic and toxicological differences in comparision to similar doses of these metals administered in drinking water. Flowing seawater systems with continuous trace element injection, atomic absorption spectroscopy, radiotracer analyses, histological and ultrastructural techniques, and cellular respiration will be studied. These studies may provide a mechanism for estimating potential human risk following ingestion of metal contaminated marine shellfish.

Keywords: PHYSIOLOGY; ARSENIC; CADMIUM; COPPER; INVERTEBRATES; FREEZE DRYING; DIET; INGESTION; MAN; SEAFOOD; CONTAMINATION; WHOLESOMENESS; BIOLOGICAL EFFECTS; HEALTH HAZARDS; TOXICITY.

33478 Teratogenicity of Acylating Agents. Dixon, R.L. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70001-01 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$240,000. **Related energy source:** fossil fuels(100). **R and D categories:** Operational safety; Health effects.

We hypothesize that acylation is a mechanism of chemical teratogenesis; to test this idea, the teratogenicity of selected anhydrides and imides is being studied. If acylation is a mechanism of teratogenicity, then acylating agents such as anhydrides (and imides) should be teratogenic. Additionally, their teratogenicity should correlate with their spontaneous reactivity; covalent binding of anhydrides (and imides) to fetal macromolecules should be demonstrated. Our preliminary results suggest that this hypothesis is valid and could become an important factor in defining chemicals which have a teratogenic potential. These studies also contribute greatly to an understanding of molecular mechanisms which account for birth defects.

Keywords: TERATOGENESIS; ACYLATION; CHEMICAL EFFLUENTS; BIOLOGICAL MODELS; ACYL RADICALS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL EFFECTS; ANHYDRIDES; TOXICITY; FETUSES; MALFORMATIONS.

33479 *Study of Developmental Disorders in a Model of Embryo* Culture During Organogenesis. Dixon, R.L.; Sanyal, M.K. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70010-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

In order to detect and study the mechanisms by which some environmental agents induce developmental disorders, an in vitro culture system of rat embryos during the organogenesis phase of development (parallelling in vivo development) has been developed. In this culture system, rat conceptuses of pregnancy days 10, 11 or 12 have been grown for two days. These embryos grow in vitro 5 to 20 fold with extensive differentiation of major organs, e.g., brain, neural tube, sensory organs, circulatory system, gut, liver, musculature, etc., comparable with those in vivo during the same period. Treatment with teratogens, TEM, BUdR, and heparin have been shown to induce different types of developmental anomalies in these embryos grown in vitro.

Keywords: EMBRYOS; CELL DIFFERENTIATION; RATS; REPRODUCTION; MUTAGENS; TERATOGENESIS; BIOLOGICAL MODELS; BIOCHEMICAL REACTION KINETICS.

33480 Effects of Environmental Agents on Ontogenesis After Parental Exposure. Staples, R.E. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70020-05 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$72,000.
R and D categories: Health effects.

The long range purpose of this project is to estimate the potential hazard of selected environmental agents to human development. Studies were conducted to determine the teratogenic potential of Dipterex, Captan, ethylenethiourea, asbestos, noise, industrial solvents, and microwaves in laboratory animals by exposure of the pregnant female to maximally tolerated dosages during the period of major organogenesis. Noise and microwaves were found to be embryotoxic but not teratogenic. Dipterex and Captan were found not to be teratogenic. Ethylenethiourea teratogenicity was found not to be affected through altered thyroid function, and industrial solvents were teratogenic.

Keywords: ANIMALS; REPRODUCTION; TERATOGENESIS; ASBESTOS; HYDROCARBONS; NOISE; MICROWAVE RADIATION; SOLVENTS; EMBRYOS; PESTICIDES; MUTAGENESIS; BIOLOGICAL MODELS; TOXICITY; BIOLOGICAL EFFECTS; HEALTH HAZARDS.

33481 Regulation of Gene Expression During Differentiation of Teratocarcinoma Cells. Carter, D.B. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70047-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The protein-mapping technique of O'Farrell has been used to study the synthesis of total SDS soluble, soluble cytoplasmic and 5M urea extractable nuclear proteins from embryoid bodies and their derived teratoma tumors. Proteins synthesized within a four-hour labeling period and incorporating methionine-35S show reproducible qualitative changes during growth from embryoid bodies to small (less than 2mm) tumors. Approximately 165 spots are visible from the soluble cytosol proteins of embryoid bodies compared to 145 spots from the corresponding fraction from teratoma tumors. There appears to be about 80% homology between the detectable proteins of embryoid body and small tumors. Alpha-fetoprotein appears to be synthesized in both the embryoid bodies and small teratomas thus far examined. The embryoid body nuclear proteins contain 146 detectable proteins whereas the teratoma contains 126 detectable proteins on 2-D gels. However, several major nuclear proteins appear in the teratoma which are not detectable in embryoid body. The total SDS extracts showed the deletion of three major proteins from embryoid bodies and the expression of three new major proteins in the small teratoma.

Keywords: TUMOR CELLS; CELL DIFFERENTIATION; NEOPLASMS; CHROMATIN; RNA; DNA; TERATOGENESIS; LABELLING; SULFUR 35; PROTEINS; HYBRIDIZATION; BIOLOGICAL MODELS.

33482 Teratocarcinoma System as a Model for Gene Expression in Normal and Abnormal Development. Harris, S.E. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70045-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$240,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The mouse embryoid body/teratocarcinoma system OTT 6050 developed by Leroy Stevens appears to be an ideal system for studying the molecular mechanism of cellular differentiation in a mammalian system. Total poly(A)-RNA was isolated from simple embryoid bodies and teratomas derived from the embryoid boides. By RNA-complementary DNA hybridization analysis, an evaluation of the sequence complexity of the preparations could be made by computer analysis. Three classes of poly(A)-containing RNA could be resolved in both embryoid bodies and teratomas based on their relative abundance in the respective RNA preparations. By similar analysis nuclear poly(A+)-RNA was analyzed. Antibodies to brain specific proteins, S-100 and glial fibrillary acidic protein are being prepared to be used as probes for gene expression during neuroepithelial differentiation in the terato-carcinoma system.

Keywords: TERATOGENESIS; CARCINOGENESIS; RNA; BIOCHEMICAL REACTION KINETICS; TUMOR CELLS; NEOPLASMS; DNA; MICE; BIOSYNTHESIS; GROWTH; GERM CELLS.

33483 Development of In Vitro Translation Systems for Specific Messenger RNA's and for Total Poly(A)-Containing RNA Preparations. Silverberg, A.E. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70049-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$120,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The in vivo mouse embryoid body/teratocarcinoma system is being utilized as a model to study the molecular mechanisms of cellular determination and differentiation and the effects of environmental agents on differentiating mammalian cells. The wheat germ S-30 and nuclease-treated rabbit reticulocyte lysate in vitro translation systems permit the analysis of the patterns of protein synthesis during the differentiation process from simple embryoid bodies to teratomas. In vitro translation systems aid in the characterization of total or polysomal poly-(A)-containing mRNA by analysis of synthesized products. Isolation of specific MNR's (e.g. alpha-fetoprotein [AFP], S-100, and glial fibrillar acidic protein [GFAP]) will permit the analysis of gene transcription with cDNA probes during differentiation and the analysis of precursors of the final protein products. AFP is produced in increased quantities following partial hepatectomy, toxic injury to the liver, and hepatomas and teratomas. In vitro translation of mRNA's and nucleic acid hydrodization with specific cDNA to AFP mRNA will permit the study of the molecular events surrounding the expression of AFP during toxic injury and carcinogenesis.

Keywords: EMBRYOS; TERATOGENESIS; RABBITS; CELL DIFFERENTIATION; PROTEINS; BIOSYNTHESIS; NUCLEIC ACIDS; TOXICITY; CARCINOGENESIS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; MESSENGER-RNA.

33484 Effects of Prenatal Exposure to Foreign Chemicals on Genital Tract Function. Lucier, G.W.; McLachlan, J.A. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70060-05-ERP-21 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** EPA-$150,000.

Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

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 chemicobiological 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.

33485 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-70065-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

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.

33486 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-70070-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

This project is designed to evaluate the effect of environmental chemicals on offspring of female rats subjected to totigestation exposure. Selected biochemical, histological and behavioral parameters are monitored for transplacental pathology. To date studies on three chemicals have been initiated: methyl-n-butyl ketone, enflurane (ethrane), and ethchlorvynol (placidyl). Although some behavioral and physiological changes have been observed, no definite conclusions are possible as yet.
Keywords: PLACENTA; PATHOLOGICAL CHANGES; FETAL MEMBRANES; CHEMICAL EFFLUENTS; FEMALES; RATS; ORGANIC CHLORINE COMPOUNDS; BEHAVIOR; PHYSIOLOGY; REPRODUCTION; BIOLOGICAL MODELS; METABOLISM.

33487 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-70080-05 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$240,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

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.

33488 Development of In Vivo Models for Toxicological Testing in Reproduction. Hall, J.L. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70085-01 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

These studies are designed to predict changes in the male reproductive system which are expressed as altered bichemistry (proteins) and/or function (fertility). A workable fertilization system using human sperm and animal ova will be developed as a model to test this altered fertility in humans induced by environmental agents. An electrophoresis model discussed in this report will complement the fertilization studies and should provide a means of reducing subtle genetic and biochemical changes to an easily interpretable system.
Keywords: REPRODUCTION; TOXICITY; IN VITRO; MALES; MALE GENITALS; PROTEINS; FERTILITY; DYNAMIC FUNCTION STUDIES; GENETIC EFFECTS; BIOCHEMISTRY; BIOCHEMICAL REACTION KINETICS.

33489 Factors Affecting the Regulation and Metabolism of Urine and Hemoproteins in Mammalian Tissues. Woods, J.S. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70140-06 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$300,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

These studies investigate the biosynthesis, utilization and metabolism of heme, and the regulation of hemoprotein function in mammalian tissues, particularly the factors affecting the regulation of heme and hemoprotein levels at different stages of development and during chronic disease processes. Elucidation of alterations in heme biosynthesis pathway enzymes and in urinary concentrations of heme precursors incurred by exposure to hematotoxic environmental agents are of special interest. Substances under current investigation include various trace metals and TCDD. Present studies suggest that the regulation of heme biosynthesis and metabolism in various tissues is exquisitely sensitive to alteration by a variety of environmentally important metals. Patterns of blood and urinary porphyrins resulting from exposure to these metals in humans, or serve as models for defining the etiology of inherited or drug-induced porphyrias. Other studies are designed to assess the effects of impared heme biosynthesis on microsomal hemoprotein function resulting from exposure to a variety of environmental hematotoxic agents.
Keywords: METABOLISM; URINE; BLOOD; PROTEINS; TISSUES; BIOSYNTHESIS; TOXICITY; ENZYMES; BIOLOGICAL PATHWAYS; PORPHYRINS; METALS; CADMIUM; MERCURY; ARSENIC; MAMMALS; DYNAMIC FUNCTION STUDIES.

33490 Development of Intestinal Functions: Normal and Toxic Responses. Schiller, C.M. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-70131-02 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$246,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

It is the long-range purpose of this project to study the perinatal development of the functioning small intestine in normal and environmentally-, nutritionally- and hormonally-stressed animals. The topics of present interest which relate to the development

of the normal functioning small intestine are: (1) ontogeny of lactate dehydrogenase isozymes, kinetic parameters and substrate/cofactor specificity during intestinal development, (2) characterization of the morphology and metabolism of isolated intestinal absorptive tip cells, (3) determination of the isozyme profile for beta-glucuronidase during intestinal development and after 1,2-dimethylhydrazine treatment, (4) differential susceptibility of isolated intestinal tip and crypt cells to 2,3,7,8-tetrachlorodibenzo-p-dioxin induction, (5) mechanism of As-induced alterations of mitochondrial function in normal and alloxan-diabetic animals, and (6) monitoring the response of key intestinal enzymes to in vivo steroid treatments.
Keywords: DYNAMIC FUNCTION STUDIES; SMALL INTESTINE; MORPHOLOGICAL CHANGES; TOXICITY; NUTRITIONAL DEFICIENCY; HORMONES; ENVIRONMENTAL EFFECTS; METABOLISM; PHYSIOLOGY; ENZYMES; CHEMICAL EFFLUENTS; METALS; METABOLIC DISEASES.

33491 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-70200-05 LET. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$276,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

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 objective of these studies is 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 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.

33501 *Pharmacokinetic Modeling and Methodology Development.* Tuey, D.B.; Matthews, H.B. (National Institute of Environmental Health Sciences, Research Triangle Park, NC, 27709). **Project number:** Z 01 ES 42002-06 ERP-7.1/ LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$28,000; EPA-$20,000.
R and D categories: Health effects.

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. 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. Physiological compartmental models have been constructed to describe the individual disposition kinetics of several different polychlorinated biphenyl (PCB) compounds in the rat. When allometric equations were used to scale these models to predict disposition kinetics in the mouse, good results were obtained for the more persistent, slowly metabolized isomers. A physiological compartmental model constructed from data obtained from rats that received a single iv dose of 2,4,5,2',4',5'-hexabromobiphenyl was able to simulate and predict the tissue levels found in rats placed on a 30-day chronic oral dose schedule.
Keywords: UPTAKE; METABOLISM; EXCRETION; DRUGS; ANIMALS; PHYSIOLOGY; AROMATICS; ORGANIC CHLORINE COMPOUNDS; BIOLOGICAL LOCALIZATION; TOXICITY.

33502 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 ERP-8.3 LP. **Contract:** NIH-N01-ES-7-2101. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$64,000; EPA-$29,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives are 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 to qualitatively examine the histopathology of comparable tumors occurring in both exposure and control groups. Seasonal variation in AHH activity was observed with fall and winter months being periods of low activity. Baseline toxicity studies disclosed that BaP produced mortality in juvenile flatfish with renal and intestinal damage as the major histopathological findings. Studies concerning long-term exposure to BaP, induction of AHH and evaluation are now in progress. These studies should provide fundamental information about the metabolism and biological responses to a carcinogenic petroleum hydrocarbon of marine organisms consumed as food. Results of the study should specifically yield useful data on the relationship between AHH activity and the carcinogenic susceptibility of marine organisms.
Keywords: PETROLEUM; HYDROCARBONS; AQUATIC ORGANISMS; METABOLISM; TOXICITY; CARCINOGENS; BENZOPYRENE; FISHES; NEOPLASMS; ENZYMES.

33503 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: fossil fuels(100). **R and D categories:** Health effects.

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 compoumds; and (3) exogenous compounds (inhibitors and inducers) on the substrate specificities of MFO systems from different tissues and species. The MFO enzyme systems catalyze metabolism of polycyclic aromatic hydrocarbons from fossil fuels and byproducts to reactive intermediate forms which can bind to biological macromolecules.
Keywords: MICROSOMES; RNA; OXIDASES; SPECIFICITY; RABBITS; LUNGS; LIVER; POLYCYCLIC AROMATIC HYDROCARBONS; METABOLISM.

33504 Enzymes Metabolizing Chemicals: Chemical and Physiological Effectors of These Systems. Devereux, T.R.; Fouts, J. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80002-08 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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. Studies of chemical metabolism, including hydrocarbons and other energy related organics, in lung cell populations may give us a better understanding of the balance between toxication and detoxication systems, and how various stresses can alter these systems and this balance.
Keywords: ENZYMES; CHEMICAL EFFLUENTS; PHYSIOLOGY; METABOLISM; BIOCHEMICAL REACTION KINETICS; TOXICITY; LUNGS; HYDROCARBONS; BIOLOGICAL MODELS; RABBITS.

33505 Xenobiotic-Metabolizing Activity in Skin and Its Response to Environmental Agents. Pohl, R.J.; Fouts, J.R. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80003-05 LP. **Supported**

by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Funding: NIEHS-$54,000.
Related energy source: fossil fuels(100). R and D categories: Health effects.

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. Persistent environmental pollutants, especially highly lipid soluble hydrocarbons, are often accumulated in skin. Increased understanding of chemical metabolizing enzymes in skin may lead to development of better systems to predict and assess toxicity of chemicals.
Keywords: SKIN; METABOLISM; DYNAMIC FUNCTION STUDIES; MICE; ULTRAVIOLET RADIATION; POLYCYCLIC AROMATIC HYDROCARBONS; ORGANIC CHLORINE COMPOUNDS; TOXICITY; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS.

33506 Study of Various Factors Affecting Species and Tissue Specific Toxication: Detoxication of Foreign Chemicals. Chhabra, R.S. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). Project number: Z01-ES-80004-06 LP. Supported by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Funding: NIEHS-$45,000.
Related energy source: fossil fuels(100). R and D categories: Health effects.

The objective is to determine if there were differences in inducibility between hepatic and intestinal microsomal xenobiotic-metabolizing enzymes. Phenobarbital (PB) or 3-methylcholanthrene (3-MC) was given orally (po) or intraperitoneally (ip) to mouse, rat, guinea pig, and rabbit. Differences in the inducibility of xenobiotic-metabolizing enzymes due to route of administration of PB were observed in guinea pig, mouse, and rat small intestine but not in liver. Differential effects of po- and ip-administered 3-MC on hepatic aryl hydrocarbon hydroxylase (AHH) and cytochrome P-450 were noted in rat and guinea pig. The induction of intestinal xenobiotic-metabolizing enzymes varied with the animal species and the substrate used. None of the rabbit intestinal xenobiotic-metabolizing enzymes was induced by PB or 3-MC treatment--even in rabbits fed semi-purified diet. However, rabbit intestinal xenobiotic-metabolizing enzymes were not totally resistant to environmental insult since starvation significantly reduced activities. Vitamin A deficiency or excess feed elicited quantitative and qualitative differences between the species and tissues in their ability to activate or inactivate foreign chemicals. Ingested energy-related pollutants, hydrocarbons or metals, may affect intestinal toxicity either by modifying activity of the chemical-metabolizing enzyme systems or by being acted on by these enzyme systems with the formation of more or less toxic products.
Keywords: CHEMICAL EFFLUENTS; ENZYMES; METABOLISM; BIOCHEMICAL REACTION KINETICS; PHENOBARBITAL; CONDENSED AROMATICS; MICE; RATS; GUINEA PIGS; RABBITS; HYDROXYLASE; VITAMIN A; METALS; HYDROCARBONS.

33507 In Vitro Metabolism of Xenobiotics by Selected Marine Species. Bend, J.R.; James, M.O. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). Project number: Z01-ES-80005-05 LP. Supported by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Funding: NIEHS-$144,000.
Related energy source: fossil fuels(100). R and D categories: Health effects.

The objectives are: to compare hepatic and extrahepatic microsomal xenobiotic oxidative metabolism in several vertebrate and invertebrate marine species; to characterize the hepatic mixed-function oxidase system of the little skate, Raja erinacea, since it possesses relatively high enzyme activity; to investigate some xenobiotic conjugating enzymes in marine vertebrates and invertebrates; to study the effect of environmental contaminant administration on in vitro xenobiotic mixed-function oxidation and conjugation by tissues from marine elasmobranchs and teleosts. 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 epoxide or arene oxide metabolizing enzymes (epoxide hydrase and glutathione s-transferases) are being characterized in control fish and in fish pre-exposed to enviromental contaminants such as polycyclic aromatic hydrocarbons or dioxins. Many hydrocarbon constituents of crude oil are metabolized to more toxic metabolities in fish used for food, and thus may pose a direct threat to humans who consume fish in their diet.
Keywords: IN VITRO; METABOLISM; ORGANIC COMPOUNDS; AQUATIC ORGANISMS; VERTEBRATES; INVERTEBRATES; TRANSFERASES; FISHES; POLYCYCLIC AROMATIC HYDROCARBONS; PETROLEUM; FOOD CHAINS; SEAFOOD; WHOLESOMENESS.

33508 Pollutants: Uptake, Distribution, Metabolism, Excretion and Storage Sites in Marine Species. Bend, J.R.; James, M.O. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). Project number: Z01-ES-80006-07 LP. Supported by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Funding: NIEHS-$54,000.
Related energy source: oil and gas(100). R and D categories: Health effects.

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.

33509 Metabolism and Disposition of Selected Radio-Labelled Hydrocarbons by Isolated, Perfused Rabbit Lung. Bend, J.R.; Smith, B.R. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). Project number: Z01-ES-80007-07 LP. Supported by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Funding: NIEHS-$300,000.
Related energy source: fossil fuels(100). R and D categories: Health effects.

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 (including testis, ovary, and adrenal). 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. Many of the hydrocarbons under study are components of fossil fuels and/or their combustion products. It is important to know how various tissues activate or detoxify these chemicals.
Keywords: METABOLISM; HYDROCARBONS; LUNGS; PERFUSED TISSUES; RABBITS; ALKENES; AROMATICS; TRANSFERASES; IN VITRO; BIOCHEMICAL REACTION KINETICS; PHYSIOLOGY; TOXICITY; LIVER.

33510 Role of Altered Membrane Function in Xenobiotic Toxicity. Pritchard, J.B.; Neufeld, G.J. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). Project number: Z01-ES-80031-02 LP. Supported by: National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). Funding: NIEHS-$66,000.
Related energy source: fossil fuels(100). R and D categories: Health effects.

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, and the rock crab (Cancer irroratus) which lacks the ability to osmoregulate. The objective is to establish the mechanism(s) responsible for the sensitivity of crustacea to organochlorine compounds. Parameters examiined 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. These studies may serve

as indicators or warning systems to the accumulation of contaminants in the marine environment.
Keywords: CELL MEMBRANES; DYNAMIC FUNCTION STUDIES; AQUATIC ORGANISMS; ORGANIC CHLORINE COMPOUNDS; TOXICITY; METABOLISM; CRUSTACEANS; EXCRETION; ENZYMES.

33511 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-80032-02 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$78,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33512 Control of Development of Drug Metabolizing Enzymes. Fouts, J.R.; Leakey, J.E.A. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** Z01-ES-80036-01 LP. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$90,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

An organism's capacity to metabolize drugs and environmental toxins is limited in the perinatal period due to low levels or absence of the enzyme systems responsible. The purpose of this study is to: (1) elucidate the natural factors controlling the development of detoxicating enzyme activity, and (2) investigate their mechanisms of action. Enzyme activities of special interest are those dependent upon cytochrome P-450. Work completed has demonstrated that the rate of development of cytochrome P-450 concentrations in neonatal rat liver may be increased by glucocorticoid hormones but not by glucagon or tri-iodothyronine. Glucocorticoids, however, fail to stimulate cytochrome P-450 development in fetal rat liver. The P-450 dependent enzyme systems metabolize many foreign chemicals, including hydrocarbons, to more or less toxic products. Knowledge of the factors controlling development of detoxicating/toxicating enzymes is of great importance to perinatal pharmacology, teratology, and endocrinology.
Keywords: DRUGS; METABOLISM; ENZYMES; TOXINS; CHRONIC EXPOSURE; DECONTAMINATION; BIOCHEMICAL REACTION KINETICS; TOXICITY; CYTOCHROMES; TERATOGENESIS; ENDOCRINE GLANDS.

33521 Cultured Epidermal Cells as a Model for Skin Carcinogenesis. Sisskin, E.E.; Barrett, J.C. (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-25000-01 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective is to study cellular mechanisms of carcinogenesis in epidermal cell cultures. Epidermal cells isolated from newborn Syrian hamsters are cultured in vitro using a variety of culture conditions. After exposure to carcinogens and promoters, cells are periodically examined for various transformation phenotypes. Cell cultures are also established from carcinogen-induced skin lesions generated in vivo; these phenotypic characteristics are compared to in vitro exposed cells. Epidermal cell cultures have been established under a variety of culture conditions. These are now being checked for signs of transformation. We expect to learn in the coming months whether the conditions used are conducive to transformation.
Keywords: IN VITRO; HAMSTERS; ANIMAL CELLS; CELL CULTURES; CARCINOGENESIS; BIOLOGICAL MODELS; SKIN; IN VIVO; EPITHELIUM; NEOPLASMS.

33522 Cellular and Molecular Mechanisms of Neoplastic Progression. Barrett, J.C. (National Institute of Environmental Health Sciences, Laboratory of Pulmonary Function and Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27712). **Project number:** Z01-ES-25001-01 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$165,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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 to malignancy. Syrian hamster embryo fibroblasts, mouse C3H 10T 1/2 fibroblasts, human skin fibroblasts and hamster tracheal epithelial cells are exposed in vitro to environmental carcinogens. In hamster embryo cells a multistep development of neoplastic transformation was observed. Preneoplastic cell populations were isolated based on altered morphology, fibrinolytic activity and growth advantage under selected conditions. These preneoplastic cells are being studied in terms of tumorigenicity, growth regulation in vitro, morphological features, proteolytic activity, karyotype, cAMP levels, and receptors for growth factors. The progression of these cells to the neoplastic state is being examined and the effect of environmental mutagens on this process is being evaluated. The expected results are hoped to provide a lead to a better understanding of the development of neoplasia and the effect of environmental insults on its progression.
Keywords: NEOPLASMS; BIOCHEMICAL REACTION KINETICS; CARCINOGENESIS; BIOLOGICAL MODELS; HAMSTERS; IN VITRO; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; SYNERGISM.

33523 In Vitro Carcinogenesis and Promotion Studies. Steele, V.E. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** Z01-ES-25002-01 LPFT. **Supported by:** National Cancer Inst., Bethesda, MD (USA). Div. of Cancer Cause and Prevention. **Funding:** NIEHS-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The major aim of the studies is to develop in vitro model systems for investigating various phases of respiratory carcinogenesis at the cellular level. Tracheal organ cultures are exposed to various test substances. Thereafter epithelial outgrowths are established which are tested for altered growth characteristics. The studies demonstrate for the first time that, using the above system, respiratory tract epithelium can be transformed in vitro. In the initial studies the direct-acting carcinogen, MMNS, was used. The first sign of a carcinogen-induced alteration was the epithelial cells, of an unlimited in vitro growth capacity resulting in establishment of permanent epithelial cell lines. Many of these carcinogen-induced cell lines become oncogenic after many weeks in culture. Similar studies are now carried out with polycyclic hydrocarbons which must be metabolically activated. First evidence has been obtained that the in vitro model is also suited to carry out promotion studies with classical promotors.
Keywords: CARCINOGENESIS; IN VITRO; RESPIRATORY SYSTEM DISEASES; EPITHELIUM; CARCINOGENS; POLYCYCLIC AROMATIC HYDROCARBONS; BIOLOGICAL MODELS; BIOLOGICAL EFFECTS; AIR POLLUTION.

33524 Tumor Induction Studies with the Tracheal Transplant Model. Topping, D.C. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** Z01-ES-25003-01 LPFT. **Supported by:** National Cancer Inst., Bethesda, MD (USA). Div. of Cancer Cause and Prevention. **Funding:** NIEHS-$78,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The purpose of the studies is to determine co-factors essential in the induction of lung cancer. The approach chosen is to expose heterotopically transplanted tracheas in rats to carcinogenic polycyclic hydrocarbons and to study the effects of other factors, such as age, exposure to asbestos, exposure to noncarcinogenic polycyclic hydrocarbons, promotors and heavy metals, on the final tumor incidence. Part of these investigations are to develop a detailed understanding of the morphological changes occurring during various phases of cancer development. The findings to date suggest that nickel subsulfide and chrysotile A asbestos are weak but definite carcinogens for respiratory tract irritants. Ongoing studies will provide information on the age specific susceptibility of respiratory tract epithelium and on the co-carcinogenic activity of the agents listed above.
Keywords: LUNGS; TRACHEA; INDUCTION; TUMOR CELLS; NEOPLASMS; POLYCYCLIC AROMATIC HYDROCARBONS; ASBESTOS; AGE DEPENDENCE; MORPHOLOGICAL CHANGES; NICKEL COMPOUNDS; SULFITES; CARCINOGENS; BIOLOGICAL EFFECTS; METABOLISM; RATS.

33525 Studies in 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 25004-01 LPFT. **Supported by:** National Inst. of

Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.
R and D categories: Health effects.

The overall objective of the project is to study the life cycle and function of several of the major cell types in the lung in vitro. To accomplish this, culture conditions need to be established which will allow the long term maintenance of the cell type in question in a differential state. Cell suspensions were prepared from rat lungs by a combination of mechanical and enzymatic procedures. The cells were placed in vitro and epithelial cell cultures were established using medium conditioned by the mouse Balb C 3T3 fibroblasts. Two clones, C05 and D07, differing in morphologies were further studied. Results have shown that both cell lines depend on the conditioned medium for their growth in culture. In C05, we have shown further that a part of the requirement of conditioned medium can be replaced by epidermal growth factors. These results suggest that an adjustment of culture medium by growth factors is needed in order to culture pulmonary epithelial cells in vitro. Studies are underway to determine the identity of the epithelial cells and to test their functional capacities.
Keywords: EPITHELIUM; CELL CULTURES; LUNGS; DYNAMIC FUNCTION STUDIES.

33526 Protein Constitutents of the Human Pulmonary Acellular Lining in Health and Disease. Hook, G.E.R. (National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** ES-80029-01 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The basic hypothesis underlyng this project is that the acellular lining of the lungs of humans can be used to detect, diagnose and monitor pulmonary damage produced by disease and inhaled environmental toxins. The initial objectives are to characterize the particulate and protein components of the normal acellular lining from humans. This will involve sampling the acellular lining of healthy volunteers using the fiberoptic bronchoscope. The baseline data obtained will be compared with that obtained from bronchoalveolar lavage effluents from patients with diseases of the lungs. Considerable advances have already been made insofar as characterization of materials from patients with pulmonary alveolar proteinosis and normal humans are concerned. Ultimate goals include the study of materials from the lungs of patients with pulmonary diseases induced through inhalation of dusts and toxicants from work environments related to the production of energy.
Keywords: PROTEINS; MAN; LUNGS; PATHOLOGICAL CHANGES; PHYSIOLOGY; BIOLOGICAL INDICATORS; AEROSOLS; BIOASSAY; TOXICITY; RESPIRATORY SYSTEM DISEASES.

33527 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:** ES-80033 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$240,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects; Ecological/biological processes and effects.

The pulmonary epithelium of mammals is known to contain silver-staining endocrine-like cells and neuroepithelial bodies. Neuroendocrine-like granules have been previously identified in both of these structures. In one study Syrian golden hamsters are being treated with diethylnitrosamine in order to induce tumors related morphologically to human lung small cell carcinomas, which are known to contain neuroendocrine-type granules and synthesize polypeptide hormones. Animals will be examined throughout the period of treatment in order to examine (1) the apparent progression of tumor formation, (2) the onset of detectable appearance of pituitary hormones such as adrenocorticotropic hormone (ACTH) using immunocytochemical methods, and (3) the establishment of tumor cell lines which are hormonally active. Since human small cell carcinomas as a histological class account for approximately twenty percent of human lung neoplasms, the origin or progenitor cell and susceptibility to neoplasia by pulmonary endocrine cells will be studied. In a related study, mouse and rat lung squamous cell carcinomas induced by intratracheal injections of 3-methylcholanthrene or localized exposure of benz(a)pyrene to tracheal transplants were found to contain ACTH-immunolike reactivity. Experiments are being designed to (1) examine the cellular source of hormone formation within the solid tumors, and (2) using cloned cell lines, determine any potential squamous cell carcinomas to progress to the more malignant small cell carcinoma.
Keywords: POLYPEPTIDES; LUNGS; EPITHELIUM; HAMSTERS; INDUCTION; HORMONES; BIOSYNTHESIS; MICE; RATS; BENZOPYRENE; CARCINOGENS; CARCINOMAS; CONDENSED AROMATICS.

33528 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-80035-01 LPFT. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$96,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The goal of the project is to study the co-oxygenation of xenobiotics and polycyclic hydrocarbons in particular by pulmonary prostaglandin synthetase. Microsomal preparations of various tissues, in particular lung tissue, were used to study the co-oxygenation of benzo(a)pyrene during prostagladin synthesis. Benzo(a)pyrene metabolites were isolated from the incubation medium by extraction and by separation by thin-layer chromatography. Prostaglandin and thromboxane products were also isolated and quantitated. It was found that the carcinogen benzo(a)pyrene was oxidized during conversion of arachidonic acid (AA) to prostaglandins (PG) and thromboxanes (TX). The major metabolites were quinones. BP was oxidized by both the AA-dependent and NADPH-dependent systems to metabolites which were electrophilic as indicated by BP associated radioactivity covalently linked to protein and DNA. In the future we propose to further investigate the mechanism of AA dependent BP oxidation and to determine the nature and the biological activity (mutagenesis, transformation) of the electrophilic metabolites.
Keywords: PROSTAGLANDINS; HORMONES; POLYCYCLIC AROMATIC HYDROCARBONS; BENZOPYRENE; OXIDATION; CARCINOGENS; METABOLITES; OXYGEN; MUTAGENESIS; LIGASES; ENZYME ACTIVITY; LUNGS.

33541 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-80016-05 LPK. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$150,000.
Related energy source: hydroelectric(100). **R and D categories:** Health effects.

Polychlorinated biphenyls (PCBs), 2,4,5,2',4',5'-hexabromobiphenyl (PBB), and Kepone/sup R/ are readily absorbed from the gut, rapidly removed from the blood, and initially stored in the liver and muscle. At later time points the less chlorinated PCBs are metabolized and excreted while the highly chlorinated PCBs and the PBB are translocated from the liver and muscle to the skin and adipose tissue which are the sites of long-term storage. The degree of PCB metabolism decreases as the chlorine content increases, and the effect of increasing chlorine content is most marked when the chlorine atoms are arranged so that the biphenyl molecule does not have two adjacent, unsubstituted carbon atoms. The PBB and Kepone do not have two adjacent, unsubstituted carbon atoms and are not subject to an appreciable amount of metabolism. Kepone is stored primarily in the liver and is excreted in the bile at a rate proportional to the liver concentration. On the other hand, the PBB is stored primarily in the adipose tissue, is subject to very little excretion, and thus has an infinite half-life in the male rat. After chronic dosing, the disposition of PCBs after long-term, low-dose exposure was simulated. From the knowledge obtained on the pharmacokinetics of PCBs, we hope to develop pharamcokinetic information which will facilitate correlation of metabolic fate with toxicity for several environmental pollutants including hydrocarbons.
Keywords: ORGANIC CHLORINE COMPOUNDS; AROMATICS; PESTICIDES; METABOLISM; TOXICITY; HYDROCARBONS; ORGANIC BROMINE COMPOUNDS.

33601 Toxicants and Avian Cell Growth and Metabolism. Wilson, B.W. (University of California at Davis, Avian Sciences Department, Davis, CA, 95616). **Project number:** R01-ES00202. **Contract:** R01-ES00202. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$49,000.
R and D categories: Health effects.

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 exam-

ined 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.

33602 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33603 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33604 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33605 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: fossil fuels(100). **R and D categories:** Health effects.

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 if 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.

33606 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 ES00592. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$77,000.
R and D categories: Health effects.

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.

33607 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33608 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33609 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33610 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33611 Chemical Behavior of Organomercury Compounds. Bach, R.D. (Wayne State Univ., 363 Life Science, Detroit, MI, 48202). **Project number:** R01-ES-00761. **Contract:** R01-ES-00761. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$44,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This investigation is principally aimed at studying the exchange reactions of organomercurials. Particular emphasis will be placed upon methylmercury compounds that are bound to sulfur. The relative rate of alkyl and ligand exchange for R-Hg-SR derivatives will be studied. The study will be extended to include biologically important compounds that contain the -SH and -S-S functional groups. The mode of reaction of these compounds with RHgX and HgX2 will be studied. The relative reactivity of CH3Hg+ to a series of ligands containing -CR3, -NR2, -OR, and -SR will be determined by nmr and chromatography techniques. The experimental data will be supplemented by theoretical calculations. We will also continue our studies on the cleavage reactions of the C-Hg bond. Our conclusions will be related to the existing ecological problems associated with mercury contamination of the environment.

Keywords: ORGANIC MERCURY COMPOUNDS; METHYLMERCURY; SULFUR; CHEMICAL BONDS; CARBON; ENVIRONMENTAL TRANSPORT; CHEMICAL REACTIONS; EXPERIMENTAL DATA; CALCULATION METHODS.

33612 Metabolism and Biochemical Actions of Cadmium. Cousins, R.J. (Rutgers, The 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: fossil fuels(100). **R and D categories:** Health effects.

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; CAL-

CIUM; COPPER; ZINC; SYNERGISM; VITAMIN D; INGESTION; DIET; ENZYMES; PROTEINS; BIOSYNTHESIS.

33613 Induction of Metallothionein by Cadmium, Copper, and Mercury. Bryan, S.E. (New Orleans 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: fossil fuels(100). **R and D categories:** Health effects.

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 ellucidate 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.

33614 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-ES00807. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$57,000.
R and D categories: Ecological/biological processes and effects.

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.

33615 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33616 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33617 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: fossil fuels(100).

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.

33618 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33619 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33620 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 ES00969. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$52,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33621 Metabolic Effects of Lead Poisoning in Childhood. Piomelli, S. (University of New York, Medical Center, 550 First Avenue, New York, NY, 10016). **Project number:** R01-ES-00976. **Contract:** R01-ES-00976. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$109,000.
Related energy source: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Health effects.

The proposed research will investigate the clinical significance of hematological evidence of lead toxicity in asymptomatic children with moderately elevated body burden of lead. These studies 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. These studies will investigate the lag phase between exposure of animals to lead and elevation of porphyrins as well as the sequence of production of free and Zn chelated protoporphyrin. These studies will evaluate the mechanism of action of lead on the mitochondrial enzyme ferrochelatase and evaluate whether this is a specific effect or an interference with mitochondrial function and Fe transport.
Keywords: LEAD; METABOLISM; TOXICITY; CHILDREN; BIOASSAY; LEAD; PORPHYRINS; ENZYMES; ANIMALS; ZINC; DIAGNOSIS; PATHOLOGICAL CHANGES.

33622 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33623 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: fossil fuels(100). **R and D categories:** Health effects.

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 chelat-

ing 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.

33624 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: fossil fuels(100). **R and D categories:** Health effects.

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 predictabe 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.

33625 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: fossil fuels(100). **R and D categories:** Health effects.

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 degress 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.

33626 Photosensitivity: Environmental and Other Factors. Harber, L.C. (Columbia University, 630 West 168 Street, New York, NY, 10032). **Project number:** R01-ES01041. **Contract:** R01-ES01041. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$175,000.
R and D categories: Health effects.

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 individuals 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.

33627 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33628 Effect of Ozone on Lung Growth and Development. Boatman, E.S. (Washington University, Department of Environmental Health, SC-34, Seattle, WA, 98195). **Project number:** R01-ES01049. **Contract:** R01-ES01049. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$62,000.
R and D categories: Health effects.

Unilateral pneumonectomy in laboratory animals induces a stimulus to the growth of the remaining lung such that lung volume greatly increases above normal. It is proposed to locate the sites at which new growth occurs and compare newly formed tissue with preexisting mature tissue. The main thrust of the research is to ascertain the effects of air pollutant gases on this accelerated lung development and to determine whether growth is impaired on exposure to pollutants in concentrations found in urban environments. The characterization of this stimulated lung growth and development in control and in animals exposed to ozone and other oxidants will be derived from measurements of pulmonary function, from quantitative morphometry and light and electron microscopy, and from biochemical analyses. The experimental design offers the advantage of investigating the effects of environmental stress on a compromised organ that consists of both mature tissue and tissue in a state of development. In this respect, the findings may have particular significance in the areas of neo-natal development and pneumonectomy in the human.
Keywords: OZONE; INHALATION; LABORATORY ANIMALS; BIOLOGICAL EFFECTS; TOXICITY; LUNGS; SURGERY; BIOLOGICAL REGENERATION; PATHOLOGICAL CHANGES; MORPHOLOGICAL CHANGES; BIOCHEMISTRY; AIR POLLUTION; URBAN AREAS; BENCH-SCALE EXPERIMENTS.

33629 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: fossil fuels(50); nuclear fuels(general)(25); hydroelectric(25). **R and D categories:** Health effects.

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 path-

way, 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.

33630 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33631 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33632 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33633 Environmental Mutagenesis and DNA Repair. Smith, P.D. (Emory University, Department of Biology, Atlanta, GA, 30322). **Project number:** R01-ES01101. **Contract:** R01-ES01101. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$112,000.
R and D categories: Health effects.

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.

33634 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33635 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: fossil fuels(100). **R and D categories:** Health effects.

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. 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 poisoniing on a more informed basis.
Keywords: CADMIUM; TOXICITY; DECONTAMINATION; TISSUES; ORGANIC SULFUR COMPOUNDS; RESPONSE MODIFYING FACTORS; ENZYMES; METABOLISM.

33636 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-ES01150. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$68,000.
R and D categories: Health effects.

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.

33637 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 ES01151. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$86,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33638 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 ES01287. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$99,000.
Related energy source: all(100). **R and D categories:** Health effects.

We are studying the mutational process in mammalian somatic cells with special emphasis on the role of alterations in regulatory control factors as a source of cell variation. For this we are using a Chinese hamster ovary (CHO) cell system we have developed 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. We shall analyze the genetics of that control in human-mouse hybrid clones and devise a system (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.

33639 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 ES01301. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$95,000.
Related energy source: all(100). **R and D categories:** Health effects.

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 paral-

lel 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.

33640 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:** fossil fuels(100). **R and D categories:** Health effects.

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.

33641 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: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Health effects.

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 (a) dissolution, (b) transit, and (c) 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.

33642 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33643 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: fossil fuels(100). **R and D categories:** Health effects.

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 CCl4 as a model compound to produce liver damage. We have found that CCl4 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 CCl4 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.

33644 Lead Toxicity Related to Heme Biosynthesis. Piper, W.N. (Univ. of California, School of Medicine, San Francisco, CA, 94143). **Project number:** R01-ES-01343. **Contract:** R01-ES-01343. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$103,000. **Related energy source:** fossil fuels(100). **R and D categories:** Health effects.

Lead poisoning remains a major health problem in the United States. Up to 19% of the children from a recent series of screening programs from 1969 to 1971 had lead blood levels of 60 mu g/100 ml or higher, concentrations that are generally accepted as severe enough to require medical treatment. Lead is known to be toxic to the erythropoietic system, producing anemia. A possible explanation for this anemia is inhibition of heme biosynthesis in erythropoietic tissue. The goal of the research proposed in this project is to elucidate the role of a dialyzable, protective factor against lead inhibition of uroporphyrinogen I synthetase, an enzyme midway along the heme synthetic pathway. Results of preliminary experiments have demonstrated that this factor is present in the liver and offers complete protection against lead inhibition of hepatic uroporphyrinogen I synthetase activity. However, this factor is evidently not present in the erythrocyte, or is present at a lower concentration, since lead is a potent inhibitor of hemolysate enzyme. The results of studies directed towards understanding this protection against lead inhibition of this enzymatic step of heme biosynthesis by this dialyzable factor will provide valuable information on mechanisms of lead

toxicity and new information on the possible treatment of lead intoxication.
Keywords: LEAD; TOXICITY; BLOOD; BIOSYNTHESIS; METABOLISM; CHILDREN; SCREENING; QUANTITATIVE CHEMICAL ANALYSIS; ECOLOGICAL CONCENTRATION.

33645 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: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

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 be 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.

33646 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:** fossil fuels(100). **R and D categories:** Health effects.

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 excerta 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.

33647 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33648 Nervous System Porphyrins and Lead and PCB Effects. Whetsell, W.O. (Mt. Sinai School of Medicine, Department of Neurology, New York, NY, 10029). **Project number:** R01-ES-01580. **Contract:** R01-ES-01580. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$98,000.
Related energy source: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

Initial studies have demonstrated that certain cellular elements of mature, organotypic nervous system cultures have a porphyrin-heme biosynthetic pathway and that the pathway is subject to effects of lead. The research described in this application is designed to (1) study the nature of the porphyrin biosynthetic pathway organotypic nervous system cultures, and (2) to investigate, in this tissue culture model, effects of two agents, lead and chlorinated hydrocarbons, which have been demonstrated to affect porphyrin-heme metabolism in non-nervous system tissues. It is proposed to 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 used to study cellular components which are affected by lead, i.e., neuronal elements versus supporting elements; spectrofluorometric techniques will be 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 (morphologic studies) and on porphyrin metabolic pathways (fluorometric or biochemical studies) will be evaluated. The efficacy of lead-chelating agents in preventing or reversing effects of lead in these cultures will also be studied. In mature cultures treated with polychlorinated biphenyls (PCB's), biochemical effects on porphyrin metabolism and morphological effects on various elements of the cultures will be evaluated.
Keywords: CENTRAL NERVOUS SYSTEM; PORPHYRINS; LEAD; AROMATICS; ORGANIC CHLORINE COMPOUNDS; BIOLOGICAL EFFECTS; METABOLISM; PATHOLOGICAL CHANGES; BEHAVIOR; BIOLOGICAL PATHWAYS; BIOLOGICAL FUNCTIONS; CHELATING AGENTS; TISSUE CULTURES.

33649 Effect of Lead on the Developing Nervous System. Chang, L.W. (University of Arkansas, Department of Pathology, College of Medicine, Little Rock, AR, 72201). **Project number:** R01-ES-01631. **Contract:** R01-ES-01631. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$11,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Single (ip or sc) injections of lead salts (acetate or nitrate), at dosage levels levels producing a LD50 response will be given pregnant mice at daily intervals from the 8th to 16th days of gestation. Chick embryos will be treated with predetermined sublethal doses at daily intervals from the 2nd to 8th days of incubation. The pathological effects of such treatment on the morphological development of vertebrate embryos will be investigated. Other avian and mammalian embryos will be exposed to previously determined teratogenic doses of lead and will receive concurrently doses of thymidine H/sup 3/, uridine H/sup 3/ or leucine H/sup 3/. This method will allow us to determine whether or not lead effects biochemical activities such as DNA, RNA and protein synthesis in the developing central nervous system. The quantitative and qualitative distribution of lead in the developing fetus will be studied by atomic absorption spectrophotometry and radioautography.
Keywords: LEAD; CENTRAL NERVOUS SYSTEM; BIOLOGICAL EFFECTS; DYNAMIC FUNCTION STUDIES; ACETATES; LEAD NITRATES; EMBRYOS; PATHOLOGICAL CHANGES; BEHAVIOR; CHICKENS; METABOLISM.

33650 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: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Health effects.

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 determi-

nations 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.

33651 Enzyme-Mediated Generation of Halogenated Pollutants. Siuda, J.F. (University of Pittsburgh, 726 Salk Hall, Pittsburgh, PA, 15261). **Project number:** R01-ES01644. **Contract:** R01-ES01644. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$41,000.
R and D categories: Ecological/biological processes and effects.

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.

33652 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:** fossil fuels(100). **R and D categories:** Health effects.

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 hysterotomies) 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.

33653 Prolonged Noise Exposure: A Longitudinal Study. Cohen, S.A. (University of Oregon, Psychology Department, Eugene, OR, 97403). **Project number:** R01 ES01764. **Contract:** R01 ES01764. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$31,000.
Related energy source: all(100). **R and D categories:** Health effects.

Laboratory research indicates that short-term exposure to environmental stress can be detrimental to task performance, decrease altruistic behavior, and result in motivational and cognitive deficits linked with the deterioration of health. These effects are often atrributed to stress induced shifts in attentional strategies and locus of personal control. The difficulty with most of this research is that it emphasizes acute rather than long-term effects. Due to a lack of well-controlled studies of those routinely living and working under stress, we are unable to say with any certainty what happens when individuals are exposed to environmental stress for prolonged periods. Are the effects of short- and long-term exposure similar. Do we adapt with prolonged exposure. Are there immediate and/or lasting aftereffects of chronic stress exposure. This proposal suggests some implications of the existing literature on short-term exposure to environmental stress for predicting the impact of prolonged exposure. Two well-controlled longitudinal studies of the effects of classroom and home noise levels on behavior and health are proposed to test the validity of these suggestions. The emphasis of the studies is to determine both the immediate and long-term impact of prolonged exposure on children's attentional strategies and generalized expectancies concerning control. Verbal skills and health will be assessed in light of their theoretical relationship to the above mentioned mechanisms. Alternative explanations for the assumed detrimental effects of noise on children will also be examined.
Keywords: BIOLOGICAL STRESS; CHRONIC EXPOSURE; NOISE; BIOLOGICAL EFFECTS; CHILDREN; BEHAVIOR; MENTAL DISORDERS; NERVOUS SYSTEM; PATHOLOGICAL CHANGES.

33654 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: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

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.

33655 Isolating Carcinogen Sensitive Mammalian Cell Mutants. Stamato, T.D. (National Jewish Hospital and Research Center, 3800 E. Colfax Avenue, Denver, CO, 80206). **Project number:** R01-ES-01803. **Contract:** R01-ES-01803. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$62,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

A technique has been developed for isolating uv-sensitive mutants of cultured Chinese hamster cells. The method uses nylon cloth replica plating and a means of identifying uv-sensitive colonies by the formation of plagues in a cell monolayer. The replication plating technique enables 2 thousand colonies per plate (approximately 2 x 10/sup 5/ total) to be examined for sensitivity to a specific lethal agent, but still permits the isolation of viable cells from a particular colony. This method will be used to isolate a series of independent uv-sensitive mutants. Methods will be developed for isolating mutants of the Chinese hamster cell that are unusually sensitive to other known mutagenic and carcinogenic agents such as x-rays and chemical agents. Studies of these mutants will then be undertaken for the purpose of identifying the biochemical events that are important in chromosomal repair and the relation of these processes may have to malignant transformation. This genetic and biochemical approach to DNA repair has been very successful in bacteria. Applying this approach to mammalian cells will offer a means of studying biochemical events whose importance may not yet be fully recognized. With a set of mutants sensitive to a particular agent, a genetic and biochemical analysis can then be made of the

steps necessary for increased survival to that agent, and of the biochemical basis for repair of exogenously caused damage to DNA. The relation between these biochemical defects and those observed in cells from patients with the disease Xeroderma pigmentosum can be examined. Also, the correlation between these defects and the effect on mutagenicity and malignant transformation can be investigated.
Keywords: ANIMAL CELLS; MUTANTS; CARCINOGENESIS; BIOLOGICAL MODELS; ULTRAVIOLET RADIATION; BACTERIA; HAMSTERS; SENSITIVITY; MUTAGEN SCREENING; OPTIMIZATION.

33656 New System for Screening Environmental Mutagens. Finnerty, V.M. (Emory University, Biology Department, Atlanta, GA, 30322). **Project number:** R01 ES01804. **Contract:** R01 ES01804. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33657 Rapid Screening for Lead Poisoning. Colbert, C. (Green Memorial Hospital, 1411 North Monroe Drive, Dayton, OH, 45431). **Project number:** R01-ES-01825. **Contract:** R01-ES-01825. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$57,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

While the causes and cure of lead poisoning are well known, early detection before effects become irreversible remains one of two major stumbling blocks to eradication of this environmental disease. Diagostic tests so far devised have limitations and there is need for a practical, reliable and definitive test. The objectives are to determine whether our quantitative computer/scanner system for rapid screening of radiographs can effectively detect lead poisoning in its early stages; and evaluate the usefulness of our system in measuring the extraction of lead from bones during treatment. Because of our capability for objective measurement, we should be able to detect lead deposits in bones even when they are not visible in radiographs. Our computerized system is wholly independent of subjective visual evidence and largely independent of film taking and processing variables, thus overcoming the drawbacks of traditional radiographic screening methods. Some 300 radiographs of known lead-poisoning cases will be analyzed by two of our standard methods for determining skeletal status: (1) measurement of radiographic bone size, weight and density combined with comparison of findings to normal values; and (2) line-scanning of selected bones to establish a mineral distribution profile which may pinpoint dense deposits in growing ends of bones.
Keywords: LEAD; TOXICITY; SCREENING; BIOLOGICAL INDICATORS; AUTOMATION; BONE TISSUES; SKELETON; EPIDEMIOLOGY.

33658 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33659 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: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

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.

33660 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33661 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: fossil fuels(80); nuclear fission(20). **R and D categories:** Health effects.

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) postimplanta-

tion 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.

33662 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 shales and tar sands(50). **R and D categories:** Health effects.

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.

33663 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: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

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.

33664 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33665 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: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

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.

33666 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33667 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33668 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33669 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: fossil fuels(75); nuclear fission(25). **R and D categories:** Health effects.

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 becn 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.

33670 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33671 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-ES01938. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$38,000.

R and D categories: Health effects.

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 micro-

wave 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 pre-exposure threshold, and temperature.
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.

33672 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33673 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-ES01960. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
R and D categories: Health effects.

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-CHROMOSOMES; MUTATIONS; RADIOINDUCTION; MUTATION FREQUENCY; SPONTANEOUS MUTATIONS; EMS; MUTAGENESIS; COMPARATIVE EVALUATIONS; POPULATION DYNAMICS; SURVIVAL TIME; GENETIC VARIABILITY.

33674 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33675 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33676 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-ES02117. **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:** Health effects.

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 examining 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.

33801 Effect of Nitrogen Dioxide on Pulmonary Monocytes. Acton, J.D. (Wake Forest University, Department of Microbiology, Winston-Salem, NC, 27103). **Project number:** 1R01-ES-02136-01. **Contract:** 1R01-ES-02136-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$37,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33802 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-01246-01. **Contract:** 1R01-ES-01246-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$84,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33803 Binding of CH3H, an Environmental Hazard, with DNA. Maki, A.H. (University of California, Department of Chemistry, Davis, CA, 95616). **Project number:** R01-ES-01268. **Contract:** R01-ES-01268. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$52,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objectives are to (1) determine the extent to which DNA of chromosomes binds alkyl and aryl mercury in living cells; and (2) obtain information on the molecular level concerning the nature of the complexes. The spectroscopic method utilized consists of the optical detection of magnetic resonance (odmr) by means of which magnetic resonance transitions in photoexcited triplet states are detected optically. A heavy atom effect caused by mercury binding to an aromatic chromophore such as a heterocyclic base of DNA makes the resulting triplet state a highly radiative trap which is especially sensitive to odmr. The odmr method thus selects the mercury-perturbed chromophore which then can be identified by the magnetic resonance frequencies and other properties of the phosphorescent state. Selectivity by the heavy atom effect is especially good in DNA which normally is not highly luminescent. As a major system for study, Allium cepa, for which cytological data of chromosomal aberrations of root cells caused by mercurial treatment exists, will be used.
Keywords: METHYLMERCURY; DNA; BINDING ENERGY; MERCURY; ALLIUM CEPA; ROOT ABSORPTION; METABOLISM; BIOCHEMICAL REACTION KINETICS; CHROMOSOMAL ABERRATIONS.

33804 Degradation of Aromatic Compounds by Bacillus Species. Crawford, R.L. (Minnesota University, P.O. Box 100, Navarre, MN, 55392). **Project number:** 1R01-ES01284-01. **Contract:** 1R01-ES01284-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$43,000.

Bacteria of the genus Bacillus are among the most ubiquitous of microorganisms, being principal components of the microflora of most soil and water environments. It is imperative that microbial ecologists better understand the capabilities and limitations of this important microbial group in degrading the myriad of aromatic compounds being continually introduced into the biosphere. The objective of the proposed research is to discover the major patterns by which Bacillus species dissimilate aromatic molecules. The range of aromatic compounds degraded by bacilli will be determined. The catabolic pathways for degradation of selected aromatic compounds will be delineated, and certain of the pathway enzymes will be purified and characterized. Compiled data will also be used to clarify the taxonomic arrangement of certain species of Bacillus.**Keywords:** AROMATICS; BIODEGRADATION; BACILLUS; CATABOLISM; BIOLOGICAL PATHWAYS; ENZYMES; TERRESTRIAL ECOSYSTEMS; AQUATIC ECOSYSTEMS; POLLUTION; BENCH-SCALE EXPERIMENTS; SOILS; SURFACE WATERS.

33805 Lead Absorption, Excretion and Metabolism. Conrad, M. (University of Alabama, University Station, Birmingham, AL, 35294). **Project number:** 1R01-ES-01306-01. **Contract:** 1R01-ES-01306-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$71,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33806 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33807 Effect of Atmospheric Pollutants on Pulmonary Defenses. Goldstein, E. (University of California, Department of Internal Medicine, Davis, CA, 95616). **Project number:** 1R01-ES-01327-01. **Contract:** 1R01-ES-01327-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33808 Prolonged Exposure to Four Levels of Air Pollutants. Feir, D.J. (St. Louis University, Biology Department, St. Louis, MO, 63103). **Project number:** 1R01-ES-01361-01. **Contract:** 1R01-ES-01361-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33809 Studies of Oxidant-Induced Pulmonary Lesions. Montgomery, M.R. (Veterans Administration Hospital, 54th Street and 48th South, Minneapolis, MN, 55417). **Project number:** 1R01-ES01365-01. **Contract:** 1R01-ES01365-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$27,000.
R and D categories: Health effects.

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.

33810 Metabolism and Toxicity of Organometallic Agents. Hanzlik, R.P. (University of Kansas, Department of Medicinal Chemistry, Lawrence, KS, 66045). **Project number:** 1R01-ES-01375-01. **Contract:** 1R01-ES-01375-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33811 Metallothionein in Metabolism and Toxicity of Cadmium. Shaikh, Z.A. (University of Rochester, 601 Elmwood Avenue, Rochester, NY, 14642). **Project number:** 1R01-ES-01448-01. **Contract:** 1R01-ES-01448-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$41,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33812 Epidemiologic Study of CORD in Cohorts. Detels, R. (University of California, Los Angeles, CA, 90024). **Project number:** 1R01-ES-01473-01. **Contract:** 1R01-ES-01473-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$427,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33813 Intranasal Homeostasis Viruses and Pollutant Gases. Bang, F.B. (Johns Hopkins University, 615 North Wolfe Street, Baltimore, MD, 21205). **Project number:** 1R01-ES-01477-01. **Contract:** 1R01-ES-01477-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Respiratory disease is the major cause of human death. SO2 is a universal air pollutant, the nasal niucosa 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.

33814 Inhaled Aerosols: Behavior, Effects, and Clearance. Frank, R. (Washington University, 679 6000 Street, Seattle, WA, 98195). **Project number:** 1R01ES0 1478-01. **Contract:** 1R01ES0 1478-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$268,000.

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

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.

33815 Nephrotoxic Effects of Environmental Hydrocarbons. Zimmerman, S.W. (University of Wisconsin, 1300 University Avenue, Madison, WI, 53706). **Project number:** 1R01-ES-01480-01. **Contract:** 1R01-ES-01480-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33816 Cadmium: Neurobehavioral and Trace Metal Studies. Cooper, G.P. (University of Cincinnati, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** 1R01-ES-01494-01. **Contract:** 1R01-ES-01494-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$85,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33817 Detecting Mutations Induced by Environmental Pollutants. Lark, K.G. (Utah University, Department of Biology, Salt Lake City, UT, 84112). **Project number:** 1R01-ES01498-01. **Contract:** 1R01-ES01498-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS.

R and D categories: Health effects.

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.

33818 Metallothionein: Structure-Function Relationships. Petering, D.H. (University of Wisconsin, Department of Chemistry, Madison, WI, 53201). **Project number:** 1R01-ES-01504-01. **Contract:** 1R01-ES-01504-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$71,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33819 Lead Retention in Relation to Nutrient Intake. Huber, A.M. (Harvard School of Public Health, 665 Huntington Avenue, Boston, MA, 02115). **Project number:** 1R01-ES-01507-01. **Contract:** 1R01-ES-01507-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Health effects.

The purpose of these studies is to evaluate the effects of marginal and excess nutrient intakes on susceptibility to lead toxicity under conditions of low lead exposure. The influence of nutrient intake on lead detoxification will also be investigated and compared with chelation therapy. In a series of studies, nutrient-lead interactions will be investigated to elucidate their mechanisms.
Keywords: LEAD; TOXICITY; METABOLISM; NUTRIENTS; SYNERGISM; BIOCHEMICAL REACTION KINETICS; RETENTION; EXCRETION.

33820 Bacterial Degradation of PCB: Consequences and Effects. Saylor, G.S. (University of Tennessee, Department of Microbiology, Knoxville, TN, 37916). **Project number:** 1R01-ES01521-01. **Contract:** 1R01-ES01521-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$51,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33821 Environmental Mutagens: Their Mechanisms of Action. Sofer, W.H. (Johns Hopkins University, Charles and 34th Streets, Baltimore, MD, 21218). **Project number:** 1R01-ES-01527-01. **Contract:** 1R01-ES-01527-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$62,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33822 Effects of Hydrocarbons on Defense Mechanisms. Tripp, M.R. (University of Delaware, Department of Biological Sciences, Newark, DE, 19711). **Project number:** 1R01-ES-01531-01. **Contract:** 1R01-ES-01531-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$59,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33823 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-01532-01. **Contract:** 1R01-ES-01532-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$43,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33824 Nature of Lead and Mercury Binding Nuclear Proteins. Cherian, G.M. (Western Ontario University, Health Sciences Center, London, Ontario, Canada). **Project number:** 1R01-ES-01535-01. **Contract:** 1R01-ES-01535-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$19,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33825 Nature of Radiation Induced Genetic Damage. Novitski, E. (University of Oregon, Department of Biology, Eugene, OR, 97403). **Project number:** 1R01-ES-01536-01. **Contract:** 1R01-ES-01536-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$65,000.

Related energy source: fossil fuels(50); nuclear fusion(50). **R and D categories:** Health effects.

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 treatment, 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.

33826 Distribution and Retention of Inhaled Pollutants. Wagner, H.N. (Johns Hopkins University, 615 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** 1R01-ES-01543-01. **Contract:** 1R01-ES-01543-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$67,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The estimation of health hazards due to inhaled atmospheric pollutants depends on knowledge of the amount and location of material retained in the lungs. In order to provide the information on which these estimates can be based, an experimental program is proposed for the measurement of the distribution and clearance of inhaled radiolabeled aerosols over a wide range of particle sizes and breathing patterns. Three factors have come together to make such an investigation particularly appropriate at this time: (1) the technical advances in recording and analyzing radioactive tracer data that have been made over the past 5 years can greatly improve the quality of the fundamental information to be gained; (2) considerable experience has been gained in generating controlled aerosols; and (3) as the nation faces the possibility of considerable expansion of nuclear and coal-fired power plants, more information is needed in order to judge the relative health hazards of alternative sources of energy.

Keywords: INHALATION; AIR POLLUTION; HEALTH HAZARDS; CHEMICAL EFFLUENTS; PARTICLES; AEROSOLS; TOXICITY; AEROSOL GENERATORS; AEROSOL WASTES; NUCLEAR POWER PLANTS; FOSSIL-FUEL POWER PLANTS; LUNGS; PATHOLOGICAL CHANGES.

33827 Metabolism, Induction, and Toxicity of PCBs. Kaminsky, L.S. (New York State Department of Health, New Scotland Avenue, Albany, NY, 12201). **Project number:** 1R01-ES01544-01. **Contract:** 1R01-ES01544-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$59,000.

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

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.

33828 Distribution of Polonium-210 in Human Lung. Harley, N. (New York University Medical Center, 550 First Avenue, New York, NY, 10016). **Project number:** 1R01-ES1550-01. **Contract:** 1R01-ES1550-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$30,000.

R and D categories: Health effects.

Polonium-210 is found in mainstream cigarette smoke and it has been suggested that the alpha radiation from the Po-210 deposited in the lung is etiologically related to bronchogenic carcinoma. Reported average concentrations of Po-210 in human lung are significantly higher in smokers than in non-smokers. The concentration is thought to be non-uniform on the bronchial epithelium. The study in this application will establish the concentration of Po-210 in lungs of smokers and non-smokers and will focus on determining the microdistribution of this radionuclide on the bronchial epithelium.

Keywords: POLONIUM 210; TOBACCO SMOKES; INHALATION; MAN; DEPOSITION; SPATIAL DISTRIBUTION; ALPHA PARTICLES; LUNGS; BIOLOGICAL RADIATION EFFECTS; RADIONUCLIDE KINETICS; CARCINOMAS; RADIOINDUCTION; COMPARATIVE EVALUATIONS; CARCINOGENESIS.

33829 Metabolism, Genome Repair, and Environmental Mutagens. Waldren, C.A. (Colorado University, 4200 E. 9th Avenue, Denver, CO, 80220). **Project number:** 1R01-ES01555-01. **Contract:** 1R01-ES01555-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$52,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33830 Active Site of Delta-Aminoelevulinic Acid Dehydratase. Lerman, C.L. (Haverford College, Department of Chemistry, Haverford, PA, 19041). **Project number:** 1R01-ES01572-01. **Contract:** 1R01-ES01572-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$35,000.
R and D categories: Health effects.

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.

33831 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-01576-01. **Contract:** R01-ES-01576-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$88,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33832 Toxicity of Prenatal Carbon Monoxide Exposure. Annan, Z. (Johns Hopkins University, 615 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** 1R01-ES-01589-01. **Contract:** 1R01-ES-01589-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$73,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33833 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-01599-01. **Contract:** 1R01-ES-01599-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$49,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33834 Teratogenicity of Chlorinated Hydrocarbon Solvents. Manson, J.M. (Cincinnati University, 3223 Eden Avenue, Cincinnati, OH, 45267). **Project number:** 1R01-ES-01601-01. **Contract:** 1R01-ES-01601-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$74,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33835 Frog Mutagenesis Test System. McKinnell, R.G. (University of Minnesota, 250 Bio Science Center, St. Paul, MN, 55108). **Project number:** 1R01-ES-01605-01. **Contract:** 1R01-ES-01605-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$81,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33836 Environmental Contaminants: Effect on Tumor Immunity. Koller, L.D. (Oregon State University, 107 Druden Hall, Corvallis, OR, 97331). **Project number:** 1R01-ES01612-01. **Contract:** 1R01-ES01612-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.

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

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.

33837 Study of Fibrous Dust Propagation Using Holography. Boettner, E.A. (University of Michigan, 109 Observatory, Ann Arbor, MI, 48109). **Project number:** 1R01-ES-01613-01. **Contract:** 1R01-ES-01613-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.

Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring.

The technique of holography has provided a new method for study of environmental situations which heretofore could not be approached. In particular, the possibility of studying the dynamics of particles and fibers in the atmosphere or in a duct by direct observation without the intrusion of measuring devices, now exists. The combination of pulsed lasers with the holographic method will permit a stopping or freezing of the motion of possible dust pollutants in space, such that their flow patterns can be observed both qualitatively and quantitatively. It is proposed to use this methodology to attain the following objectives: (1) determine the speed and mode of fall of fiberous and platy materials (e.g., asbestos, glass fibers, talc, etc.) as they move through space; (2) establish how the rate and type of movement varies with size, shape, and concentration of particles per unit volume; (3) compare this with the values obtained using mathematical formulas and experimental data developed previously by others for the movement of particulate matter; (4) determine the action of fiberous and platy materials as they move or are drawn to the face of filters of various types at various speeds (what can be done by varying the rate of air flow through the filter to change this mode of motion for a more efficient collection); and (5) determine the effect of a surface on the same types of dusts as they move toward the face of a filter.

Keywords: HOLOGRAPHY; PARTICLES; AEROSOLS; ASBESTOS; FIBERGLASS; ENVIRONMENTAL TRANSPORT; DUSTS.

33838 Metal Intoxication and Metallocytochrome Synthesis. Vanderkooi, J.M. (University of Pennsylvania, Department of Biochemistry and Biophysics, Philadelphia, PA, 19174). **Project number:** 1R01-ES-01628-01. **Contract:** 1R01-ES-01628-01. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$20,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The purpose of this project is to examine whether during heavy metal toxication mistakes are made in the synthesis of cytochromes so that the porphyrin does contain iron. Animals will be exposed to high concentrations of metals either through diets or through the atmosphere. Because porphyrins containing closed metals, unlike iron porphyrins, are fluorescent, incorporation of metals such as zinc can be detected in low levels by examining the luminescence of tissues as lung or liver, or tissue fragments such as mitochondria or endoplasmic reticulum. The incorporation of metals into cytochromes will be considered as a possibility of a cause of metal toxicosis and may provide a means to diagnose metal toxication caused by environmental pollution. Finally, the role of enzymes, in inserting the metal into the porphyrin will be examined in vitro and the results compared with the in vivo findings.

Keywords: BIOSYNTHESIS; CYTOCHROMES; METALS; TOXICITY; ZINC; ANIMALS; ANIMAL CELLS; METABOLISM; IRON; BIOLOGICAL INDICATORS; ENZYMES; ENVIRONMENTAL TRANSPORT.

33901 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33902 Pulmonary Effects of Environmental Oxidant Pollutants. Dungworth, D.L. (University of California at Davis, Dept. of Veterinary Pathology, Davis, CA, 95616). **Project number:** R01-ES-00628. **Contract:** R01-ES-00628. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$440,000.

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

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 potential 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.

33903 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(50); oil shales and tar sands(50). **R and D categories:** Health effects.

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 bronchoalveolar 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.

33904 Health Effects of Fossil Fuels Utilization. Wogan, G.N. (Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139). **Project number:** P01ES01640. **Contract:** P01ES01640. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$525,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

33911 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33912 Nickel Carcinogenesis in Tissue Culture. Costa, M. (University of Connecticut, Institute of Material Science, Storrs, CT, 06268). **Project number:** R23-ES-01677. **Contract:** R23-ES-01677. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$40,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Primary cultures and cell lines will be used to test the carcinogenicity of nickel and nickel compounds. Criteria of transformation will include colony morphology, cell growth in soft agar-containing media and proliferation of cells in appropriate hosts. These studies will be extended to include other metal carcinogens. Using a few potent metal carcinogens, the changes in cAMP levels, cAMP-dependent and independent protein kinase activity and composition as well as phosphorylation of the non-histone chromasomal proteins will be measured during and following transformation. Other mechanistic studies will include measurements of the rate of dissolution of nickel compounds in media, subcellular distribution, binding to macromolecules and effects on fidelity of transcription. It is hoped that the mechanistic studies will lead to the availability of biochemical tests for carcinogenicity of metal compounds. Preliminary studies have revealed that potentially carcinogenic metals affect cAMP dependent protein kinase phosphorylation of histones in vitro; similar in vitro tests with known non-carcinogenic metal compounds show no inhibition of the cAMP stimulated reaction. As metal carcinogens decrease fidelity of transcription and, in high enough concentrations, eventually inhibit it, these compounds seem also to inhibit phosphorylation which in the case of the non-histone chromosomal proteins may result in infidelity of gene readout. This possibility would be tested by examining changes in the state of phosphorylation of different molecular weight classes of nuclear proteins. These experiments would be performed in the intact cell by pulse labelling with 32-PO4 during and following nickel induced transformation. The nuclear proteins will be isolated and examined for differences in their composition and phosphorylation by polyacrylamide gel electrophoresis.
Keywords: NICKEL; METABOLISM; TOXICITY; CARCINOGENESIS; TISSUE CULTURES; NICKEL COMPOUNDS; CARCINOGENS; BIOLOGICAL MODELS.

33913 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33914 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: fossil fuels(80); nuclear fission(20). **R and D categories:** Health effects.

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 appropri-

ate, 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.

33915 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: fossil fuels(100). **R and D categories:** Health effects.

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.

33916 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-ES01724. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$43,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33917 Interaction of Air Pollutants with Chronic Respiratory Disease. Thomas, G.B. (IIT Research Institute, 10 W. 35th Street, Chicago, IL, 60616). **Project number:** R23-ES-01729. **Contract:** R23-ES-01729. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$36,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective of this research 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: concentration of mycoplasma in the lungs and middle ear; lung edema; histopathology of lungs, tracheas, and nasal cavities using light and scanning electron microscopy; circulating antibody; serum immunoglobulin levels; and 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. The results will be correlated with previously established effects of these pollutants on healthy animals and animals with acute pneumonia.
Keywords: RESPIRATORY SYSTEM DISEASES; CHRONIC EXPOSURE; MICE; AIR POLLUTION; BIOLOGICAL MODELS; OZONE; NITROGEN DIOXIDE; SYNERGISM; PNEUMONIA; HEALTH HAZARDS; ETIOLOGY; MYCOPLASMA; INFECTIVITY; BIOLOGICAL EFFECTS.

33918 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: fossil fuels(80); nuclear fission(20). **R and D categories:** Health effects.

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.

33919 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-ES01797. **Supported by:** National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$42,000.
Related energy source: all(100). **R and D categories:** Health effects.

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.

33920 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 Environ-

mental Health Sciences, Research Triangle Park, NC (USA). **Funding:** NIEHS-$38,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34004 Model Systems for the Study of Chemical Carcinogenesis at the Cellular Level. Yuspa, S.H.; Lichti, U.; Bowden, T.; Hennings, H.; Colburn, N. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-601-4. **Contract:** Z01-CP-04504-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

Mouse epidermal cell cultures have been utilized as a model for studying mechanisms of epithelial carcinogenesis in vitro. Untreated cells have a limited lifespan in culture while carcinogen treated cells form longterm lines, some of which are tumorigenic in animals. Carcinogens induce both excision repair and post-replication repair in these cultures and by use of a radioimmunoassay the fate of the carcinogen-nucleoside adduct formed in culture can be followed. Promoters stimulate ornithine decarboxylase activity and DNA synthesis after brief exposure. Exogenous polyamides enhance the proliferative response while steroids inhibit it. The steroid appears to act by decreasing the cell's ability to respond to polyamines and its effects can be overcome by exogenous polyamines.
Keywords: CHEMICAL EFFLUENTS; CARCINOGENESIS; BIOLOGICAL MODELS; ANIMAL CELLS; MICE; EPITHELIUM.

34006 Metabolism of Chemical Carcinogens by Cultured Human Bronchus and Pancreatic Duct. Harris, C.; Selkirk, J.; Autrup, H.; Yang, S.; Stoner, G. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** BX-348-1. **Contract:** Z01-CP-04513-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The maintenance of human bronchus and pancreatic duct in a controlled experimental setting provides an excellent in vitro system to study the metabolism of chemical carcinogens including those found in tobacco smoke and in the environment. Cultured human bronchus can metabolically activate several classes of chemical carcinogens, e.g., polynuclear aromatic hydrocarbons, acyclic and cyclic N-nitrosamines, hydrazines and mycotoxins. The pathway of benzo(a)pyrene (BP) metabolism leading to the binding (-)-7 beta,8 alpha-dihydroxy-9 alpha,10 alpha-epoxy-7,8,9,10-tetrohydrobenzopyrene to DNA has been defined in cultured human bronchial mucosa. The major BP-DNA adduct is between the 10-position of BP and the 2-amino group of guanine. Therefore, the metabolic pathway forming the predominant BP-DNA adduct in human bronchus is similar to that found in experimental animals in which BP is carcinogenic. A 75-fold variation among individuals in the binding of BP to DNA in cultured bronchi has been measured. Nontumorous bronchi from patients with epidermoid carcinomas of the lung bind significantly more BP to DNA than specimens from patients with either no cancer or adenocarcinoma of the lung.
Keywords: METABOLISM; TOBACCO SMOKES; HUMAN POPULATIONS; PANCREAS; BRONCHI; POLYCYCLIC AROMATIC HYDROCARBONS; BENZOPYRENE; PATIENTS; DNA; CARCINOGENS; CHEMICAL BONDS; GENETIC VARIABILITY; LUNGS.

34007 Studies on the Mechanism of Induction of Aryl Hydrocarbon Hydroxylase. McIntosh, P.R. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** BX-351-1. **Contract:** Z01-CP-04502. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The activity of the aryl hydrocarbon hydroxylase of rat liver and of cultured rat liver cells is stimulated by pre-exposure of the rat or cultured cells to particular carcinogens. It is the purpose of this project to investigate the mechanisms by which this induction occurs. As the first stage of this investigation, electrophoretic estimations were made of the levels of the various microsomal proteins in rat liver after treatment of the rats with the carcinogenic polycyclic hydrocarbon, 3-methylcholanthrene. These results were compared with those found after phenobarbital treatment. With the carcinogen two microsomal proteins were induced concomitantly in several strains of rat, and there was evidence suggesting that a third microsomal protein was decreased in amount. Increases in some microsomal proteins were also found after phenobarbital treatment, but these proteins were of somewhat lower molecular weight than those produced in response to the carcinogen. Similar investigations of the induction process are now being made in vitro, in slices of rat liver and in cultured diploid rat liver cells.
Keywords: METABOLISM; RATS; LIVER; CELL CULTURES; POLYCYCLIC AROMATIC HYDROCARBONS; BIOCHEMICAL REACTION KINETICS.

34008 DNA Repair Deficiency and Probability of Cancer in Certain Human Genetic Diseases. Scudiero, D.A. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** BX-352-1. **Contract:** Z01-CP-04598-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The purpose of this project is to study chemical carcinogen-induced DNA repair in cell lines derived from patients with various genetic diseases showing an enhanced frequency of malignancy. Such investigations can determine if these cells have deficiencies in their ability to repair DNA damage and if such deficiencies can be correlated with the increased probability of cancer in these patients. Also, these studies can yield information about different classes of DNA-lesions induced by chemical carcinogens and whether or not the type of lesion induced can be correlated with the ability of different cell lines to repair damage induced by particular chemical agents.
Keywords: DNA; BIOLOGICAL REPAIR; HUMAN POPULATIONS; GENETICS; CARCINOGENESIS; BIOLOGICAL MODELS; PATIENTS; CARCINOGENS.

34011 Identification of the Ultimate Carcinogenic Form of Benzo(a)pyrene. Yang. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** BX-356-1. **Contract:** Z01-CP-4597-02 CH. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The long range purpose of this project is to find out what the ultimate carcinogenic metabolite of benzo(a)pyrene is. The steps toward this goal are: (1) to understand the detailed metabolic profiles of benzo(a)pyrene formed by microsomal mixed-function oxidases and epoxide hydratase; (2) to determine the chemical identity of the metabolites; (3) to elucidate the mechanism of enzymatic activation; (4) to synthesize the identified metabolites in large quantity; and (5) to test the carcinogenic and mutagenic activity of the synthesized metabolites.
Keywords: BENZOPYRENE; TOXICITY; METABOLISM; CHEMICAL PROPERTIES; ENZYMES; BIOCHEMICAL REACTION KINETICS.

34013 Genetic and Epigenetic Regulation of Mixed-Function Mono-Oxygenases. Wiebel, F.J. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** BX-355-1. **Contract:** Z01-CP-04586-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The activities of the microsomal mixed-function mono-oxygenases detoxifying and activating carcinogenic polycyclic hydrocarbons are key factors in the initiation of chemical tumorigenesis. The constitutive level and the inducibility of these enzymes are under tight genetic control but are also subject to modification by exogenous chemicals, i.e., inducers and inhibitors. It is the aim of this project to study the regulatory mechanism of enzyme activity in cells in culture, to dissect the genetic components of regulation in somatic cell hybrids and to explore the mechanism of induction by exogenous compounds. It has been found that the AHH structural and inducer genes are associated with the Human Chromosome Number Two

Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; TUMOR CELLS; CELL CULTURES; MAN; CHROMOSOMES; CARCINOGENESIS; BIOLOGICAL MODELS; METABOLISM.

34015 Derivatives of Carcinogenic Polycyclic Hydrocarbons. Harvey, R.G. (University of Chicago, 5801 South Ellis Avenue, Chicago, IL, 60637). **Project number:** AR-537-5. **Contract:** N01-CP-33385. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34017 Role of DNA Repair Mechanisms in the Etiology of Cancer. Day, R.S. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-413-6. **Contract:** Z01-CP-04785-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The adenovirus host-cell reactivation assay, in which adenovirus 2 or 5 is treated with physical or chemical agents, and subsequently assayed for biological activity on monolayers of human fibroblasts, either capable of repairing ultraviolet damaged DNA or not, was used to study the interaction of several compounds on DNA. Benzo(a)pyrene diol-epoxide I, the probable carcinogenic form of benzo(a)pyrene, when dissolved in tetrahydrofuran was found to inactivate adenovirus 5 30-fold more rapidly when the treated viruses were grown in xeroderma pigmentosum fibroblasts than when they were grown in normal fibroblasts. Moreover, one diol-epoxide I molecule bound to one virus appears to inactivate that virus when it effects xeroderma pigmentosum fibroblasts. A new ultraviolet light effect on the lambda phage--E. coli system was discovered, and a mutant of adenovirus 2 unable to grow in normal human fibroblasts, but able to grow in human tumor cells was discovered.
Keywords: DNA; BIOLOGICAL REPAIR; BIOCHEMICAL REACTION KINETICS; CARCINOMAS; ETIOLOGY; CARCINOGENESIS; BIOLOGICAL MODELS; ESCHERICHIA COLI; BENZOPYRENE; ULTRAVIOLET RADIATION; MAN; ANIMALS; BIOLOGICAL EFFECTS.

34018 Analytical Applications of Mass Spectrometry to Carcinogenesis Problems. Roller, P. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** BX-336-1. **Contract:** Z01-CP-04581-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The laboratory is involved in carrying out independent research, as well as participation in collaborative projects on carcinogenesis related problems, where mass spectrometry, as an analytical tool, can be applied to determine the structure or confirm the identity of nonpolymeric organic molecules of interest. Studies include: (1) the identification of carcinogen metabolites in activation and metabolism studies; (2) the identification of naturally occurring potential carcinogens in the environment; (3) elucidation of mass spectral fragmentation mechanisms; (4) development of methods for derivatization and analysis as well as of antitumor agents; and (5) analysis of bioactive materials that may play a role in cancer causation and prevention mechanisms, such as vitamin A derivatives and substances with immunological properties.
Keywords: CARCINOGENS; MASS SPECTROSCOPY; METABOLITES; VITAMIN A; ANTINEOPLASTIC DRUGS; MOLECULAR STRUCTURE; STRUCTURAL CHEMICAL ANALYSIS.

34019 Chemistry of N-Nitroso Compounds. Keefer, L. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-610-4. **Contract:** Z01-CP-04542-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Data concerning the chemical and physical properties of the carcinogenic N-nitroso compounds will be collected. Specific emphases will include studies of: (1) promotion of N-nitrosation reactions of environmental interest by metal species; (2) stereochemistry of oxidative attack by microsomes upon dimethylnitrosamine molecules; (3) studies of tautomerism in the conjugate acid of the polydentate nitrosamino ligand; and (4) preparation of novel nitrosamines and their derivatives for chemical and biological studies. Possible implications of this work with respect to the overall goal of human cancer prevention will be considered.
Keywords: NITROSO COMPOUNDS; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; DATA COMPILATION; STEREOCHEMISTRY; CHEMICAL REACTIONS; CHEMICAL PREPARATION; ANTINEOPLASTIC DRUGS.

34022 Study of Nature of the Polycyclic Hydrocarbon. Brookes, P. (Inst. of Cancer Research, Fulham Road, London, England, SW7 3NV). **Project number:** BL-624-1. **Contract:** N01-CP-33367. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The contractor shall completely characterize the nature of the chemical structure of the polycyclic hydrocarbon bound to DNA which is formed when cells in tissue culture or animal tissues are exposed to polycyclic hydrocarbons. The project has several stages, as follows: to treat cells transformable in cell culture with polycyclic hydrocarbons (PCH), generally benzypyrene or DMBA derivatives; to isolate DNA-PCH adducts; to purify DNA-PCII; to selectively degrade and fractionate the PCH-nucleotide, DNA-nucleoside, or DNA-polynucleoside fragment; to chemically characterize the nature of the PCH-nucleoside(tide) fragment(s); and to compare the above with products formed upon the reaction of DNA with various PCH metabolites, e.g., epoxides and phenols which will become available through our synthetic program.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; CHEMICAL BONDS; ANIMAL CELLS; BENZOPYRENE; TISSUES; CELL CULTURES; METABOLISM; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL EFFECTS.

34023 Studies on Significance of Mutation in Carcinogenesis. Tso, P.C. (Johns Hopkins University, 615 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** BN-405-2. **Contract:** N01-CP-55713. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objectives are to develop the Syrian hamster embronic fibroblasts (both normal and transformed) as a model system for the investigation of somatic mutation; develop the Syrian hamster embryonic fibroblast as a model system for the investigation of in vitro neoplastic transformation; study comparatively neoplastic transformation and somatic mutation in the same cell system; investigate the genetic or epigenetic nature of both processes; and develop effective and reliable assay systems for somatic mutation and for in vitro neoplastic transformations for the investigation of the metabolic activation of these carcinogens.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; MUTATIONS; HAMSTERS; EMBRYOS; FIBROBLASTS; IN VITRO; BIOASSAY; METABOLISM; HYDROCARBONS.

34026 Investigate Aspects of Lung Cancer Incidence. Sachs, L. (Weizmann Institute of Sciences, P.O. Box 26, Rehovoth, Israel). **Project number:** AR-398-6. **Contract:** N01-CP-02217. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The objective is to determine the relationship between the presence of aryl hydrocarbon hydroxylase and susceptibility to the cytotoxicity of benzo(a)pyrene.
Keywords: LUNGS; NEOPLASMS; HYDROCARBONS; BENZOPYRENE; CYTOLOGY; BIOLOGICAL EFFECTS.

34030 Production of Antibodies to Chemical Carcinogens. Vanvunakis, H. (Brandeis University, 415 South Street, Waltham, MA, 02154). **Project number:** BZ-197-2. **Contract:** N01-CP-23243. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The objectives are to couple a chemical carcinogen or other small molecules to a macromolecular carrier that promotes the antigenicity of the compound; inject the compound attached to the carrier into rabbits or other suitable animals in order to produce antibodies that react significantly with the compound; test the antibodies made against a given compound as well as others with similar structures; develop radioimmunoassays for detection of the compounds in the nanogram range or less for detection of corresponding antibodies; establish the feasibility of detecting by immunologic tests the presence of these and other compounds in the body fluids of man; and establish the feasibility of detecting specific antibodies.

Keywords: ANTIBODIES; CARCINOGENESIS; BIOLOGICAL MODELS; BIOSYNTHESIS; RABBITS; RADIOIMMUNOASSAY; IMMUNOLOGY; FEASIBILITY STUDIES.

34033 Significance of Experimental Carcinogenesis Data. Tomatis, L. (International Agency for Research on Cancer, 150 Cours Albert Thomas, Lyon, France). **Project number:** BG-121-2. **Contract:** N01-CP-55630. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The objectives are to compare metabolism of carcinogens in human and in animal tissues to predict target organs and/or species selectivity for their carcinogenic action; examine the metabolic competence of cultured human and animal tissue to generate critical metabolites and the capacity of these cells to undergo malignant transformation in vitro after exposure; develop, improve, and quantitatite host or tissue mediated mutagenicity assays for the rapid detection of transient or non-isolatable metabolites formed from a chemical in vitro.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; MAN; ANIMALS; TISSUES; METABOLISM; BIOASSAY; MUTAGEN SCREENING; IN VITRO; CARCINOGENS; METABOLITES.

34034 Resource for Carcinogenesis Bioassays and Related Research. Clayson, D.B. (University of Nebraska, Lincoln, NE). **Project number:** N01-CP-33278. **Contract:** N01-CP-33278. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The bioassay of suspected chemical carcinogens, definition of the biological and chemical mechanisms of the carcinogenesis process, and the analysis of trace levels of environmental carcinogens are three principal research aims under this contract.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; BIOASSAY; BIOLOGICAL EFFECTS; HYDROCARBONS; ORGANIC COMPOUNDS; METABOLISM; BIOCHEMICAL REACTION KINETICS; METALS.

34041 Study of Polycyclic Hydrocarbon Metabolism. Ernster, L. (University of Stockholm, Box 6409, Fack S-104 OS, Stockholm 50, Sweden). **Project number:** AN-328-4. **Contract:** N01-CP-33363. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

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.

34043 Bioassays of Environmental Carcinogenesis. Sparks, R.D. (University of Nebraska, 42nd and East Dewey Avenue, Omaha, NE, 68105). **Project number:** BO-6-2. **Contract:** N01-CP-33278. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The NCI carcinogenesis area is committed to scrutinizing possible environmental hazards and directs a major part of its programs to this goal. Included is testing in various materials for carcinogenicity and fundamental studies in carcinogenesis. Selection of compounds for testing is jointly determined by NCI and the Epply Inst., and testing capacity has been made available from time to time for compounds requiring urgent national attention. More fundamental studies are principally related to improving screening and testing methodologies but also include research in mechanisms of action and in the chemistry and pharmacology of metabolized carcinogens and related compounds. The effort continues to provide advanced training in a field of short supply of competent investigators, and is permitting inclusion of several graduate students within the activities of the group.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; BIOASSAY; CHEMICAL EFFLUENTS; MUTAGEN SCREENING; METABOLISM; BIOCHEMICAL REACTION KINETICS.

34044 Study of Etiology of Cancer. Price, P.L. (Microbiological Associates, Inc., 5221 River Road, Bethesda, MD, 20014). **Project number:** BF-721-4. **Contract:** N01-CP-43240. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The objectives are to develop, evaluate, standardize, and apply in vitro systems for studying the effects of known and suspected carcinogens in the environment; define the events, with special emphasis on the role of endogenous Type C RNA viral genomes, associated with activation of viruses in tissue culture by chemicals, DNA viruses, or spontaneously, and characterization of endogenous viral isolates; utilize cell systems to study potential anticancer products, including viral vaccines, viral inhibitors, interferon, etc.; utilize and adapt subhuman mammalian transformation and viral induction procedures to studies of human tumor and transformed cell lines for assaying suspected environmental carcinogens, and in efforts to detect and rescue human Type C RNA viruses or viral genomes; study the effect of viral vaccines, viral inhibitors, interferon, etc., on naturally occurring and chemically induced tumors; and study the role of the enzyme aryl hydrocarbon hydroxylase (AHH) in chemical carcinogenesis.
Keywords: CARCINOGENESIS; ETIOLOGY; IN VITRO; RNA; CHEMICAL EFFLUENTS; HYDROCARBONS; VIRUSES; TOXICITY.

34045 Microsomal Enzyme Studies. Peisach, J. (Yeshiva University, 1300 Morris Park Avenue, Bronx, NY, 10461). **Project number:** BG-114-2. **Contract:** N01-CP-55606. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The contractor shall study the structural configurations as measured by the optical and EPR absorption changes, characteristics of low and high spin species of cytochrome P-450 induced by the administration of aryl hydrocarbons. Specifically, the contractor shall: prepare a soluble cytochrome P-450 from rat liver microsomes obtained from animals treated with polycyclic hydrocarbons such as 3-methylcholanthrene; characterize the P-450 preparation optically and magnetically, and, using various biophysical probes, determine the chemical structure in the vicinity of the heme; assay the characterized material optically and magnetically in rat liver, in liver homogenates, and in liver microsomes; correlate the arylhydrocarbon hydroxylase activity with the specific content of this particular cytochrome P-450; and assay the same material in livers from other animals.
Keywords: MICROSOMES; ENZYMES; HYDROCARBONS; TOXICITY; POLYCYCLIC AROMATIC HYDROCARBONS; ANIMALS; BIOASSAY; LIVER; RATS.

34047 Fetal Sensitivity to Intrauterine Radiation. Lilienfeld, A.M. (Johns Hopkins University, School of Hygiene and Public Health, 618 N. Wolfe Street, Baltimore, MD, 21205). **Project number:** CC-664-1. **Contract:** P01-CA-11489-080013. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This project is part of a broader program (CA 11489-08) whose summary states: This grant supports a program of research including the following research projects: (1) prospective study of the relationship of endocrine factors and other selected components of the serum to the development of cancers of different sites; (2) study of mortality and morbidity experience among workers in an arsenic plant; (3) study of mortality and morbidity experience among workers in a chromate plant; (4) epidemiological study of prostate cancer; (5) a retrospective study of brain tumors; (6) an epidemiological study of mortality emphasizing cancer of the cervix in the Amish and non-Amish populations of selected counties in Indiana and Ohio; and (7) study of breast cancer incidence among women with a history of infertility.
Keywords: IONIZING RADIATIONS; LOCAL IRRADIATION; UTERUS; WOMEN; PREGNANCY; DELAYED RADIATION EFFECTS; FETUSES; EMBRYONIC CELLS; RADIOSENSITIVITY; CARCINOGENESIS.

34048 Carcinogenesis Bioassay of Propylene. Lindberg, D. (Tracor Jitco Inc., 1776 E. Jefferson St., Rockville, MD, 20852). **Project number:** CH-410. **Contract:** N01 CP 43350. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Propylene (C50077 in the Carcinogenesis Bioassay Data System) will be tested for two years by inhalation in the Fischer 344 rat and the B6C3F1 mouse. Prechronic testing will determine the maximum tolerated dose (MTD). During the chronic phase, 50 animals/species/sex/dose level will be exposed to the MTD and 1/2 MTD. Controls will be pooled with those for two other chemicals being tested under the subcontract. For each group of three chemicals, there will be a positive chemical control to test the species and strain for sensitivity to a known carcinogen--dimethylnitrosamine. Fifty animals/species/sex/dose level will be used in the positive chemical control test. All animals will be sacrificed at the end of the

chronic test for histopathological evaluation; no clinical chemistry, teratogenesis, or mutagenesis evaluations will be undertaken.
Keywords: BIOASSAY; PROPYLENE; BIOLOGICAL EFFECTS; TOXICITY; CARCINOGENESIS; RATS; MICE.

34050 Radiation Protection and Measurements. Ney, W.R. (National Council on Radiation Protection, Bethesda, MD, 20014). **Project number:** IRL-96-13. **Contract:** R01-CA-18001-13. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The National Council on Radiation Protection and Measurement (NCRP) and the International Commission on Radiation Units and Measurements (ICRU) seek to collect, analyze, develop, and disseminate information and recommendations on radiation protection and measurement. Research will be initiated aimed at: (1) assessment of the available information which is pertinent to the problem; (2) identification of areas where more information is needed; and (3) synthesis of present knowledge relevant to the problem area into practical recommendations on radiation protection and measurement which also highlight areas in need of further study. The programs of the Council and Commission are broad and continually changing to meet newly identified needs. Research is underway on: (1) photographic dosimetry in external beam therapy, (2) management of radioactive waste, (3) radiobiological dosimetry, (4) biological aspects of radiation protection criteria, (5) microdosimetry, (6) assessment of population exposure from consumer products, medical applications, nuclear power, and occupational exposure, and (7) average energy required to produce an ion pair.
Keywords: RADIATION PROTECTION; RADIATION MONITORING; RADIATION DOSES; RADIOTHERAPY; NUCLEAR MEDICINE; HEALTH HAZARDS; HUMAN POPULATIONS; RADIOISOTOPE HEAT SOURCES; OCCUPATIONAL DISEASES; RADIATION HAZARDS; NUCLEAR ENERGY.

34051 Repair of Radiation-Induced Lesions in DNA. Smith, K.C. (Stanford University, School of Medicine, Palo Alto, CA, 94305). **Project number:** ICA-2896-22. **Contract:** R01-CA-02896-22. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** nuclear fission(100). **R and D categories:** Health effects.

The following will be determined: (1) the genetic control of repair replication and liquid holding recovery; (2) the role of DNA polymerase I in postreplication repair; (3) the effect of a uvrD mutation on excision repair; (4) correct location of the phr gene; (5) a new repair deficient strain of E. coli found to be nonmutable by uv radiation; and (6) human fibroblasts sensitive to x radiation (sought from patients who have shown an unusually severe skin reaction during radiation therapy).
Keywords: RADIOINDUCTION; POLYMERASES; DNA REPLICATION; BIOLOGICAL REPAIR; BIOLOGICAL MODELS; ESCHERICHIA COLI; ULTRAVIOLET RADIATION; X RADIATION; SKIN; RADIOTHERAPY; MAN; GENETICS; GENES; PATIENTS; BIOLOGICAL RADIATION EFFECTS; BIOCHEMICAL REACTION KINETICS.

34052 Biological Aspects of Carcinogenesis by Radiation. Kaplan, H.S. (Stanford University, Palo Alto, CA). **Project number:** ICA-3352-21. **Contract:** R01-CA-03352-21. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Further characterization of the endogenous C-type viruses of mice, especially the radiation leukemia virus (RadLV), a leukemogenic endogeneous virus extractable from x-ray-induced thymic lymphomas of strain C57BL/Ka mice; studies of the factors which determine the inducibility, kinetics of replication, and host range of these viruses in vitro; and studies of the complex interactions among (1) external physical or chemical leukemogenic agents, (2) endogenous viruses, (3) the lymphoid cell populations which are the target cells for neoplastic transformation, and (4) the internal host environment, with special reference to the thymus and the immune system.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; BIOLOGICAL RADIATION EFFECTS; BIOCHEMICAL REACTION KINETICS; MICE; LEUKEMIA; VIRUSES; X RADIATION; THYMUS; IMMUNOLOGY.

34053 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:** ICA-4483-19. **Contract:** R01-CA-04483-19. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

Radiation-induced inhibition of cell growth and proliferation will be studied, with particular emphasis on the deficiency in amount of DNA that is replicated in the generation following irradiation. HeLa S3 cells and 220 kV x rays will be the main experimental materials. Treatment of irradiated cells with inhibitors of DNA synthesis and other compounds, in particular caffeine and its analogs, which results in enhanced cell killing, will be studied in further analysis of x-ray-induced potentially lethal damage.
Keywords: X RADIATION; IRRADIATION; CELL CULTURES; HELA CELLS; BIOLOGICAL RADIATION EFFECTS; DNA REPLICATION; CAFFEINE; XANTHINES; RADIOSENSITIVITY EFFECTS; CELL KILLING; RADIOINDUCTION; CELL PROLIFERATION; GROWTH; INHIBITION.

34054 DNA Repair and Recovery in the Mammalian Cell Cycle. Humphrey, R.M. (University of Texas, Cancer Center, P.O. Box 20036, Houston, TX, 77025). **Project number:** ICA-4484-20. **Contract:** R01-CA-04484-20. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fuels(general)(75); solar(25). **R and D categories:** Health effects.

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.

34055 Response of Pigment Cells to X- and UV-Radiations. Queuedo, W.C. (Brown University Graduate School, University Hall, Box 1867, Providence, RI, 02912). **Project number:** ICA-6097-15-1. **Contract:** R01-CA-06097-15S1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fuels(general)(75); solar(25). **R and D categories:** Health effects.

The proposed project is directed at determining the extent to which the responses of mammalian pigment cells to uv- and x-radiations arise from direct modification of the irradiated cell or are dependent on events initiated within the particular cellular community of which it is a part. The problem of pigment cell niche and radiosensitivity is examined and is subjected to experimental analysis. The significance of melanin pigment as a radioprotective agent is evaluated in the case of epidermal melanocytes. Particular emphasis is placed on determining the consequences of the proposal that the epidermal melanin unit, consisting of a melanocyte together with its constellation of associated epidermal cells (keratinocytes), is the fundamental integrated unit of pigmentary function in the epidermis of vertebrates. The functional and morphological properties of the epidermal melanin unit are examined in the skin of vertebrates representative of each of the major classes. Particular attention is given to the roles that genes and hormones play in modifying the responses of mammalian melanocytes to ionizing and ultraviolet radiations. The cellular basis for radiation-induced changes in melanocyte populations and the nature of cellular interactions during pigmentation of skin and hair are also examined.
Keywords: X RADIATION; BIOLOGICAL RADIATION EFFECTS; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS; MELANIN; MORPHOLOGY; RADIOSENSITIVITY; SKIN.

34056 Synthesis of Carcinogenic Compounds. Newman, M.S. (Ohio State University, School of Math and Physical Sciences, 164 West 17th Avenue, 102 Administration Building, Columbus, OH, 43210). **Project number:** ICA-7394-14. **Contract:** R01-CA-07394-14. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The purpose of this research is to prepare oxygenated derivatives of 7,12-dimethylbenz(a)anthracene, DMBA, to aid in the identification of metabolic products of DMBA which might be important in finding out what role DMBA plays in the initiation of cancer. The 1-, 2-, 3-, 4-, 8-, 9-, 10-, and 11-hydroxy derivatives of DMBA are the primary targets. Each may exist as the corresponding keto derivatives. The relative reactivity of these keto forms will be assessed as they may be involved in reactions with DNA or proteins. We also hope to make selected derivatives of methylcholanthrene to learn how similar its metabolism might be to that of DMBA. Sufficient

quantities of all of the compounds envisioned are to be made so that interested investigators may obtain samples for their research.
Keywords: BENZANTHRACENE; CONDENSED AROMATICS; HYDROCARBONS; HYDROXY COMPOUNDS; CARCINOGENS; CHEMICAL PREPARATION; CHEMICAL REACTIONS; DNA; PROTEINS.

34057 Radiobiology Research Program. Conger, A.D. (Temple University, 3223 North Broad Street, Philadelphia, PA, 19122). **Project number:** ICA-8231-13-1. **Contract:** R01-CA-08231-13. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Genome size (amount of chromosomal protein plus DNA, per cell) and radiosensitivity for mutation induction and for cell killing will be measured in different species and in different tumor cell culture lines, and correlations tested. Genome size is a good predictor of relative radiosensitivity. Several human and animal tumor cell lines of different radiosensitivities will be examined for their genome size and cytological characteristics, to see if these differences account for their different sensitivities. The same tumor lines will also be grown in tissue culture as solid microsphere colonies, to test the effect of solid vs. single-cell growth on radiosensitivity. Microsphere colonies simulate in vivo solid tumors.
Keywords: RADIOBIOLOGY; DNA; ANIMAL CELLS; RADIOSENSITIVITY; MUTAGENESIS; CELL CULTURES; MAN; ANIMALS; CARCINOGENESIS; BIOLOGICAL RADIATION EFFECTS; IONIZING RADIATIONS; BIOLOGICAL MODELS; CYTOLOGY.

34058 Radiation Effects on Protein and Nucleic Acid Metabolism. Yatvin, M.B. (University of Wisconsin, School of Medicine, 307 North Charter Street, Madison, WI, 53706). **Project number:** ICA-8318-9. **Contract:** R01-CA-08318-09. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Studies on the action of ionizing radiation on nucleic acid metabolism in tissue are being extended to the whole animal. To minimize the physiological perturbations which are operative in such experiments and to enable us to better interpret such data, we have enlarged our program to include tissue culture experiments. It is hoped that such studies will lead to a better understanding for how radiation interferes with cell function and results in cell death.
Keywords: IONIZING RADIATIONS; IRRADIATION; TISSUE CULTURES; ANIMALS; BIOLOGICAL RADIATION EFFECTS; PROTEINS; NUCLEIC ACIDS; METABOLISM; ANIMAL CELLS; CELL KILLING; RADIOINDUCTION; MOLECULAR BIOLOGY.

34059 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:** ICA-8936-11. **Contract:** R01 CA 08936-11. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34060 Effects of Radiation on Stationary Cells. Little, J.B. (Harvard University, School of Public Health, 55 Shattuck Street, Boston, MA, 02115). **Project number:** ICA-11751-9. **Contract:** R01-CA-11751-09. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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.

34061 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:** ICA-12115-7. **Contract:** R01-CA-12115-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project is geared to providing fundamental information as to whether such structural modifications of polycyclic aromatic hydrocarbons as perturbed delocalization, three-dimensional characteristics, and other electronic features are crucial to maintenance of carcinogenic reactivity. Certain benzenoid hydrocarbons and heterocycles are known to be potent carcinogens. This proposal describes the synthesis of new types of potentially delocalized nonbenzenoid systems which have in common the size, shape, and reactivity conceivably necessary for carcinogenic reactivity. Knowledge of the reactivity and carcinogenicity of these inherently novel molecules is important because of the possible insight which may be gained into the chemical basis for carcinogenesis. Specifically, the target compounds are in certain cases expected to possess homoaromatic character, in other cases to exhibit rapid valence tautomerism, and in still other instances to possess fixed double bonds. Accordingly, a wide range of structural types are to be made available. All stable target compounds prepared in this work are to be evaluated for possible carcinogenicity.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; METABOLISM; TOXICITY; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL MODELS; ALKENES.

34062 Induction of Leukemia in Rodents by Radiation. Warren, S. (New England Deaconess Hospital, 185 Pilgrim Road, Boston, MA, 02215). **Project number:** ICA-12944-6. **Contract:** R01-CA-12944-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The data from about 2600 pairs of parabiosed rats irradiated with 1000 R are now being compiled with regard to incidence of leukemia and incidence of lymphopoietic tumors. Observation of the rats irradiated at dose levels in the 50 to 400 R range is being continued. Data are being compiled from a series of mice irradiated in similar dose ranges.
Keywords: LEUKEMIA; RADIOINDUCTION; RODENTS; CARCINOGENESIS; LYMPHOCYTES; TUMOR CELLS; DOSE-RESPONSE RELATIONSHIPS; IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS.

34063 Potential Carcinogenic and Genetic Effects of Tritium. Mewissen, D.J. (University of Chicago, School of Medicine, 5801 South Ellis Avenue, Chicago, IL, 60637). **Project number:** ICA-13080-7. **Contract:** R01-CA-13080-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

This research is aimed at assessing comparatively the potential carcinogenic potency of tritiated water versus tritiated DNA, RNA and protein precursors, namely thymidine, uridine, or leucine, in relation to their specific patterns and sites of incorporation in C57 Black/6M mice. For this purpose the basic (spontaneous) tumor spectrum in control animals will be defined as a multiple competitive tumor model, from which the variation in the tumor spectra possibly associated with exposure to various tritiated compounds will be evaluated, both quantitatively and qualitatively. In addition, it is planned to investigate the potential cumulative genetic injury result-

ing from exposure of male mice to tritiated water or tritiated thymidine, prior to sibling mating, during 25 successive generations. The incorporation patterns of tritiated precursors of DNA, RNA, and proteins versus tritiated water in selected target organs have been investigated, in an attempt to correlate the possibly induced tumor spectra with various sites of tritium incorporation.
Keywords: TRITIUM; RADIONUCLIDE KINETICS; CARCINOGENESIS; GENETIC RADIATION EFFECTS; TRITIUM COMPOUNDS; MICE; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL MODELS; RADIOINDUCTION; DNA; RNA; PROTEINS; REPRODUCTION.

34064 Radiation Injury in Subpopulations of Lymphocytes. Anderson, R.E. (University of New Mexico, School of Medicine, University Hill NE, Albuquerque, NM, 87106). **Project number:** ICA-13805-6. **Contract:** R01-CA-13805-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

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.

34065 Radiation In Vitro and Mammary Cell Survival and Neoplasia. Clifton, K.H. (University of Wisconsin, School of Medicine, 307 North Charter Street, Madison, WI, 53706). **Project number:** ICA-13881-6. **Contract:** R01-CA-13881-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

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.

34066 Inhibition of Chemical Carcinogenesis. Wattenberg, L.W. (University of Minnesota, School of Medicine, 1305 Mayo, Minneapolis, MN, 55455). **Project number:** ICA-14146-6. **Contract:** R01-CA-14146-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The ultimate goal of this program is to obtain data which can be used to evaluate the present or potential role of inhibitors of environmental chemical carcinogens. Pursuant to this goal are several major objectives. The first is to determine the mechanism of inhibition of chemical carcinogenesis by antioxidants and other compounds found to exert an inhibitory effect. The second is to determine conditions under which inhibition occurs including parameters which will predict the host's capacity to utilize specific inhibitory mechanisms. The third is to determine chemical characteristics which control the ability of compounds to inhibit chemical carcinogenesis. The mechanism of inhibition of polycyclic hydrocarbon carcinogenesis by antioxidants will be investigated. Studies of the manner by which disulfiram and butylated hydroxyanisole (BHA) cause decreased binding of benzo(a)pyrene metabolites to various cellular macromolecules will be carried out. These include investigations of the effects of these antioxidants on enzyme systems. In addition, efforts at demonstrating direct interactions between antioxidants and reactive metabolites of chemical carcinogens will be made.
Keywords: INHIBITION; CHEMICAL EFFLUENTS; CARCINOGENESIS; CHEMICAL REACTION KINETICS.

34067 Immune Surveillance in Radiation Carcinogenesis. Anderson, R.E. (University of New Mexico, School of Medicine, University Hill NE, Albuquerque, NM, 87106). **Project number:** ICA-14270-6. **Contract:** R01-CA-14270-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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.

34068 In Vitro Study of Mammalian Cells Damaged by Tritium. Burki, H.J. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** ICA-14310-6. **Contract:** R01-CA-14310-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Health effects.

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 POPULA-

TIONS; 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.

34069 Acidic Chromatin Proteins and Carcinogens. Spelsberg, T.C. (Univ. of Minnesota, School of Medicine, 200 1st. St., S.W., Rochester, MN, 55901). **Project number:** ICA-14920-5. **Contract:** R01 CA 14920-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Since chemical carcinogens are known to cause chromosomal aberrations, alter DNA dependent RNA synthesis, and activate latent viral genes incorporated into host cell chromosomes, it is proposed that the carcinogens mediate all or part of the action on cells at the level of chromatin. Within minutes after IP injection of labelled carcinogens into rats or application of these compounds to cells in culture, as much as 90% of the total nuclear binding is associated with isolated chromatin. Recent studies have demonstrated the presence of specific high affinity binding sites for chemical carcinogens in the chromosomal material in mouse embryo cells. Further studies suggest that the polycyclic aromatic hydrocarbons display a greater affinity for these sites than the noncarcinogenic compounds. It is planned to more thoroughly ascertain the specificity of this binding site for carcinogenic compounds, to determine whether or not these sites are present in cells which are resistant to transformation, to determine whether or not these specific sites are found in certain organs of mice, to isolate and characterize the chromosomal component to which these carcinogens are bound, and to ascertain the exact structure of metabolites of the parent hydrocarbons which are bound to the chromosomal material.
Keywords: PROTEINS; CARCINOGENS; DNA; BIOCHEMICAL REACTION KINETICS; HYDROCARBONS; BENZOPYRENE; SYNERGISM; RECEPTORS; LABELLED COMPOUNDS.

34070 Hydrocarbon-Induced Malignant Transformation In Vitro. Marquardt, H.W. (Sloan Kettering Inst. of Cancer Research, 410 E. 68th. St., New York, NY, 10021). **Project number:** ICA-15205-4. **Contract:** R01 CA 15205-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Mechanisms involved in hydrocarbon-induced malignant transformation will be studied in an in vitro model system for chemical carcinogenesis which employs fibroblasts from mouse prostate. Studies on the metabolic activation of polycyclic aromatic hydrocarbons will be continued, especially the biologic activity of diol-epoxides. Studies on the binding of hydrocarbons and their derivatives to DNA and on the capacity of these compounds to induce DNA-repair will be continued. Our studies led us to suggest that reverse transcriptase may also play a role in chemical transformation. We will continue to study the effect of inhibitors of this enzyme activity on chemically induced transformation. Moreover, we will further explore the suitability of our in vitro model system to predict the oncogenic potential of environmental chemicals.
Keywords: HYDROCARBONS; TOXICITY; IN VITRO; NEOPLASMS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; MICE; BIOLOGICAL MODELS.

34071 Radiation-Induced Modifications in Protein Synthesis. Oleinick, N.I. (Case Western Reserve University, School of Medicine, Cleveland, OH, 44106). **Project number:** ICA-15378-5. **Contract:** R01-CA-15378-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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.

34072 Inhibition of Initiation--Promotion Carcinogenesis. Neeman, M. (Roswell Park Memorial Inst., 666 Elm Street, Buffalo, NY, 14203). **Project number:** ICA-15890-3. **Contract:** R01-CA-15890-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The overall objective of the proposed research is to develop new inhibitors for tumor promotion to serve as tools in studies of the mechanism of the initiation-promotion sequence. Anti-inflammatory compounds will be studied as potential inhibitors of carcinogenesis initiated in mouse skin by 7,12-dimethylbenz(a)anthracene (DMBA) and promoted by 12-0-tetradecanoyl-phorbol-13-acetate (TPA). Among the anti-inflammatory agents to be bioassayed are to be included nonsteroidal compounds. Phorbol 12,13-diesters will be modified by synthesis of esters potentially capable of covalent bonding with cellular macromolecules.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; INHIBITION; CHEMICAL BONDS; MICE; BIOASSAY; XYLENES; BIOLOGICAL EFFECTS; METABOLISM.

34073 Mutants and Altered Radioresponse of Cells and Tumors. Gregg, E.C. (Case Western Reserve University, School of Medicine, Cleveland, OH, 44106). **Project number:** ICA-15901-5. **Contract:** R01-CA-15901-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Health effects.

Our objectives are severalfold: (1) to produce radiation resistant mutants from a stable strain of mammalian cells growing in various environments of radiation; (2) to identify, describe and assess biochemical, biophysical, and cytological differences between the mutants and the parent strain; (3) to quantitate the overall mutation rate for radiation resistance as a function of various parameters such as dose rate, temperature, and time schedule for dose delivery including the simulation of a fractionated radiation therapy regimen; and (4) to examine some of the kinetics of the production of specific mutations if warranted by the data obtained.
Keywords: MUTANTS; RADIOSENSITIVITY; ANIMAL CELLS; TUMOR CELLS; IONIZING RADIATIONS; DOSE-RESPONSE RELATIONSHIPS; RADIOINDUCTION; MUTAGENESIS.

34074 Cytochrome P450, Chemical Carcinogenesis Benzo(a)pyrene. Jefcoate, C.R. (University of Wisconsin, School of Medicine, 307 North Charter Street, Madison, WI, 53706). **Project number:** ICA-16265-3. **Contract:** R01-CA-16265-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The project will focus on the biochemical mechanisms which determine the combination of benzo(a)pyrene metabolites with cellular DNA and which lead to gene mutations. The metabolism of benzo(a)pyrene will be studied in liposomes reconstituted from purified P450 cytochromes, P450 reductase, oxide-hydrase and selected lipids, with rat liver microsomes or nuclear envelope after induction by various agents. The biophysical characteristics, particularly fluidity, of these membrane preparations will be investigated and related to benzo(a)pyrene metabolism. The conjugation of benzo(a)pyrene metabolites with various DNA molecules will be examined in these systems. Analytical techniques will be established to identify and quantitate nucleoside-metabolite conjugates obtained by hydrolysis of metabolite-modified DNA. The production of benzo(a)pyrene metabolites and the formation of metabolite nucleoside conjugates will be examined in isolated nuclei and whole cells from rat liver and lung. The modification of DNA in these systems will be examined in terms of parental DNA, newly synthesized DNA, euchromatin, heterochromatin and the production of DNA breaks. These parameters will be examined to explain the sensitivity of lung cells but not hepatocytes to oncogenic transformation by benzo(a)pyrene.
Keywords: BENZOPYRENE; METABOLISM; TOXICITY; BIOCHEMICAL REACTION KINETICS; CYTOCHROMES; CARCINOGENESIS; BIOLOGICAL MODELS; DNA; GENES; RATS; LIVER; LUNGS.

34075 Repair and Survival in Irradiated Cells. Yatvin, M.B. (University of Wisconsin, School of Medicine, 307 North Charter Street, Madison, WI, 53706). **Project number:** ICA-16579-3. **Contract:** R01-CA-16579-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The aim of this proposal is to resolve, if possible, the discrepancies between biophysical and biochemical evidence of repair and ultimate survival in irradiated cells. Because of its unique role in controlling cell function, many recent studies have focused on DNA and the results of alkaline sucrose gradient analysis of DNA from irradiated cells. These studies have been interpreted to indicate that there is extensive repair of single strand breaks. Recent experiments in our laboratory suggest that alternative mechanisms may play an important role. Because of the close association between DNA and the plasma membrane in E. coli, preliminary studies of bacterial cell membrane changes after irradiation will be extended. Studies on the effect of radiation on cell membranes may have relevance to the clinical treatment of malignant disease in that they may provide a better rationale for the use of combined radiation and chemotherapy.
Keywords: DNA; BIOLOGICAL REPAIR; RADIATION INJURIES; BIOLOGICAL RADIATION EFFECTS; ANIMAL CELLS; SURVIVAL CURVES; CELL MEMBRANES; ESCHERICHIA COLI; RADIOSENSITIVITY.

34076 Intermolecular Cross Links in Chemical Tumorigenesis. Kubinski, H.A. (University of Wisconsin, School of Medicine, 307 North Charter Street, Madison, Wi, 53706). **Project number:** ICA-16989-3. **Contract:** R01-CA-16989-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

During the past year we have carried out a survey of several tumor-inducing agents for their ability to produce macromolecular complexes in vitro. Using several independent techniques, we have found that all ultimate carcinogenic agents tested thus far fall into two broad categories: (1) chemicals which are capable of inducing complexes between nucleic acids and nucleic acids and proteins; and (2) those which induce the protein-nucleic acid adducts only. Most mono- and polyfunctional alkylating agents and chromium salts belong to class A. Aromatic amines, salts of beryllium, and ultraviolet light, are examples of class B agents. Non-ultimate carcinogenic chemicals produce no macromolecular complexes under our experimental conditions, but form such complexes following their activation by liver extracts. These observations suggest that formation of strong bonds between macromolecules may be involved in the process of tumor induction. We plan to study the effects of carcinogenic chemicals on DNA and RNA in living cells and means of elimination of such structures from the injured tissue. Present studies on the effects of carcinogens on biologically active (transforming) DNA will be continued. Further practical applications of our observations on the increased cellular attachment of nucleic acids exposed to carcinogens and mutagens will be made.
Keywords: CARCINOGENESIS; IN VITRO; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; NUCLEIC ACIDS; PROTEINS; DNA; RNA; BIOCHEMICAL REACTION KINETICS; IONIZING RADIATIONS; ULTRAVIOLET RADIATION; BIOASSAY; ANIMAL CELLS; CELL CULTURES.

34077 Mutagenic Action of Cancer Therapy on Testis Cells. Meistrich, M.L. (University of Texas, Cancer Center, P.O. Box 20036, Houston, TX, 77025). **Project number:** ICA-17364-3. **Contract:** R01-CA-17364-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The effects of mutagens, such as radiation or chemotherapeutic agents, on the survival of spermatogenic cells of mouse testes and the damage produced in their DNA will be studied. Biochemical alterations in testicular cell DNA produced by mutagen treatment will be assayed in cells at each stage of spermatogenesis. Direct damage to the DNA and repair will be assayed by measuring strand breaks, alkaline-labile bonds, and endonuclease-sensitive sites. The restoration of fertility at long times after radiation is being compared to the regeneration of stem cells. We have developed an enzyme assay and a rapid microscopical method to measure the survival of stem cell function, and are correlating these results with a histological method which is applicable only at high radiation doses. The enzyme assay and counts of sperm nuclei can detect effects of low doses. The ultimate objectives of this study are, using mice treated with radiation and mutagenic chemicals, to: (1) understand the biochemical mechanisms underlying mutagenesis; and (2) quantitate survival of testicular stem cells and its relation to fertility in order to extrapolate these data to man.
Keywords: CHEMOTHERAPY; IONIZING RADIATIONS; IRRADIATION; MICE; BIOLOGICAL RADIATION EFFECTS; SPERMATOZOA; SPERMATOCYTES; STEM CELLS; FERTILITY; DNA; STRAND BREAKS; BIOLOGICAL REPAIR; BIOLOGICAL REGENERATION; BIOLOGICAL RECOVERY; ANTINEOPLASTIC DRUGS; BIOLOGICAL EFFECTS; MUTAGENESIS; RADIOTHERAPY; SIDE EFFECTS; CYTOLOGICAL TECHNIQUES; HISTOLOGICAL TECHNIQUES; BIOCHEMICAL REACTION KINETICS; BENCH-SCALE EXPERIMENTS.

34078 Carcinogenesis, Mutagenesis, and Photo-Labeling of DNA. White, W.E. (University of Alabama, School of Medicine, 1919 7th Ave. S., Birmingham, AL, 35233). **Project number:** ICA-17394-3. **Contract:** R01 CA 17394-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Photoaffinity labeling is used to covalently attach selected fluorene to DNA in vitro and to macromolecular targets in vivo. This direct attachment circumvents the requirement for metabolic activation. This attachment leads to frameshift reversions in the Ames system; no mutations are observed in the dark or in strains possessing DNA repair. 2-azidofluorene has been applied to the backs of sheared Balb/c and C57/BL/6J mice. Sections of skin and viscera were taken from sacrificed animals. After two months no differences were observed among the treated mice in the dark, treated mice in the light and control animals. In vitro labeling on calf thymus DNA occurs on both purines and pyrimidines and probably on the sugar phosphate backbone also.
Keywords: CARCINOGENESIS; MUTAGENESIS; DNA; MUTAGEN SCREENING; MICE; PHOTOSENSITIVITY.

34079 Hepatic P-450 Systems Induced by Aryl Carcinogens. Cooper, D.Y. (University of Pennsylvania, School of Medicine, 36th and Hamilton Walk, Philadelphia, PA, 19104). **Project number:** ICA-17618-3. **Contract:** R01 CA 17613-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Cytochrome P-448 in animals treated with arylhydrocarbons (AH) differs from cytochrome P-450 in control or phenobarbital (PB)-treated animals with respect to several parameters. During the tenure of this grant, the additional properties of the low affinity to halothane, metopirone, and CO of the reduced form of AH-induced P-448 as compared with control and PB-induced P-450 have been explored. Studies for the next year will concentrate on localizing more precisely the bases for these alterations in biophysical and biochemical properties of the multi-enzyme systems induced by AH and PB. The methods to be applied for studying the interactions will include optical spectrophotometry and electron paramagnetic resonance spectroscopy. The physical and chemical properties of the solubilized systems will be compared with those of the corresponding membrane-bound microsomal systems in order to assess to what extent the observed differences between aryl and non-aryl induced P-450 systems can be attributed to changes in the heme, the protein moiety, or the microenvironment of the membrane, the final goal being to determine in what way changes in the P-450 systems induced by polycyclic aromatic hydrocarbons and other xenobiotics are of significance in converting procarcinogens to carcinogens or in their inactivation. An additional goal of this project is to study why AH induction appears to differ from that by drugs such as phenobarbital.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; BIOLOGICAL EFFECTS; ANIMALS; LIVER; CYTOCHROMES; CHEMICAL REACTIONS; CARCINOGENS.

34080 Derivation of Carcinogenic Epoxides. Smith, L.L. (University of Texas, School of Medicine, 300 University Blvd., Galveston, TX, 77550). **Project number:** ICA-17872-3. **Contract:** R01-CA-17872-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

We propose to continue to attempt to separate, purify, and identify the several oxidation products formed from benz(a)pyrene and from pyrene and other related polycyclic aromatic hydrocarbons in radiation-induced air oxidations. Radiation-induced oxidations will be made using either cobalt-60 gamma radiation or 254 nm ultraviolet light, with pure crystalline substrates or substrates absorbed onto silica gel. All oxidation product mixtures and all resolved pure oxidation products will be evaluated for their putative mutagenicity using test strains of Salmonella typhimurium bacteria.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; BENZOPYRENE; PYRENE; GAMMA RADIATION; ULTRAVIOLET RADIATION; IRRADIATION; IN VITRO; CHEMICAL RADIATION EFFECTS; OXIDATION; CHEMICAL REACTION YIELD; EPOXIDES; MUTAGEN SCREENING; CARCINOGENS.

34081 Carcinogen--DNA Complexes: Structure and Interactions. Clarke, R.H. (Boston University, School of Liberal Arts, 755 Commonwealth Ave., Boston, MA, 02215). **Project number:** ICA-17922-3. **Contract:** R01 CA 17922-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34082 Mechanisms of Carcinogenesis in Cell Cultures. Bertram, J.S. (Roswell Park Memorial Institute, Buffalo, NY, 14203). **Project number:** ICA-18197-2. **Contract:** R01-CA-18197-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(40); nuclear fission(40); solar(20). **R and D categories:** Operational safety; Health effects.

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; and (3) the biochemical mechanism of action of the compounds actinomycin D, caffeine, chloroguine, and adriamycin.
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.

34083 Synthesis, Photo and Thermochemistry of Arene Oxides. Griffin, G.W. (Louisiana State University, School of Science, New Orleans, LA, 70122). **Project number:** ICA-18346-3. **Contract:** R01-CA-18346-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34084 Approaches to Chemical Carcinogenesis Mechanisms. Fletcher, T.L. (Fred Hutchinson Cancer Research Center, Seattle, WA, 98104). **Project number:** ICA-19279-2. **Contract:** R01-CA-19279-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project includes the synthesis, reactivity study, and collaborative biological testing of certain derivatives of polycyclic aromatic amine carcinogens and some potential new types of carcinogens which have been selectively designed to provide information concerning: (1) structural requirements necessary or sufficient for carcinogenic activity at a given organ site, (2) positive identification of some metabolic products arising from the action of the carcinogens on cellular proteins, (3) the structures and perhaps significance of some of the carcinogen-nucleic acid adducts, and (4) a unified hypothesis of carcinogenesis which has been proposed.
Keywords: CARCINOGENESIS; BIOCHEMISTRY; CONDENSED AROMATICS; AMINES; CHEMICAL ACTIVATION; MOLECULAR STRUCTURE; CARCINOGENS; DNA; RNA; COMPLEXES.

34085 Injury and Tumor Formation in the Rat Lung. Evans, MJ. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** ICA-19354-2. **Contract:** R01-CA-19354-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The purpose of this proposed research is to study epithelial tumor formation in the terminal bronchioles and alveoli of the rat lung. The studies will entail exposing animals to nitrogen dioxide (NO2) and to a chemical carcinogen benzo(alpha)pyrene (BP). NO2 exposure results in tissue injury followed by proliferation of two epithelial cell types in the lung (nonciliated cells in the terminal bronchioles and Type 2 cells in the alveoli). We will introduce the carcinogen at specific times during the proliferative phase of repair to determine if it will alter this response and cause an increased incidence of tumor formation. We will study the effects of BP on (1) the duration of cell proliferation, and (2) the transition of nonciliated cells to ciliated cells and of Type 2 cells to Type 1 cells. These results will then be related to the incidence and types of tumors formed.
Keywords: NITROGEN DIOXIDE; BIOLOGICAL EFFECTS; BENZOPYRENE; CARCINOGENESIS; LUNGS; RATS; INJURIES; RESPIRATORY TRACT CELLS; CELL PROLIFERATION; BIOLOGICAL REPAIR; NEOPLASMS.

34086 Aryl Hydrocarbon Hydroxylase Levels in Head-Neck Cancer. Alfred, L.J. (C.R. Drew Postgraduate Medical School, Los Angeles, CA, 90059). **Project number:** ICA-19659-2. **Contract:** R01-CA-19659-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

One of the earliest, if not the primary, responses of cultured animal cells to treatment with polycyclic hydrocarbons (PH) is the induced synthesis of aryl hydrocarbon hydroxylase (AHH). Based on AHH activity in lymphocyte cultures, human subjects fall into three inducible groups (low, intermediate, high), and healthy persons with high AHH inducibility may have a greater propensity for developing lung cancer. Thus, responsiveness of human lymphocytes to AHH induction appears to be related to a genetic variability in the occurrence of lung cancer. To test this hypothesis, we will determine whether cultured lymphocytes derived from adult patients with demonstrated carcinoma of the head and neck region have statistically higher levels of AHH than lymphocytes from healthy controls. The immediate objectives of the proposed study are: (1) to measure the induced AHH activity in cultured lymphocytes from the peripheral blood of adult patients with head and neck cancer, and from healthy control subjects; (2) to determine the rates of proliferation of the above lymphocyte culture systems; and (3) to isolate and identify the T and B lymphocytes from health and cancer subjects, and compare the AHH activity in both cell populations. The long range goal of this study is to develop a reproducible cell culture system to determine man's potential susceptibility to toxic and carcinogenic environmental chemicals.
Keywords: HYDROXYLASE; HEAD; NECK; NEOPLASMS; CARCINOGENESIS; POLYCYCLIC AROMATIC HYDROCARBONS; PATIENTS; RESPIRATORY TRACT CELLS; ENZYME ACTIVITY.

34087 3-D Fluorometric Analysis of Hydrocarbon Metabolites. Rho, J.H. (University of Southern California, School of Medicine, Los Angeles, CA, 90033). **Project number:** ICA-19974-2. **Contract:** R01-CA-19974-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34088 Reactive Heterocyclics--Cancer and Biomechanism. Rastetter, W.H. (Massachusetts Institute of Technology, School of Science, 77 Massachusetts Ave., Cambridge, MA, 02139). **Project number:** ICA-20574-2. **Contract:** R01 CA 20574-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The synthesis and chemistry of a variety of reactive heterocyclics will be studied. Nucleophilic additions to reactive 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 viral caused cancer. Model systems will be studied to mimic the mechanism of carcinogenic activation of polycyclic aromatic hydrocarbons 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: HETEROCYCLIC COMPOUNDS; SYNTHESIS; CHEMICAL REACTIONS; EPOXIDES; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; OXIDASES; POLYETHYLENE GLYCOLS; ANTIBIOTICS.

34089 Toxicity of Alpha-Emitting Heavy Elements. Dasilvahorta, J. (University of Lisbon, Lisbon 4, Portugal). **Project number:** ICA-20671-1. **Contract:** R13-CA-20671-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

The Portuguese Study Group of Thorium Dioxide's Side Effects has been conducting, since 1961, clinical, pathological, and epidemiological research on the side-effects of thorotrast when injected in human beings for diagnostic purposes, under the sponsorship of U.S. Public Health Service grants. The Portuguese Study Group organized in Portugal, in June 1977, an International Conference on the Toxicity of Thorotrast and Other Alpha-Emitting Heavy Elements. Public awareness and concern regarding the development and use of transuranic elements in energy production and other fields is increasing, because of the increasing quantities of such elements being produced, used, and distributed and the known or suspected carcinogenic properties of these alpha-emitting radionuclides. Such concern makes it vital that researchers use whatever means at their disposal to assess the nature and magnitude of the potential hazards and therefore provide the scientific community and the public, information about the danger of these elements in whatever form they are used. The question of how current studies being conducted on thorium and radium toxicity can serve as a useful benchmark for studying and evaluating the toxicity of other alpha-emitters, namely uranium and plutonium, was discussed.
Keywords: PORTUGAL; RESEARCH PROGRAMS; MEETINGS; THOROTRAST; DIAGNOSTIC USES; SIDE EFFECTS; ALPHA SOURCES; ALPHA PARTICLES; RADIATION HAZARDS; RADIUM; URANIUM; PLUTONIUM; TOXICITY; PATIENTS; MAN; DIAGNOSTIC TECHNIQUES.

34090 In Vivo Radiation-Activation of Endogenous Sarcoma Virus Genome. Chan, E.W. (Argonne National Lab., Div, of Biological and Medical Research, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** Y01 CP7-0504. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW-$208,000.
Related energy source: coal(5); nuclear fuels(general)(95). **R and D categories:** Health effects.

This program is aimed at providing basic information for estimating the cancer risk to man from the environmental pollutants associated with energy production. The goal of these Virus Studies is to determine whether radiation and chemical agents cause cancer by activating endogenous viral genetic information. Its immediate objectives are: (1) to characterize the three previously isolated ERP/ANL bone tumor viruses biochemically, biophysically, and biologically, and examine their evolutionary history and relatedness to other murine sarcoma viruses; (2) to obtain molecular evidence that sarcoma viruses can be activated by radiation; (3) to discover the mechanisms of viral oncogenesis; and (4) to determine whether viruses are involved in other spontaneous and induced neoplasms. Properties characteristic of type C retroviruses were obtained for the FBJ and FBR bone tumor isolates. Further characterization and subsequent development of type-specific competitive radioimmuno and molecular hybridization assays will facilitate the search for definitive evidence regarding the role of viruses in radiation carcinogenesis. If viruses are necessarily involved, then antiviral measures will be indicated in the treatment of radiation cancers.
Keywords: CARCINOGENESIS; NEOPLASMS; SKELETON; BIOCHEMISTRY; BIOPHYSICS; BIOCHEMICAL REACTION KINETICS; ONCOGENIC VIRUSES; RADIOIMMUNOASSAY; RADIOTHERAPY; MUTAGENS; BIOLOGICAL MODELS; RADIOSENSITIVITY.

34091 Role of Mutagenesis in Chemical Carcinogenesis. Maher, V.M. (Michigan State University, Soil Science Building, East Lansing, MI, 48823). **Project number:** ICA 21247-2. **Contract:** R01 CA 21247-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(75); solar(25). **R and D categories:** Health effects.

Several lines of evidence point to the involvement of somatic mutations in the mechanism of action of carcinogens. There is also reason to think that DNA repair plays a role in carcinogenesis. Experimental findings link higher incidence of skin cancer, increased susceptibility to uv-induced mutations, and defective DNA repair in XP patients. We also find that such XP cells are abnormally sensitive to the cytotoxic action of active forms of aromatic amides and to MNNG. Since this points to the involvement of different kinds of DNA repair defects in enhancing the cytotoxic and mutagenic action of carcinogens, we will investigate the question using, in addition to our XP cells, cells derived from persons with two other forms of genetic pre-disposition to cancer, viz., ataxia telangiectasia (AT) (sensitive to X-rays) and Fanconi's anemia (FA) (sensitive to mitomycin C). With such cells we will: (A) investigate the effect of DNA excision repair on the mutagenicity of carcinogens; and (B) investigate the effect of post-replication repair on such action. For these studies we will utilize, where applicable, radioactively-labeled carcinogens to determine the number and kinds of DNA-carcinogen adducts which correlate with the induction of mutations in these human cells.
Keywords: XP CELLS; SOMATIC CELLS; PATIENTS; HEREDITARY DISEASES; HYDROCARBONS; CARCINOGENESIS; CARCINOGENS; MUTAGENESIS; SOMATIC MUTATIONS; DNA; BIOLOGICAL REPAIR; ULTRAVIOLET RADIATION; X RADIATION; LABELLED COMPOUNDS; ADDUCTS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL EFFECTS.

34092 Intracellular Enzyme Kinetics and Carcinogens. Kohen, E. (Papanicolaou Cancer Research Institute, 1155 14th Street NW, Box 6188, Miami, FL, 33136). **Project number:** ICA-21153-2. **Contract:** R01-CA-21153-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Intracellular enzyme kinetics of spontaneously or chemically induced malignant transformation and the intracellular interactions of carcinogens were studied. Microspectrofluorometry allows the topographic scan of dynamic metabolic changes and the localization of carcinogens. The transient rise or decay halftimes were first evaluated in carcinogen-free cells by mathematical approximation. The synchronous activity of cell compartments (e.g., cytoplasm vs. nucleus) in reference to function demand (e.g., ATP trap, metabolizable hydrocarbons, barbiturates, aflatoxins) was detected. The cell fluorescence spectrum was resolved in free vs. bound NADH, flavins, with differing patterns in ascites, melanoma or sarcoma lines. In benzpyrene-treated EL2 or L cells highly fluorescent metabolites (or interactions) precede low or nonfluorescent metabolites. In EL2 cells these phenomena are detected after injection of substrate leading to formulation of NADPH, in the L cell they occur spontaneously but may be accelerated by substrate. The current goals are to use transient parameters for studies of biochemical systems in normal vs. spontaneously transformed fibroblasts (e.g., NCTC 9197-9195) or cells submitted to challenges (e.g., carcinogens, growth with various substrates, agents affecting organelle function).
Keywords: ENZYMES; BIOCHEMICAL REACTION KINETICS; CARCINOGENESIS; METABOLISM; SYNCHRONOUS CULTURES; CYTOLOGY; HYDROCARBONS; BARBITURATES; FLUORESCENCE.

34093 Modification of X-Ray Induced Damages in Phage T4. Wallace, S.S. (New York Medical College, School of Medicine, Valhalla, NY, 10595). **Project number:** ICA-21342-3. **Contract:** R01-CA-21342-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

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.

34094 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:** ICA-21371-2. **Contract:** R01 CA 21371-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Environmental control technology; Health effects.

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.

34095 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:** ICA-21481-2. **Contract:** R01 CA 21481-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34096 Screening for Neoplasms in Irradiated Populations. Hempelmann, L.H. (University of Rochester, School of Medicine, 601 Elmwood Avenue, Rochester, NY, 14642). **Project number:** ICA-21452-1. **Contract:** R01-CA-21452-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The purpose of this program is to determine the risks of development of tumors in irradiated populations and to evaluate alternatives in diagnosis and treatment of the tumors. The study populations have been followed for from 15 to more than 20 yrs and are at high risk of developing tumors of the thyroid gland (Populations A and C) and breast (Population B). Thyroid palpation and technetium scan will be performed on Population A and Subgroup I of Population C. Follow-up scans using 131-I will be performed on those with abnormal screening scans. Population B will undergo mammographic-thermographic studies. The prevalence of cold nodules will be described and the response to treatment with thyroid suppressive drugs will be monitored. The efficacy of repetitive thermographic-mammographic examination of women at high risk of development of breast cancer will be determined.
Keywords: X RADIATION; LOCAL IRRADIATION; PARTIAL BODY IRRADIATION; RADIOTHERAPY; SIDE EFFECTS; PATIENTS; DELAYED RADIATION EFFECTS; NEOPLASMS; RADIOINDUCTION; DIAGNOSIS; THERAPY; CARCINOGENESIS; RISK ASSESSMENT; DIAGNOSTIC TECHNIQUES; THYMUS; INFANTS; THYROID; TECHNETIUM 99; IODINE 131; SCINTISCANNING; ANTITHYROID DRUGS; MAMMARY GLANDS; WOMEN; BIOMEDICAL RADIOGRAPHY; THERMOGRAPHY; HEAD; CHILDREN; THYROID; TECHNETIUM 99; IODINE 131; SCINTISCANNING; ANTITHYROID DRUGS.

34097 Radiation-Induced Thyroid Cancer. Schneider, A.B. (Michael Reese Hospital and Medical Center, 2929 S. Ellis Avenue, Chicago, IL, 60616). **Project number:** ICA-21518-2. **Contract:** R01-CA-21518-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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.

34098 Effects of Carcinogens on Pro-and Eucaryotic DNA Replication. Hurwitz, J. (Yeshiva University, School of Medicine, 1300 Morris Park Ave., Bronx, NY, 10461). **Project number:** ICA-21622-1. **Contract:** R01 CA 21622-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

The influence of two known carcinogens, beta-propiolactone and benzo(a)pyrene diol epoxide on DNA replication will initially be studied using the partially purified system responsible for catalyzing the three stages of phi X174 DNA replication. We shall examine the influence of these compounds on: (a) the structure of the DNA; (b) the ability of complexed DNA carcinogen to be utilized in DNA replication; and (c) whether biologically active DNA products are formed or if specific errors can accumulate which alter the biologically active circular DNA. At present, there is no eucaryotic system which has progressed to the level of sophistication as that found with the procaryotic system. For this reason we shall initially attempt to isolate from adenoviral infected nuclei (plus uninfected nuclei), cell-free extracts capable of supporting adenoviral DNA-dependent deoxynucleotide incorporation. Simultneously, efforts will be directed to obtaining from eucaryotic systems a DNA polymerase plus ancillary protein dependent elongation of DNA-primed long DNA templates. If we are successful with this system, the influence of various carcinogens on these reactions will be examined.

Keywords: BENZOPYRENE; LACTONES; GLYCEROL; EPOXIDES; CARCINOGENS; BIOLOGICAL EFFECTS; BACTERIOPHAGES; ANIMAL CELLS; PLANT CELLS; DNA REPLICATION; DNA; MOLECULAR STRUCTURE; PATHOLOGICAL CHANGES.

34100 Repair Mechanisms in Carcinogenesis. Setlow, R.B. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C No. 06914. **Contract:** YOL-CP-50202. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** NCI-$80,000.
Related energy source: fossil fuels(40); nuclear fuels(general)(30); solar(30). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

The small fish, Poecilia formosa, are an ideal experimental system to make quantitative correlations between numbers of damages to DNA and neoplastic transformation. We have a large colony of such animals. We intend to treat cells in vitro with a number of physical and chemical carcinogenic agents and to assess the tumorigenic potential by injecting the cells into isogenic recipient animals and scoring the animals for tumors 6 to 12 months later. Chemicals will be chosen that mimic uv or x-rays in mammalian cell damage and repair and dose response curves will be obtained. Thyroid cells injected ip tend to localize in the thyroid gland. Earlier work showed that injected uv-irradiated thyroid cells gave rise to thyroid tumors but that photoreactivating illumination before uv reduces the number of tumors, indicating that pyrimidine dimers in DNA are the initiating event in tumor formation. Hence a comparison of the dose response data with those for uv (for which the initial numbers of lesions per unit length of DNA are known) will give the density of lesions arising from chemical treatment. Since cells will be treated in vitro, both chemical and physical dosimetry will be good. Thus this system should greatly assist in identifying the initial molecular changes that give rise to transformation and hence will aid in quantitatively evaluating potential chemical carcinogens in the environment.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; BIOLOGICAL REPAIR; FISHES; DNA; BIOLOGICAL RADIATION EFFECTS; ULTRAVIOLET RADIATION; X RADIATION; CHEMICAL EFFLUENTS.

34101 Respiratory Carcinogenesis. Little, J.B. (Harvard University, 55 Shattuck Street, Boston, MA, 02115). **Project number:** AN-281-4. **Contract:** N01-CP-33273. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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.

34102 Study of Polycyclic Hydrocarbon Metabolism. Wattenberg, L.W. (University of Minnesota, 1305 Mayo, Minneapolis, MN, 55455). **Project number:** AN-329-4. **Contract:** N01-CP-33364. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34103 Study of Pathogenesis of Mammary Cancer. Dao, T.L. (New York State Department of Health, 666 Elm St., Buffalo, NY, 14203). **Project number:** AR-317-5. **Contract:** NO1 CB 23865. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100).

The objectives of this project are to: determine the role of hormones and other host factors in the pathogenesis of mammary dysplasia and neoplasia; determine the incidence of tumors at different anatomical sites in the mammary chains of Sprague-Dawley rats treated with 7,12-Dimethylbenz(a)anthracens (DMBA) in order to compare the tumor incidence with the number of hyperplastic alveolar nodules (HAN) developing in these different glands; determine the effects of estrogen and prolactin alone and in combination, and at various dosage levels, on the in vitro growth (organ culture) of mammary tissue from Sprague-Dawley rats; and determine hormone levels in the blood, pituitary grafts, and lesions of the median emesis of rats.
Keywords: RATS; MAMMARY GLANDS; NEOPLASMS; PATHOGENESIS; BENZANTHRACENE; HYDROCARBONS; CARCINOGENESIS; HORMONES; BIOLOGICAL EFFECTS.

34104 Study of Modulating Factors in Carcinogenesis. Moon, R.C. (IIT Research Institute, 10 West 35th Street, Chicago, IL, 60616). **Project number:** AR-418-5. **Contract:** N01-CP-23292. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective of this project is to establish, if possible, a single-dose carcinogenic regimen for induction of respiratory tract tumors, preferably with non-metabolized carcinogens, so that more readily interpretable studies of co-carcinogenesis or promotion can be performed for respiratory carcinogenesis. When a single-dose regimen is available, we will study susceptibility factors, such as those which influence the rate of cell proliferation in the respiratory tract, in light of the tumor yield produced by the carcinogen. Whether the susceptibility of the respiratory tract to metabolized carcinogens can be influenced by chemicals known to inhibit their metabolism (e.g., benzo(a)pyrene, and 7,8-benzflavone), will be determined. The effects of anticarcinogenic agents, such as vitamin A analogs, on the progression of initiated tumors into detectable and lethal tumors will be examined. A bioassay resource will be provided which will be readily responsive to the need to initiate similar respiratory carcinogenesis studies.
Keywords: CARCINOGENS; ACUTE EXPOSURE; LUNGS; BIOLOGICAL EFFECTS; NEOPLASMS; CARCINOGENESIS; RESPIRATORY TRACT CELLS; CELL PROLIFERATION; HYDROCARBONS; METABOLITES; METABOLISM; INHIBITION; ANTINEOPLASTIC DRUGS; BIOASSAY; RESPONSE MODIFYING FACTORS.

34106 Synthesis of Polycyclic Hydrocarbon Derivatives. Engel, J.F. (Midwest Research Institute, 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** AR-540-5. **Contract:** N01-CP-33387. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

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.

34107 Effects of Arylhydrocarbon Hydroxylase Inducers on Microsomes (Rats, Mice). Wattenberg, L.W. (University of Minnesota, 1305 Mayo, Minneapolis, MN, 55455). **Project number:** AZ-1582-4. **Contract:** R01-CA-09599-200002. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 09599-20) whose summary states: The proposed research has three parts. The first is a study of naturally occurring inducers of aryl hydrocarbon hydroxylase (AHH) activity. Efforts will be made to identify inducers of AHH in plants other than Cruciferae. The second part is an investigation of the efffects of naturally occurring and synthetic inducers on the metabolite pattern produced by incubation of polycyclic hydrocarbon carcinogens, such as benzo(a)pyrene, with microsomes from animals to whom the inducers had been administered. The third part consists of experiments in which naturally occurring

and synthetic inducers will be administered to animals that will subsequently be challenged by polycyclic hydrocarbon carcinogens. **Keywords:** HYDROCARBONS; RATS; MICE; HYDROXYLASE; ENZYME ACTIVITY; METABOLISM; METABOLITES; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENESIS; BENZOPYRENE.

34108 Arylhydrocarbon Hydroxylase Inducers and Polycyclic Hydrocarbons (Mice, Rats). Wattenberg, L.W. (University of Minnesota, 1305 Mayo, Minneapolis, MN, 55455). **Project number:** AZ-1583-4. **Contract:** R01-CA-09599-200003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This proect is part of a broader program (CA 09599-20) whose summary states: The proposed research has three parts. The first is a study of naturally occuring inducers of aryl hydrocarbon hydroxylase (AHH) activity. Cruciferous plants contain indoles which have inducing activity. A determination of the role of each of these indoles in AHH induction by these plants will be carried out along with work to ascertain if other compounds affecting this activity are present. Efforts will be made to identify inducers of AHH in plants other than Cruciferae. The second part is an investigation of the effects of naturally occurring and synthetic inducers on the metabolite pattern produced by incubation of polycyclic hydrocarbon carcinogens, such as benzo(a)pyrene, with microsomes from animals to whom the inducers has been administered. The synthetic inducers include compounds whose administration results in inhibition of neoplasia from polycyclic hydrocarbon carcinogens. The third part consists of experiments in which naturally occurring and synthetic inducers will be administered to animals that will subsequently be challenged by polycyclic hydrocarbon carcinogens. These experiments are designed to establish the relationship between alterations in microsomal metabolism of polycyclic hydrocarbons resulting from administration of inducers, and changes in the neoplastic response of animals to polycyclic hydrocarbon carcinogens. **Keywords:** HYDROCARBONS; HYDROXYLASE; POLYCYCLIC AROMATIC HYDROCARBONS; ENZYME ACTIVITY; CARCINOGENESIS; BENZOPYRENE; MICE; RATS; METABOLISM; METABOLITES.

34109 Repair Kinetics of Radiation-Induced Cell Division Delay. Leeper, D. (Thomas Jefferson University, 1025 Walnut Street, Philadelphia, PA, 19107). **Project number:** AZ-1821-3. **Contract:** P01-CA-11602-080003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader research program supporting the activities of a specialized Radiation Therapy Research and Clinical Center. This project investigates the kinetics of cellular repair processes in relation to radioinduced division delay.
Keywords: IONIZING RADIATIONS; IRRADIATION; CELL CULTURES; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; CELL DIVISION; MITOTIC DELAY; RADIOINDUCTION; BIOLOGICAL REPAIR; BIOCHEMICAL REACTION KINETICS.

34110 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-12662-060003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Health effects.

This project is part of a broader program (CA 12662-06) whose summary states: This program project, a specialized Cancer Research Center within the Department of Radiation Therapy, Harvard Medical School, supports a variety of basic studies designed to clarify certain aspects of damage interactions between the major therapeutic modalities used in human cancer: radiation, chemotherapeutic agents, and immunologic factors. Interaction between these modalities are studied at the molecular, cellular and tissue levels. Therefore, the major purpose of this Center will be to provide a 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.

34111 3-Methylcholanthrene and Glucuronide Synthesis in Perfused Rat Liver. Gessner, T. (Roswell Park Memorial inst., 666 Elm Street, Buffalo, NY, 14203). **Project number:** AZ-2012-3. **Contract:** P01-CA-13038-060046. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: coal(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 13038-06) whose summary states: This program is concerned with the exploration of new approaches leading to the development of more effective cancer therapy through the integrated and yet diversified contributions of various groups of existing and new laboratories of the Department of Experimental Therapeutics at Roswell Park. New compounds are tested for biological activity in bacterial, viral and mammalian cell systems in vitro and in tumor-bearing rodents. The preclinical pharmacology of compounds of interest is being studied in several animal species prior to their initial clinical trial. Fundamental studies on the biochemical and pharmacological basis for selective cellular effects of drugs are being carried out in relation to the drug development activities in a variety of experimental systems and in man, and provide an important source of information leading to the design of additional drugs with improved selectivity of action.
Keywords: 3-METHYLCHOLANTHRENE; PERFUSED ORGANS; RATS; LIVER; TOXICITY; CARCINOGENESIS; NEOPLASMS; RADIOTHERAPY; GLUCURONIDASE; BIOSYNTHESIS; BIOCHEMICAL REACTION KINETICS; DRUGS; ANIMAL CELLS.

34112 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-06519-150022. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

This project is a part of a broader research program involving clinical and laboratory studies of the mechanisms of radiation carcinogenesis and therapy. Molecular processes are stressed as is the efficacy of various therapeutic regimens. In this paper, the role of DNA repair processes in cellular recovery mechanisms, and their subsequent role in the sensitization of normal and tumor cells to radiation are stressed.
Keywords: IONIZING RADIATIONS; ANIMAL CELLS; BACTERIA; BIOLOGICAL RECOVERY; DNA; BIOLOGICAL REPAIR; RADIOSENSITIVITY; RADIOTHERAPY; RADIOSENSITIZERS; RADIOPROTECTIVE SUBSTANCES; ENZYME ACTIVITY; RESPONSE MODIFYING FACTORS; MATHEMATICAL MODELS; GENETICS; BIOCHEMICAL REACTION KINETICS.

34113 Effect of S1 Nuclease on Phi-X174 RF and Other Double-Stranded DNA. Godson, G.N. (Yale University, 333 Cedar Street, New Haven, CT, 06510). **Project number:** BD-571-3. **Contract:** P01-CA-06519-1500095. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

Clinical studies include epidermoid carcinoma of the head and neck region; bronchogenic carcinoma; Hodgkin's disease and non-Hodgkin's lymphomas; GT malignancies including stomach, pancreas and large bowel; malignant melanoma; mycosis fungoides; breast carcinoma; and cervical and uterine carcinoma. Laboratory studies include determination of time-dose relationships for tumor cure and normal tissue reactions in animal systems; cell kinetic studies of mammalian tumors; late recurrences following radiation therapy in animal tumors; mechanisms of reoxygenation in mammalian tumors; radiation sensitivity of vascular endothelium; use of radiation sensitizing and protecting agents to improve therapeutic ratio; physiological and host defense mechanisms influencing tumor response; immune response to tumors and animal systems; radiation effects on the hematopoietic system; radiation sensitivity of cultured human cells; pharmacological development of new radiation modifying agents; mathematical models and data analysis in experimental and clinical radiation therapy; effects of fractionated x-irradiation on rat normal tissues and sarcoma; effects of hyperthermia on the radiosensitivity of the EMT6 mouse mammary tumor; tests of toxicity and sensitizing ability of new and known hypoxic radiosensitizers; and others.
Keywords: NUCLEASES; NUCLEIC ACIDS; DNA; BIOCHEMICAL REACTION KINETICS; CARCINOGENESIS; RADIOTHERAPY; NEOPLASMS; BIOLOGICAL MODELS; BIOLOGICAL RADIATION EFFECTS.

34114 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-581-3. **Contract:** P01-CA-06519-150105. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

Clinical studies include epidermoid carcinoma of the head and neck region; bronchogenic carcinoma; Hodgkin's disease and non-Hodgkin's lymphomas; GI malignancies including stomach, pancreas and large bowel; malignant melanoma; mycosis fungoides; breast carcinoma; and cervical and uterine carcinoma. Laboratory studies

include determination of time-dose relationships for tumor cure and normal tissue reactions in animal systems; cell kinetic studies of mammalian tumors; late recurrences following radiation therapy in animal tumors; mechanisms of reoxygenation in mammalian tumors; radiation sensitivity of vascular endothelium; use of radiation sensitizing and protecting agents to improve therapeutic ratio; physiological and host defense mechanisms influencing tumor response; immune response to tumors and animal systems; radiation effects on the hematopoietic system; radiation sensitivity of cultured human cells; pharmacological development of new radiation modifying agents; mathematical models and data analysis in experimental and clinical radiation therapy; effects of fractionated x-irradiation on rat normal tissues and sarcoma; effects of hyperthermia on radiosensitivity of tumor cells, and others.
Keywords: PSORALEN; NEAR ULTRAVIOLET RADIATION; NEOPLASMS; RADIOTHERAPY; HEAD; NECK; CHEMOTHERAPY; PHOTOSENSITIVITY; RADIOSENSITIVITY; BIOLOGICAL RADIATION EFFECTS; ANIMAL CELLS; TUMOR CELLS; RESPONSE MODIFYING FACTORS; MATHEMATICAL MODELS.

34115 Therapy and Pyrimidine Catabolism, Radiation and Repair (Mammals). Green, S. (University of Miami, 1400 NW 10th Avenue, Miami, FL, 33124). **Project number:** BD-1070-4. **Contract:** P30-CA-14395-050008. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

This project is part of a broader program (CA 14395-05) whose summary states: This program supports the Comprehensive Cancer Center for the State of Florida as a multi-disciplinary cancer center whose participants are involved in clinical and basic cancer research, cancer education at all levels and intensive community outreach programs throughout the State of Florida. Cooperative programs have been established with the state's other universities, the American Cancer Society, Department of Health, etc. The overall objectives of this program are the establishment of a core of excellence in cancer for the State of Florida and the development of interrelationships with other cancer directed interests in the State (and nationally) in order to bring to the people of Florida the benefits of the latest knowledge and research in cancer.
Keywords: FLORIDA; CARCINOGENESIS; BIOLOGICAL MODELS; RADIOTHERAPY; RADIATION INJURIES; BIOLOGICAL RADIATION EFFECTS; PUBLIC HEALTH; EDUCATION; NEOPLASMS; PYRIMIDINES; BIOLOGICAL REPAIR.

34116 Enhancement of Response to Chemical Carcinogens by Trypsin and Other Chemical Agents in Cultured Human Cell Lines. Yohn, D.S. (Ohio State University, 1900 Coffey Road, Columbus, OH, 43210). **Project number:** BF-732-3. **Contract:** N01-CP-43276. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: coal(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives of the project are to: evaluate chemical carcinogens on Detroit 550 cells for in vitro transformation; investigate the response of primary human fetal tissues to chemical carcingens; attempt to enhance the response of cells in culture with substances such as trypsin or methylmethanesulfonate (MMS) prior to treatment with chemical carcinogens; determine the effects of the active intermediate of unsaturated polycyclic hydrocarbons on human cells in vitro; and continue to evaluate in vivo methods such as inoculation of immunosuppressed hamsters or intracerebral inoculation of mice to determine whether transformed cells are malignant.
Keywords: CARCINOGENS; CELL CULTURES; ANIMAL CELLS; MAN; IN VITRO; EVALUATION; RESPONSE MODIFYING FACTORS; TRYPSIN; METHYL METHANESULFONATE; BIOLOGICAL EFFECTS; POLYCYCLIC AROMATIC HYDROCARBONS; METABOLITES; CARCINOGENESIS.

34117 Supply of Hamsters Treated with Respiratory Carcinogens. Baxter, D.W. (IIT Research Inst., 10 W. 35th St., Chicago, IL, 60616). **Project number:** BF-737-3. **Contract:** N01 CP 43289. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Health effects; Ecological/biological processes and effects.

The objective is to provide a steady weekly supply of a minimum of 100 Syrian golden hamsters which have been treated with a carcinogenic regimen of benzo(a)pyrene-ferric oxide and/or N-nirosomethylurea.
Keywords: CARCINOGENS; HAMSTERS; BENZOPYRENE; NITROSO COMPOUNDS; CARCINOGENESIS.

34118 Study of the Release of RNA Tumor Viruses and Its Genetic Control. Bentvelzen, P.A. (Organization for Health 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: fossil fuels(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

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; (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; (4) study the cellular and humoral immunological response of mice to MMTV-specific proteins; and (5) develop immunization procedures for mice using nucleic acid free immunogens which will provide good protection against spontaneous mammary tumor development.
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.

34119 Study of Immunology. Pomeranz, J.R. (Case Western Reserve University, 2109 Adelbert Road, Cleveland, OH, 44106). **Project number:** BF-781-3. **Contract:** N01-CP-43354. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective is to study and confirm the induction of primary mammary tumors following the infusions of DMBA into guinea pigs. These experiments will also be extended to investigate the effects of CFA administration at different times, and doses on the induction of these tumors in guinea pigs.
Keywords: IMMUNOLOGY; MAMMARY GLANDS; NEOPLASMS; GUINEA PIGS; DIMETHYLBENZANTHRACENE; CARCINOGENS; CARCINOGENESIS.

34120 Genetic Susceptibility to Carcinogenic Hydrocarbons (Human). Parshad, R. (Howard University, 2400 6th Street NW, Washington, DC, 20001). **Project number:** BL-194-3. **Contract:** P30-CA-14718-050007. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 14718-05) whose summary states: The Howard University Cancer Center program is in the process of substantial growth in all four of its program phases--Scientific Research, Clinical Activities, Education and Training, and Community Programs. New and expanded programs in Clinical Education and Graduate Research Training are being planned. Significant new efforts are being exerted to develop new research and clinical initiatives. Increasing demands are being placed on the administration and other core elements of the Center. Expansion of all non-building dependent core activities is being undertaken now as the program momentum builds, e.g., epidemiology. New core elements are being added, e.g., electron microscopy, endocrinology and virology. New clinical and research initiatives are being developed in breast cancer, prostate cancer, and nutritional carcinogenesis. In addition, several new projects are being undertaken to develop new research leads.
Keywords: HYDROCARBONS; GENETIC EFFECTS; CARCINOGENESIS; MAN; SENSITIVITY; EPIDEMIOLOGY; ELECTRON MICROSCOPY; VIRUSES; ENDOCRINE GLANDS; NEOPLASMS; MAMMARY GLANDS; PROSTATE.

34121 Study of Polycyclic Hydrocarbon Metabolism. Prough, R.A. (University of Texas, 5323 Harry Hines Blvd., Dallas, TX, 75230). **Project number:** BN-328-2. **Contract:** NO1 CP 33362. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: coal(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives of the project include: characterization of human lung microsomal fractions and their related mono-oxygenase activities; preparation and separation of various lung cell types from rats or hamsters; biochemical characterization of these cells with special reference to PAH metabolism; and attempts to prepare lung cells from human tissue. Human lung tissue will be fractionated and the mono-oxygenase activities and components will be measured. Inhibitor studies will allow a contrast of human lung microsomal fractions with those of hamster, testing the adequacy of the hamster model for lung PAH carcinogenesis. The preparation of lung cells and their separation will allow the biochemical characterization of

various lung cell types in an attempt to note which cells may be unique in terms of PAH metabolism or tumorigenesis.
Keywords: MAN; RATS; HAMSTERS; LUNGS; MICROSOMES; ENZYME ACTIVITY; METABOLISM; POLYCYCLIC AROMATIC HYDROCARBONS; RESPIRATORY TRACT CELLS; CYTOLOGICAL TECHNIQUES; CARCINOGENESIS; BIOLOGICAL MODELS; BIOCHEMISTRY; COMPARATIVE EVALUATIONS.

34122 Carcinogenesis Screening Using Cell Culture Assays. Sivak, A. (Arthur D. Little Inc., 25 Acorn Avenue, Cambridge, MA, 02142). **Project number:** BN-404-2. **Contract:** N01-CP-55711. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** coal(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

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.

34123 Interaction of Hormones. Broorse, J.J. (Organization for Health Research TNO, Lange Kleiweg 151, Rijswijk Z.H., Netherlands). **Project number:** BZ-198-1. **Contract:** N01-CP-33330. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** nuclear fission(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives of the project are to: investigate the cocarcinogenicity or interaction of female sex hormones singly or in combination with neutron radiation in the induction of breast cancer in laboratory animals; and develop techniques to be used as a basis for the analysis of risk factors involved in radiation-induced mammary cancer.
Keywords: NEUTRONS; IRRADIATION; LABORATORY ANIMALS; BIOLOGICAL RADIATION EFFECTS; MAMMARY GLANDS; NEOPLASMS; RADIOINDUCTION; HORMONES; RADIOSENSITIVITY EFFECTS; CARCINOGENESIS; SYNERGISM; RISK ASSESSMENT.

34124 Radiation Carcinogenesis (Rats). Shellabarger, C.J. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-228-2. **Contract:** P01-CA-12536-070001. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 12536-07) whose summary states: A major effort will be to use protons, deuterons and 3He particles, in the track segment method, to produce defined LET values up to 150 keV/micron. Synchronized Chinese hamster cells, at several phases of the cell cycle, will be used to determine the reaction between cell killing and LET. In parallel experiments, the production of chromosome aberrations will be studied as a function of LET.
Keywords: BIOLOGICAL RADIATION EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS; RATS; NEOPLASMS; RADIOINDUCTION; SYNCHRONOUS CULTURES; CELL CULTURES; ANIMAL CELLS.

34125 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:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 12536-07) whose summary states: A major effort will be to use protons, deuterons and 3He particles, in the track segment method, to produce defined LET values up to 150 keV/micron. Synchronized Chinese hamster cells, at several phases of the cell cycle, will be used to determine the reaction between cell killing and LET. In parallel experiments, the production of chromosome aberrations will be studied as a function of LET.
Keywords: CHROMOSOMAL ABERRATIONS; RADIATION INJURIES; RADIATION QUALITY; LET; RADIOINDUCTION; BIOLOGICAL RADIATION EFFECTS; CELL CYCLE; SYNCHRONOUS CULTURES; HAMSTERS; ALPHA PARTICLES; PROTONS; DEUTERONS; GAMMA RADIATION.

34126 X-Ray Cell Transformation of Rat and Hamster Embryos. Borek, C. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-233-2. **Contract:** P01-CA-12536-070009. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 12536-07) whose summary states: A major effort will be to use protons, deuterons and 3He particles, in the track segment method, to produce defined LET values up to 150 keV/micron. Synchronized Chinese hamster cells, at several phases of the cell cycle, will be used to determine the reaction between cell killing and LET. In parallel experiments, the production of chromosome aberrations will be studied as a function of LET.
Keywords: X RADIATION; EMBRYOS; RATS; HAMSTERS; CELL CYCLE; SYNCHRONOUS CULTURES; BIOLOGICAL RADIATION EFFECTS; ANIMAL CELLS; CHROMOSOMAL ABERRATIONS.

34127 Radiation Cytogenetics. Geard, C.R. (Columbia University, 630 West 168th Street, New York, NY, 10032). **Project number:** CB-234-2. **Contract:** P01-CA-12536-070011. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 12536-07) whose summary states: A major effort will be to use protons, deuterons and 3He particles, in the track segment method, to produce defined LET values up to 150 keV/micron. Synchronized Chinese hamster cells, at several phases of the cell cycle, will be used to determine the reaction between cell killing and LET. In parallel experiments, the production of chromosome aberrations will be studied as a function of LET.
Keywords: ALPHA PARTICLES; PROTONS; DEUTERONS; SYNCHRONOUS CULTURES; HAMSTERS; CELL CYCLE; CHROMOSOMAL ABERRATIONS; BIOLOGICAL RADIATION EFFECTS; GAMMA RADIATION; LET; RADIOINDUCTION.

34128 Role of Viral Infection and 3-Methylcholanthrene in Neoplastic Response (Mice). Duranreynals, M.L. (Yeshiva University, 1300 Morris Park Avenue, Bronx, NY, 10461). **Project number:** CB-376-2. **Contract:** P30-CA-13330-060047. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 13330-06) whose summary states: This application is for the continuing core support of a Cancer Research Center at the Albert Einstein College of Medicine which embraces 50 cancer investigators in essentially all of the disciplines of the medical school. That core support supplements cancer research grants and contracts and provides a broad spectrum of research needs and services which cannot be supplied by individual grants. The major elements in the core support include developmental funds for new investigators; the provision of a limited number of research associates and assistants; supporting services such as a biohazard facility, a computerized tumor registry; an immunology test laboratory, an animal institute, and a machine shop; common equipment facilities; and partial support of a clinical research unit.
Keywords: NEOPLASMS; IMMUNOLOGY; VIRUSES; MICE; CHOLANTHRENE; CARCINOGENESIS.

34129 Experimental Radiation Skin Carcinogenesis (Rats, Mice). Albert, R.E. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** CB-403-2. **Contract:** P30-CA-13343-050012. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

This project is part of a broader program (CA 13343-05) whose summary states: This proposal seeks continuation of support for a Center Grant for a series of studies aimed at cancer prevention. The underlying philosophy is that where the causes (or enhancing factors) of cancer can be identified, means for control can be sought. In a similar way, identification of the underlying mechanisms involved in the conversion of a normal to a malignant cell may permit the development of means for interrupting that conversion, thereby preventing the development of malignancy. The program deals with

chemical, physical, and biological factors in the causation of cancer as well as their interaction. The approaches described cover a wide range and include biochemical studies of intracellular mechanisms including cell kinetics, the development of mathematical models for cancer induction, and epidemiological studies on human populations aimed at the identification of causal factors.
Keywords: BIOLOGICAL RADIATION EFFECTS; NEOPLASMS; SKIN; RATS; MICE; PREVENTIVE MEDICINE; RADIOINDUCTION; CARCINOGENESIS.

34130 Evaluating Exposure of Miners to Radon with Lead-210. Eisenbud, M. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** CB-408-2. **Contract:** P30-CA-13343-050017. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 13343-05) whose summary states: This proposal seeks continuation of support for a Center Grant for a series of studies aimed at cancer prevention. The underlying philosophy is that where the causes (or enhancing factors) of cancer can be identified, means for control can be sought. In a similar way, identification of the underlying mechanisms involved in the conversion of a normal to a malignant cell may permit the development of means for interrupting that conversion, thereby preventing the development of malignancy. The program deals with chemical, physical, and biological factors in the causation of cancer as well as their interaction. The approaches described cover a wide range and include biochemical studies of intracellular mechanisms including cell kinetics, the development of mathematical models for cancer induction, and epidemiological studies on human populations aimed at the identification of causal factors.
Keywords: NEOPLASMS; PREVENTIVE MEDICINE; MINERS; CARCINOGENESIS; ANIMAL CELLS; EPIDEMIOLOGY; RADON; LEAD 210.

34131 Toxicology-Dosimetry and Particulate Carcinogens (Human). Palmes, E.D. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** CB-112-2. **Contract:** P30-CA-13343-050021. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 13343-05) whose summary states: This proposal seeks continuation of support for a Center Grant for a series of studies aimed at cancer prevention. The underlying philosophy is that where the causes (or enhancing factors) of cancer can be identified, means for control can be sought. In a similar way, identification of the underlying mechanisms involved in the conversion of a normal to a malignant cell may permit the development of means for interrupting that conversion, thereby preventing the development of malignancy. The program deals with chemical, physical, and biological factors in the causation of cancer as well as their interaction. The approaches described cover a wide range and include biochemical studies of intracellular mechanisms including cell kinetics, the development of mathematical models for cancer induction, and epidemiological studies on human populations aimed at the identification of causal factors.
Keywords: CARCINOGENS; NEOPLASMS; PREVENTIVE MEDICINE; HUMAN POPULATIONS; EPIDEMIOLOGY; MATHEMATICAL MODELS; DOSIMETRY.

34132 Radiation Oncology Studies (Human). Ubinas, J. (University of Puerto Rico, P.O. Box 5067, San Juan, PR, 00936). **Project number:** CB-595-2. **Contract:** P30 CA 16598-030005. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 16598-03) whose summary states: The Puerto Rico Cancer Center coordinates all activities in cancer service, education and research in the Medical Sciences Campus, the Medical Center and the Department of Health. It provides a certain number of core services available to all the investigators in the field of cancer in the Medical Sciences Campus. It also fosters the creation of an environment where new basic findings in cancer research may be translated into the practice of oncology. The Center is the prime mover in the planning of an Island-Wide Cancer Management System for Puerto Rico. It has also been a stimulus in the design and promotion of a number of educational and training programs to professionals in the field and laymen in the community. As such, the Cancer Center provides leadership in the development of coordinated and efficient use of available human and financial resources to the best advantage in the fight against cancer and other malignant diseases.
Keywords: TUMOR CELLS; HUMAN POPULATIONS; CARCINOGENESIS; RADIOTHERAPY; EDUCATION; NUCLEAR MEDICINE; MEDICAL PERSONNEL; TECHNOLOGY UTILIZATION; BIOLOGICAL RADIATION EFFECTS.

34133 Tumor Cell Radiobiology (Mice). Maruyama, Y. (University of Kentucky, Limestone and Euclid, Lexington, KY, 40506). **Project number:** CB-714-2. **Contract:** P01 CA 17786-030002. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

This project is part of a broader research program whose objective is the development of a modern radiation oncology facility for research into the clinical, basic, and applied aspects of radiation oncology. This project examines the role of mitosis and the cell cycle in the enhancement of radiation effects.
Keywords: TUMOR CELLS; RADIOBIOLOGY; MICE; BIOLOGICAL MODELS; RADIOTHERAPY; SIDE EFFECTS; NEOPLASMS; CHEMOTHERAPY; NUCLEAR MEDICINE.

34134 Modification of Radiation Effects (Mice). Utley, J.F. (University of Kentucky, Limestone and Euclid, Lexington, Ky, 40506). **Project number:** CB-715-2. **Contract:** P01 CA 17786-030003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader research program whose objective is the development of a modern radiation oncology facility for research into the clinical, basic, and applied aspects of radiation oncology. This project examines the role of mitosis and the cell cycle in the enhancement of radiation effects.
Keywords: BIOLOGICAL RADIATION EFFECTS; MICE; BIOLOGICAL REPAIR; TUMOR CELLS; RADIOTHERAPY; CHEMOTHERAPY; ANIMAL CELLS.

34135 Mitosis and Cell Cycle--Enhancement of Radiation Effects. Sisken, J.E. (University of Kentucky, Limestone and Euclid, Lexington, KY, 40506). **Project number:** CB-727-2. **Contract:** P01 CA 17786-030015. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader research program whose objective is the development of a modern radiation oncology facility for research into the clinical, basic, and applied aspects of radiation oncology. This project examines the role of mitosis and the cell cycle in the enhancement of radiation effects.
Keywords: CELL CYCLE; MITOSIS; BIOLOGICAL RADIATION EFFECTS; RADIOSENSITIVITY EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS.

34136 Physical Factors that Influence Radiobiologic Response. Schulz, R.J. (New Haven, CT, 06510). **Project number:** CC-181-1. **Contract:** P01 CA 06519-150125. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 06519-15) whose summary states: clinical studies are conducted on epidermoid carcinoma of the head and neck region; bronchogenic carcinoma; Hodgkin's disease and non-Hodgkin's lymphomas; GI malignancies including stomach, pancreas and large bowel; malignant melanoma; mycosis fungoides; breast carcinoma; and cervical and uterine carcinoma. Laboratory projects involve determination of time-dose relationships for tumor cure and normal tissue reactions in animal systems; cell kinetic studies of mammalia tumors; late recurrences following radiation therapy in animal tumors; mechanisms of reoxygenation in mammalian tumors; radiation sensitivity of vascular endothelium; use of radiation sensitizing and protecting agents to improve therapeutic ratio; physiological and host defense mechanisms influencing tumor response; immune response to tumors and animal systems; radiation effects on the hematopoietic system; radiation sensitivity of cultured human cells; pharmacological development of new radiation modifying agents; mathematical models and data analysis in experimental and clinical radiation therapy; and other biological radiation effects studies.
Keywords: RADIOSENSITIVITY; NEOPLASMS; HEAD; NECK; BRONCHI; LYMPHOMAS; HODGKINS DISEASE; DIGESTIVE SYSTEM; MELANOMAS; ANIMAL CELLS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL RADIATION EFFECTS; TUMOR CELLS; TOXICITY; BIOLOGICAL REPAIR.

34137 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-323-1. **Contract:** P30 CA 08748-125506. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 08748-12) whose summary states: 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, 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.

34138 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-329-1. **Contract:** P30 CA 08748-125514. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 08748-12) whose summary states: 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, 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.

34139 Photochemistry of Purine N Oxides in Oncogenesis. Parham, J.C. (Sloan-Kettering Inst. of Cancer Research, 410 East 68th Street, New York, NY, 10021). **Project number:** CC-381-1. **Contract:** P30-CA-08748-125703. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 08748-12) whose summary states: 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, secretarial services, etc., required by many laboratories; consultant services; renovations; and initial funding for new developmental programs.
Keywords: PHOTOCHEMISTRY; PURINES; OXIDES; CARCINOGENESIS.

34140 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-389-1. **Contract:** P30-CA-D8748-125720. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

This project is part of a broader program (CA 08748-12) whose summary states: 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, 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.

34141 Cellular Radiobiology (Human, Hamsters). Rubin, P. (University of Rochester, 601 Elmwood Ave., Rochester, NY, 14642). **Project number:** CC-613-1. **Contract:** P01 CA 11051-090065. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is part of a broader program (CA 11051-09A1) whose summary states: The Clinical Radiation Research Center (CRRC) programs constitute 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.

34142 Recovery from Radiation-Induced Cell Cycle Delay (Mammals). Leeper, D. (Thomas Jefferson University, 1025 Walnut Street, Philadelphia, PA, 19107). **Project number:** CC-708-1. **Contract:** P01-CA-11602-080020. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 11602-08) whose summary states: This application seeks funds to continue the activities of a specialized Radiation Therapy Research and Clinical Center, initiated under National Cancer Institute Grant No. CA-11602. As a result of the initial grant, our departmental staff has been augmented and an expanded, modern facility has been created, bringing into close physical proximity, clinical, radiation physics, nuclear medicine and basic research areas. We now propose to develop an extensive and well-balanced program that will encompass clinical research, demonstration of superior clinical management of cancer patients, basic cancer research, radiation physics research and research in nuclear medicine. In our program, special emphasis will be given to an interdisciplinary approach to research and management of cancer patients, as exemplified by our interdepartmental clinics and research projects. In addition, we hope to continue and expand our efforts, in cooperation with other local hospitals, to develop a Conjoint Radiation Therapy Oncology Center, thereby extending the impact of our clinical service and research activities to a large patient population throughout the Delaware Valley area.
Keywords: RADIOTHERAPY; NUCLEAR MEDICINE; CARCINOGENESIS; NEOPLASMS; PATIENTS; RESEARCH PROGRAMS; RADIOBIOLOGY; NUCLEAR PHYSICS; AIR QUALITY; BIOLOGICAL MODELS; ENVIRONMENT; BIOLOGICAL RADIATION EFFECTS.

34143 Effect of Ionizing and Other Irradiation on Cellular Membrane. Wallach, D.F. (Tufts University, School of Medicine, 136 Harrison Ave., Boston, MA, 02111). **Project number:** CC-757-1. **Contract:** P01 CA 12178-070016. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 12178-07) whose summary states: A Radiotherapy-Oncology Center has been established at the Tufts-New England Medical Center for the treatment of human malignancies, and to conduct research on the effects of irradiation on normal and malignant tissues. Education on clinical and biological aspects of cancer is carried out at all levels. Active efforts are sustained to cooperate with clinicians in affiliated hospitals in providing optimal care to cancer patients at the community level. Special efforts are directed toward the combined use of surgery, radiotherapy and chemotherapy in the management of various tumors. Research is ongoing in the application of the computer to all aspects of the practice of Therapeutic Radiology. Radiobiologic research centers on the role of the cell membrane in neoplastic conditions.
Keywords: CELL MEMBRANES; BIOLOGICAL RADIATION EFFECTS; IONIZING RADIATIONS; ULTRAVIOLET RADIATION; RADIOSENSITIVITY; RADIOTHERAPY; TECHNOLOGY ASSESSMENT; NEOPLASMS; DISEASES; NUCLEAR MEDICINE.

34144 DNA Insult Induced by BUDR and Irradiation (Rats, Hamsters, Human). Tso, P.O. (Johns Hopkins University, 615 North Wolfe Street, Baltimore, MD, 21205). **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This project is part of a broader program investigating the molecular mechanisms of neoplastic transformation. The subproject deals with the response-modifying effects of BUDR on radioinduced damage to the DNA molecule.
Keywords: DNA; BIOLOGICAL RADIATION EFFECTS; RATS; HAMSTERS; MAN; RADIOSENSITIVITY; CARCINOGENESIS; EPIDEMIOLOGY; VIRUSES; HERPES SIMPLEX; BIOCHEMICAL REACTION KINETICS; NEOPLASMS; ORGANIC NITROGEN COMPOUNDS; ANTIGENS; BUDR; RADIOSENSITIVITY EFFECTS.

34145 Influence of Irradiation on Carcinogenesis. Segaloff, A. (Alton-Ochsner Medical Foundation, 1520 Jefferson Highway, New Orleans, LA, 70121). **Project number:** CI-41-1. **Contract:** N01-CP-65754. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fusion(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

It is the intention of the RFP to support laboratory research using known models of synergism in mammary gland tumorigenesis. A number of variables must be assessed in attempting to relate ultimately the developed results of mammographic technology and other forms of radiation exposure.
Keywords: CARCINOGENESIS; SYNERGISM; MAMMARY GLANDS; NEOPLASMS; IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS; BIOCHEMISTRY.

34146 In Vitro Mutagenesis System for Carcinogen Screening. Matheson, D. (Litton Bionetics Inc., 5516 Nicholson Lane, Kensington, MD, 20795). **Project number:** C1-52-1. **Contract:** N01-CP-65853. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects; Ecological/biological processes and effects.

The specific aim of this project is to evaluate and determine the usefulness and reliability of an in vitro cell mutagenesis system using L5178Y mouse lymphoma cells for routine use as an assay for initial determination of the carcinogenic potential of chemical compounds.
Keywords: CELL CULTURES; L CELLS; MUTATIONS; CARCINOGENS; MUTAGEN SCREENING; MUTAGENESIS; IN VITRO; TECHNOLOGY ASSESSMENT.

34147 *Mutagenesis System for Carcinogenesis Screening.* Mitchell, A.D. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** CI-53-1. **Contract:** N01-CP-65854. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The specific aim of this project is to evaluate and determine the usefulness and reliability of an in vitro cell mutagenesis system using L5178Y mouse lymphoma cells for routine use as an assay for initial determination of the carcinogenic potential of chemical compounds.
Keywords: HYDROCARBONS; MUTAGEN SCREENING; CARCINOGENS; LYMPHOMAS; ANIMAL CELLS.

34148 Mutagenesis Systems for Carcinogenesis Screening. Rosenkranz, H.S. (New York Medical College, Valhalla, NY, 10595). **Project number:** CI-54-1. **Contract:** N01-CP-65855. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The contractor shall furnish services, qualified personnel, and material, equipment, and facilities not otherwise provided by the Government under the terms of this contract, as needed to perform the work set forth below. Objectives are to test approximately 80 substances to be supplied by the NCI, for mutagenicity in a blind study, and test all substances with and without metabolic activation.
Keywords: MUTAGEN SCREENING; CARCINOGENS; METABOLITES; HYDROCARBONS.

34149 Mutagenesis Systems for Carcinogenesis Screening. Brusick, D.J. (Litton Bionetics Inc., 5516 Nicholson Lane, Kensington, MD, 20795). **Project number:** CI-55-1. **Contract:** N01-CP-65856. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The contractor shall furnish services, qualified personnel, and material, equipment, and facilities not otherwise provided by the Government under the terms of this contract.
Keywords: MUTAGEN SCREENING; CARCINOGENS; MUTAGENESIS; HYDROCARBONS.

34150 Mutagenesis Systems for Carcinogenesis Screening. Simmons, V.F. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** CI-56-1. **Contract:** N01-CP-65857. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The contractor shall furnish services, qualified personnel, and material, equipment, and facilities not otherwise provided by the Government under the terms of this contract.
Keywords: MUTAGEN SCREENING; CARCINOGENESIS; HYDROCARBONS.

34151 Radiosensitivity and Chromosomal Volume (Mammals, Amphibians, Plants). Conger, A.D. (Temple University, 3223 N. Broad Street, Philadelphia, PA, 19122). **Project number:** CK-325-1. **Contract:** R01-CA-08231-13004. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

This project is part of a broader program (CA 08231-13) whose summary states: Genome size (amount of chromosomal protein plus DNA, per cell) and radiosensitivity for mutation induction and for cell killing will be measured in different species and in different tumor cell culture lines, and correlations tested. Genome size is a good predictor of relative radiosensitivity. Several human and animal tumor cell lines of different radiosensitivities will be examined for their genome size and cytological characteristics to see if these differences account for their different sensitivities. The same tumor lines will also be grown in tissue culture as solid microsphere colonies to test the effect of solid vs. single-cell growth on radiosensitivity. Microsphere colonies simulate in vivo solid tumors.
Keywords: RADIOSENSITIVITY; CHROMOSOMAL ABERRATIONS; NEOPLASMS; TUMOR CELLS; GENETIC RADIATION EFFECTS; MUTAGENESIS; RADIOINDUCTION; GENOME MUTATIONS.

34152 Ozone as a Mutagen In Vivo and In Vitro (Hamsters). Conger, A.D. (Temple University, 3223 N. Broad Street, Philadelphia, PA, 19122). **Project number:** CK-327-1. **Contract:** R01-CA-08231-130006. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Ecological/biological processes and effects.

This project is part of a broader program (CA 08231-13) whose summary states: Genome size (amount of chromosomal protein plus DNA, per cell) and radiosensitivity for mutation induction and for cell killing will be measured in different species and in different tumor cell culture lines, and correlations tested. Genome size is a good predictor of relative radiosensitivity. Several human and animal tumor cell lines of different radiosensitivities will be examined for their genome size and cytological characteristics, to see if these differences account for their different sensitivities. The same tumor lines will also be grown in tissue culture as solid microsphere colonies, to test the effect of solid vs. single-cell growth on radiosensitivity. Microsphere colonies simulate in vivo solid tumors.
Keywords: OZONE; MUTAGENESIS; IN VIVO; IN VITRO; ANIMAL CELLS; DNA; PROTEINS; RADIOSENSITIVITY; NEOPLASMS; TISSUE CULTURES; HAMSTERS.

34153 Prevention, Detection and Control of Radiation. Degroot, L.J. (University of Chicago, 5801 S. Ellis Ave., Chicago, IL, 60637). **Project number:** CK-763-1. **Contract:** P01 CA 19266-020007. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This project is part of a broader research program envolving multidisciplinary research activities in the diagnosis, staging, and treatment of cancer as well as basic research into all aspects of oncology. This project deals with the detection and control of ionizing radiations as it relates to the protection of patients and personnel in a radiological setting.
Keywords: CARCINOGENESIS; DIAGNOSIS; BIOLOGICAL RADIATION EFFECTS; RADIOTHERAPY; BIOLOGICAL MODELS; NEOPLASMS; RADIOBIOLOGY; NUCLEAR MEDICINE.

34154 Postirradiation Phenomena. Caldwell, W.L. (University of Wisconsin, 307 N. Charter Street, Madison, WI, 53706). **Project number:** CK-802-1. **Contract:** P01 CA 19278-020018. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (CA 19278-02) whose summary states: the objectives of this proposal from the Division of Radiation Oncology, at the University of Wisconsin Center for Health Sciences, are: (1) to develop preclinical research in radiation biology and broaden the range of research to include radioimmunobiology, effects of combined modalities, and experimental radiotherapeutics; (2) to initiate and continue clinical studies in radiation therapy with emphasis on tumor localization, treatment planning and quality control, normal tissue tolerance and therapy with combined modalities; (3) to undertake research on the dosimetry of high energy electrons and photons and apply these findings clinically; (4) to further clinical studies and development with ultrasound and develop suitable tumor-localizing radionuclides for im-

proved detection and definition of tumors; (5) to provide an excellent setting for training in radiation biology, radiation therapy and radiation physics at the pre- and postdoctoral level; and (6) to promote optimal use of radiation therapy as part of a multidisciplined approach to the treatment of cancer within the U.W. Center for Health Sciences and in the Wisconsin region.
Keywords: CARCINOGENESIS; RADIOBIOLOGY; RADIOIMMUNOASSAY; RADIOTHERAPY; ULTRASONIC WAVES; SCINTISCANNING; BIOLOGICAL RADIATION EFFECTS; DOSIMETRY; NUCLEAR MEDICINE; EDUCATION; BIOLOGICAL MODELS.

34155 Toxicity, Chemical Mutagensis and Carcinogenesis. Alper, J. (Roger Williams General Hospital, 825 Chalkstone Avenue, Providence, RI, 02908). **Project number:** CK-893-1. **Contract:** P01-CA-20892-020012. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Ecological/biological processes and effects.

This project is part of a broader program (CA 20892-02) whose summary states: This is a broad coordinated program combining work in the fields of drug development and biochemical pharmacology to generate new scientific information with direct and practical relevance for use in man. A significant feature of the proposed program is the collaborative interdisciplinary approach that will result in an efficient mechanism for translating basic scientific information through clinical investigators to practicing physicians, and provide an effective feedback from the clinic to the laboratory as well. A fundamental objective is to seek basic pharmacological and immunological information that will contribute to clinical utilization in human cancer.
Keywords: DRUGS; MUTAGENS; CARCINOGENS; PHARMACOLOGY; MAN.

34156 Mutagenesis Malignant Transformation and DNA Repair (Mouse Embryo Fibroblasts). Heidelberger, C. (University of Southern California, 2025 Zonal Avenue, Los Angeles, CA, 90033). **Project number:** CK-904-1. **Contract:** R01-CA-21036-020003. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** fossil fuels(100). **R and D categories:** Operational safety.

Quantitative associations among the following processes are sought as a means for developing both information on the mechanism of carcinogenesis and a pre-screen for environmental carcinogens including oncogenic transformation, cytotoxicity, chemical mutagenesis, DNA synthesis, and the production and repair of alkalilabile lesions in cellular DNA. This is done with cultured fibroblasts (Chinese hamster V79 and mouse embryo C3H/10T1/2 cells) treated wih various doses of several simple alkylating agents.
Keywords: MUTAGENESIS; DNA; MICE; MUTAGEN SCREENING; BIOSYNTHESIS; HAMSTERS; EMBRYOS; ANIMAL CELLS; CELL CULTURES; CARCINOGENS.

34157 DNA Repair Studies in Cultured Hepatocytes. Pitot, H.C. (University of Wisconsin, 307 N. Charter Street, Madison, WI, 53706). **Project number:** DD-591. **Contract:** N01-CP-85609. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** fossil fuels(100). **R and D categories:** Health effects.
Keywords: DNA; BIOLOGICAL REPAIR; CARCINOGENS.

34158 Application of Crystalliographic Techniques. Glusker, J.P. (Inst. for Cancer Research, 7701 Burholme Avenue, Philadelphia, PA, 19111). **Project number:** IAM-2884-29. **Contract:** R01-CA-10925-29. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects; Ecological/biological processes and effects.

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.

34159 Ontogenetic Studies of Drug Metabolism. Soyka, L.F. (Univ. of Vermont, Coll. of Agriculture, 85 S. Prospect St., Burlington, VT, 05401). **Project number:** IHD-8708-5. **Contract:** R01 CA 19647-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Our studies aim to elucidate in biochemical terms the influence of perinatal exposure to a model aromatic polycyclic hydrocarbon carcinogen on the development of liver and lung enzymes which are responsible for the metabolism of a variety of drugs and chemicals. We have found that perinatal exposure of mice produces alterations in basal levels of this system and in the inducibility when exposed to chemicals, such as phenobarbital and 3-methylcholanthrene (3-MC), which are known to alter the activity of the mixed function oxidases. We plan to relate these biochemical changes to development of local, lung, and liver tumors following challenge with 3-MC at various postnatal ages. The second area of our work relates to the inhibition of drug metabolism seen following treatment with killed suspensions of Corynebacterium parvum. We hope to define the mechanism(s) by which such immunomodulators affect drug metabolism. Furthermore, we will attempt to relate such changes in metabolism to the development of tumors in mice in the groups exposed either transplacentally or via suckling to 3-MC and/or its metabolites.
Keywords: DRUGS; METABOLISM; CARCINOGENESIS; BIOLOGICAL MODELS; POLYCYCLIC AROMATIC HYDROCARBONS; EMBRYOS; NEONATES; LIVER; LUNGS; MICE; PHENOBARBITAL; CHEMICAL EFFLUENTS; INHIBITION; BACTERIA; BIOCHEMICAL REACTION KINETICS; ENZYMES.

34160 Molecular Basis of Radiation Lethality. Smith, K.C. (Stanford Univ., Palo Alto, CA, 94305). **Project number:** ICA-6437-17. **Contract:** R01 CA 06437-17. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Health effects; Ecological/biological processes and effects.

We wish to gain further insight into the molecular events leading to ionizing radiation-induced cell death, and the molecular basis of the oxygen effect; more specifically the roles of DNA single- and double-strand breaks and base damage, and their enzymic repair in these processes in bacterial and mammalian cells. We will also study the role of error-prone repair in the process of x-ray-induced mutagenesis. These studies will be conducted on x-ray sensitive cell lines that we are currently isolating.
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.

34161 Possible Neoplastic Effects of Non-Neoplastic Viruses. Duranreynals, M.L. (Yeshiva Univ., School of Medicine, 1300 Morris Park Ave., Bronx, NY, 10461). **Project number:** ICA-7160-14. **Contract:** R01 CA 07160-14. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This research concerns the role in the neoplastic response of mice to skin painting with 3-methylcholanthrene (MCA) of the response to acute viral infection and to endogenous infection by murine leukemia virus (MuLV) and whether the carcinogen induces or not aryl hydrocarbon hydroxylase (AHH). A high incidence of skin tumors was observed only in inbred and hybrid mice in which the carcinogen induces low or no leukemia and induces AHH; the skin is highly susceptible to vaccinia infection which in turn enhances the skin neoplastic response to the carcinogen; and MuLV is very low or not detectable. A high incidence of leukemias has been observed only in inbred and hybrid mice in which: the carcinogen induces few or no skin tumors and does not induce AHH: the skin is only very weakly susceptible or resistant to vaccinia virus; and MuLV is restricted or not detectable. High spontaneous leukemia is associated with a high level of MuLV and can occur in AHH noninducible mice (AKR) and in AHH inducible mice (C58); in the latter, the high level of MuLV seems to inhibit the induction of skin tumors by MCA painting.
Keywords: LEUKEMIA VIRUS; 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.

34162 Biochemistry and Radiation Effect During the Cell Cycle. Helmstetter, C.E. (Roswell Park Memorial Inst., 666 Elm St., Buffalo, NY, 14203). **Project number:** ICA-8232-13. **Contract:** R01 CA 08232-13. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The long-term objective of this project is the determination of the sequence of molecular events during duplication of E. coli, and the biochemical mechanisms which control the initiation and completion of each of the major steps in the sequence. A major objective for the current project is the determination of the molecular mechanisms which control the initiation of DNA replication. Four specific projects will be undertaken. First, the number of F' plasmids per cell, and the timing of replication of the plasmids during the division cycle, will be determined. Second, an attempt will be made to transfer gene segments near the origin of chromosome replication between various substrains of E. coli in an effort to determine the functions of these genes and to map their loci. Third, the mechanism which controls the timing of initiation of chromosome replication will be analyzed for performing temperature shifts in synchronous cultures of E. coli B/r dnaC. Fourth, a newly isolated recA mutant of E. coli B/r will be used to investigate the coupling between chromosome replication and cell division during thymine starvation, and to generate F' plasmids possessing the origin of chromosome replication.
Keywords: CELL CYCLE; ESCHERICHIA COLI; BIOCHEMICAL REACTION KINETICS; DNA REPLICATION; GENETIC RADIATION EFFECTS; GENETIC VARIABILITY; SYNCHRONOUS CULTURES; CELL DIVISION; MUTANTS; MUTAGENESIS; THYMINE; NUTRITIONAL DEFICIENCY.

34163 Cellular Responses to Irradiation. Dewey, W.C. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** ICA-8618-12. **Contract:** R01 CA 08618-12. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Health effects.

The first objective is to obtain quantitative information on effects of hyperthermia either by itself or in combination with x-irradiation when the treatments are applied during different phases of the cell cycle. The second objective is to determine the target responsible for the x-ray-induced delay in cell cycle progression occurring during the G2 phase of the cell cycle. The third objective is to obtain quantitative information on the x-ray induction of mutant or variant cells.
Keywords: X RADIATION; HAMSTERS; GENETIC RADIATION EFFECTS; HYPERTHERMIA; SYNERGISM; TEMPERATURE EFFECTS; RADIOSENSITIVITY; ANIMAL CELLS; RADIOINDUCTION; BIOCHEMICAL REACTION KINETICS; MUTANTS; CHROMOSOMAL ABERRATIONS; CELL CYCLE; THERMAL POLLUTION; THERMAL EFFLUENTS; DOSE-RESPONSE RELATIONSHIPS; RADIOACTIVE EFFLUENTS; BIOLOGICAL EFFECTS.

34164 Microsomal Induction and Response to Carcinogens. Wattenberg, L.W. (Univ. of Minnesota, 1305 Mayo, Minneapolis, MN, 55455). **Project number:** ICA-9599-20. **Contract:** R01 CA 09599-20. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The proposed research has three parts. The first is a study of naturally-occurring inducers of aryl hydrocarbon hydroxylase (AHH) activity. Efforts will be made to identify inducers of AHH in plants other than Cruciferae. The second part is an investigation of the effects of naturally-occurring and synthetic inducers on the metabolite pattern produced by incubation of polycyclic hydrocarbon carcinogens, such as benzo(a)pyrene, with microsomes from animals to whom the inducers had been administered. The third part consists of experiments in which naturally-occurring and synthetic inducers will be administered to animals that will subsequently be challenged by polycyclic hydrocarbon carcinogens.
Keywords: CARCINOGENS; DOSE-RESPONSE RELATIONSHIPS; HYDROXYLASE; ARYL RADICALS; HYDROCARBONS; BENZOPYRENE; METABOLISM; ANIMALS; MICROSOMES; NEOPLASMS; RESPONSE MODIFYING FACTORS; CARCINOGENESIS; INHIBITION; BIOCHEMICAL REACTION KINETICS.

34165 Radiobiology/Oncology Research Program. Kaplan, H.S. (Stanford Univ., Palo Alto, CA, 94305). **Project number:** ICA-10372-11. **Contract:** P30 CA 10372-11. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This proposal is aimed at a continuation of a CORE program which comprises four major components: (1) support of those service-type functions common to the several research and training projects, including animal colony maintenance, tissue culture and bacteriological glassware and media preparation, histopathology, laboratory, and administrative/secretarial functions; (2) salary support for key scientific professional personnel; (3) modest support for new pilot research projects prior to application for full-scale support; and (4) major items of equipment which are utilized as a shared resource.
Keywords: RADIOBIOLOGY; TUMOR CELLS; CARCINOGENESIS; BIOLOGICAL MODELS; GENETIC RADIATION EFFECTS; NEOPLASMS; TISSUE CULTURES; LABORATORY EQUIPMENT; HISTOLOGY; PATHOLOGY; CYTOLOGY.

34166 Repair of Radiation Damage in Cellular DNA. Lett, J.T. (Colorado State Univ., Fort Collins, CO, 80523). **Project number:** ICA-10714-10. **Contract:** R01 CA 10714-10. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Investigations will be pursued in several related areas: (1) rejoining of DNA strand breaks in Chinese hamster ovary cells following low doses (less than 1000 rads) of x-rays (using reorienting-gradient zonal ultracentrifugation); (2) effects of hyperthermic exposure on the rejoining of DNA strand breaks in Chinese hamster ovary cells following low doses (less than 1000 rads) of x-rays; (3) effects of hypo- and hyperthermic exposures on the survival of the very radiosensitive murine leukemic lymphoblast, L5178Y S/S, as a function of cycle position; and (4) rejoining of DNA strand breaks in L5178Y S/S cells as a function of cycle position.
Keywords: BIOLOGICAL RADIATION EFFECTS; RADIATION INJURIES; BIOLOGICAL REPAIR; GENETIC RADIATION EFFECTS; HAMSTERS; OVARIES; STRAND BREAKS; CHROMOSOMAL ABERRATIONS; DNA; X RADIATION; LOW DOSE IRRADIATION; HYPOTHERMIA; HYPERTHERMIA; TEMPERATURE EFFECTS; LEUKEMIA; RADIOSENSITIVITY; RESPONSE MODIFYING FACTORS; SURVIVAL CURVES; CELL CYCLE.

34167 Nucleic Acid Function in Relation to Cancer. Goldthwait, D.A. (Case Western Reserve Univ., 2109 Adelbert Rd., Cleveland, OH, 44106). **Project number:** ICA-11322-9. **Contract:** R01 CA 11322-09. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

Repair of DNA treated with chemical carcinogens or with gamma-irradiation is under investigation. The major focus is on enzymes which recognize these forms of damage. Endonuclease II of E. coli will be purified to homogeneity and its exact mechanism, with regard to the N-glycosidase and the phosphodiester bond hydrolase, will be studied. The activity of several mammalian systems is also under investigation. Some of the aspects of radiation damage, such as the structure of altered base(s) which is (are) recognized by endonuclease II, will be investigated.
Keywords: ESCHERICHIA COLI; CARCINOGENESIS; DNA; BIOLOGICAL REPAIR; GAMMA RADIATION; RADIATION INJURIES; GENETIC RADIATION EFFECTS; BIOCHEMICAL REACTION KINETICS; HYDROLASES; CARCINOGENS; MAMMALS; METABOLISM.

34168 Chemistry of Carcinogenic Hydrocarbons. Harvey, R.G. (Univ. of Chicago, 5801 S. Ellis Ave., Chicago, IL, 60637). **Project number:** ICA-11968-6. **Contract:** R01 CA 11968-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The proposed research has as its initial objective the development of a new synthetic approach to K-region oxidized derivatives of polycyclic hydrocarbons not subject to the deficiencies of existing methods in order to make these compounds available in adequate quantities for further research. The second objective is to investigate the chemical properties of the arene oxides, dihydrodiols, and phenols with attention to processes potentially involved in the intimate mechanism of carcinogenesis. These include: (1) the tautomeric equilibrium between the keto and enol forms of the aromatic phenols; (2) rearrangement of arene oxides to phenols, oxepins, etc.; (3) dehydration and accompanying unknown reactions of dihydrodiols; and (4) reactions of K-region oxides with mild nucleophilic reagents, models for attack by cellular components. The results will be assessed in the light of a proposed theory relating carcinogenicity to chemical reactivity in the K-region as a function of polarization of the epoxide function.
Keywords: HYDROCARBONS; METABOLISM; BIOCHEMICAL REACTION KINETICS; POLYCYCLIC AROMATIC HYDROCARBONS; EPOXIDES; PHENOLS; CARCINOGENESIS; TOXICITY; PRODUCTION; CYTOLOGY.

34169 Environmental Carcinogenesis. Wynder, E.L. (American Health Foundation, 1370 Ave. of the Americas, New York, NY, 10019). **Project number:** ICA-12376-6-1. **Contract:** P01 CA 12376-

06S3. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Studies will continue on a number of cancer types and will include a recently initiated bias study on personal habits, a spouse study, a rare cancer study, and examination of contraceptive use in liver cancer. Nutritional aspects of breast cancer in humans, monkeys, and rats will continue to be studied from the point of view of fat-related hormonal changes, including investigations of basic mechanisms. Carcinogenicity of chemicals arising from the environment will be examined, and a new study will be started on bladder cancer, in which chemicals in human urine will be tested for mutagenic and carcinogenic activity in bacterial systems and mouse skins. Related animal model experiments will be carried out, including attempts to initiate prostate cancer in rats by direct injections of methylnitrosourea.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; EPIDEMIOLOGY; BEHAVIOR; LIVER; NEOPLASMS; NUTRITION; MAMMARY GLANDS; MAN; MONKEYS; RATS; BIOCHEMICAL REACTION KINETICS; CHEMICAL EFFLUENTS; BLADDER; BACTERIA; MICE; PROSTATE; URINE; TOXICITY; UREA; HUMAN POPULATIONS.

34170 DNA Repair and Its Relationship to Carcinogenesis. Friedberg, E.C. (Stanford Univ., Palo Alto, CA, 95305). **Project number:** ICA-12428-7. **Contract:** R01 CA 12428-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Studies on the molecular mechanisms of both nucleotide and base excision repair are in progress. The former system involves the use of DNA photoproducts as a model substrate (principally pyrimidine dimers). Enzyme activities and possible non-enzyme cofactors required for the excision of thymine dimers from both DNA and chromatin in vitro are being studied in normal and Xeroderma pigmentosum cells in culture. Base excision repair (the removal of uracil from DNA) is being studied in prokaryote cells. A specific DNA glycosidase that removes uracil from DNA has been purified and characterized and subsequent steps in base excision repair are being studied.
Keywords: DNA; BIOLOGICAL REPAIR; CARCINOGENESIS; BIOLOGICAL MODELS; NUCLEOTIDES; BIOCHEMICAL REACTION KINETICS; CHROMATIN; HYDROCARBONS; TOXICITY.

34171 Susceptibility of Cutaneous Cells to DNA Injury by Ultraviolet Radiation. Carter, D.M. (Yale Univ., 333 Cedar St., New Haven, CT, 06510). **Project number:** ICA-12496-6-1. **Contract:** R01 CA 12496-06S1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

This project explores the defenses of cutaneous cells to photomediated DNA injury by ultraviolet irradiation. The shielding effects of melanin pigment to cells of irradiated skin as well as to individual cells irradiated in culture are examined with respect to cell viability, damage to DNA, DNA replication, cell division, and pigment production. Pigmented and non-pigmented melanoma cells as well as fibroblasts are used in these experiments. The production of thymine dimers (by 260 nm uv light) and of 4,5',8-trimethyl psoralen (TMP) cross-linking photoadducts (by 360 nm uv light) are quantitatively measured in DNA extracted from irradiated cells. The DNA-repair mechanisms that remove TMP cross-links in different types of cutaneous cells are sought with emphasis on excision and recombination steps. Experimental methods employed include two-dimensional paper chromatography, hydroxyapatite column chromatography, autoradiography, zone sedimentation in sucrose gradients, and equilibrium centrifugation in density gradients. This work deals with protection against potentially mutagenic and carcinogenic damage to DNA by uv light.
Keywords: DNA; BIOCHEMICAL REACTION KINETICS; ULTRAVIOLET RADIATION; SKIN; CELL DIVISION; DNA REPLICATION; MELANIN; BIOLOGICAL REPAIR; CARCINOGENESIS; MUTAGENESIS; BIOLOGICAL MODELS; GENETIC EFFECTS.

34172 New Animal Models of Chemical Carcinogenesis. Homburger, F. (Bio Research Inst., 9 Commercial Ave., Cambridge, MA, 02141). **Project number:** ICA-13232-5-1. **Contract:** R01 CA 13232-05S1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This will be the fifth year of a continuing study intending to define various inbred strains of Syrian hamsters (Mesocricetus auratus auratus) with respect to their responses to various types of carcinogens administered by various routes. We intend now to study the mechanisms responsible for these differences by genetic studies (F1, F2, appropriate backcrosses) and to examine, where possible, the molecular basis for the observed differences. This will include the measurement of the Michaelis constant for aryl hydrocarbon hydroxylase in hepatic microsomes in susceptible and resistant strains. Constitutive and induced aryl hydrocarbon hydroxylase activities will be compared in carcinogen resistant and in susceptible segments of gut and colon in males, with the resistant female colons of the same BIO 15.16 strain serving as controls. Attempts will be made to develop transplantable tumor lines of various types from the carcinogen-induced neoplasms and to carry such tumors in cheek pouches of syngeneic inbred hamsters.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; POLYCYCLIC AROMATIC HYDROCARBONS; HAMSTERS; BENZOPYRENE; BENZANTHRACENE; TOXICITY; HYDROXYLASE; MALES; FEMALES; NEOPLASMS.

34173 Effects of Fast Neutrons On Cultured Mammalian Cells. Moss, A.J. (Univ. of Arkansas, 4301 W. Markham St., Little Rock, AR, 72201). **Project number:** ICA-13270-4. **Contract:** R01 CA 13270-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Health effects; Ecological/biological processes and effects.

The proposed work is designed to measure the production of neutron-induced DNA damage (single strand breaks) and the cells' ability to repair this damage under a variety of experimental conditions. The results with fast neutrons will be contrasted with those obtained with 250 kvp x-rays. Parallel experiments in which cell survival (viability) is measured will allow comparison of effects at the cellular and molecular levels. The results of this study will provide valuable information about the cellular and molecular (DNA) effects of fast neutrons on mammalian cells. The data will yield estimates of the RBE and OER for fast neutrons using both molecular and cellular endpoints. The influence of various conditions such as cell type, cell age in the mitotic cycle, hypoxia, and treatment with pharmacologic radiation modifiers, on the ability of neutron-irradiated cells to repair damage to their DNA will provide more insight into the mechanism of neutron-induced cell inactivation.
Keywords: FAST NEUTRONS; CELL CULTURES; ANIMAL CELLS; RADIOTHERAPY; NEUTRON BEAMS; NEOPLASMS; DNA; BIOLOGICAL REPAIR; CELL CYCLE; MITOSIS; X RADIATION; BIOLOGICAL RADIATION EFFECTS.

34174 Photochemical Reactions Related to Skin Cancer. Black, H.S. (Baylor Univ., Coll. of Medicine, 1200 Mounsund Ave., Houston, TX, 77025). **Project number:** ICA-13464-6. **Contract:** R01 CA 13464-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: solar(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Health effects.

The role of ultraviolet light (uvl) and sunlight in the etiology of certain types of skin cancer seems well established. The mechanism(s) associated with these processes are not understood. It has been suggested that the carcinogenic activity of light is dependent upon the photochemical conversion of sterols to carcinogenic substances. The formation of a sterol-derived photoproduct with carcinogenic properties has now been demonstrated in uv-irradiated human and hairless mouse skin. The role of this compound, cholesterol alpha-oxide, in the etiology of uv-carcinogenesis is under investigation. This proposal is designed to determine whether additional information will implicate the compound in the etiology of uvl-carcinogenesis and involves: (1) studies on the role of antioxidants in suppression of uvl-carcinogenesis; (2) studies on the metabolism and detoxification of the carcinogen; (3) the ability of the carcinogenic compound to transform normal cells, in cell culture, to cells with malignant potential; and (4) the ability of the carcinogen to induce tumors when applied, in vivo, to mice. Should the carcinogen induce transformation in cell culture and initiate tumors in vivo, then an overwhelming body of evidence implicating the compound in the etiology of skin cancer will have been amassed. Studies of the metabolism of this compound may indicate means by which its formation can be prevented.
Keywords: SKIN; NEOPLASMS; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; MAN; MICE; METABOLISM; DECONTAMINATION; PHOTOCHEMISTRY.

34175 Enzymes and Reactions for Repair of DNA in Human Cells. Brent, T.P. (St. Jude Children's Hospital, 332 N. Lauderdale Street, Box 318, Memphis, TN, 38101). **Project number:** ICA-14799-4. **Contract:** R01-CA-14799-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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.

34176 Interactions Between DNA and Skin-Sensitizing Coumarins. Song, P. (Texas Tech University, P.O. Box 4340, Lubbock, TX, 79409). **Project number:** ICA-13598-6. **Contract:** S01-CA-13598-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

DNA is modified by uv light (365 nm) and 8-methoxypsoralen, a skin sensitizing and carcinogenic agent. One methoxypsoralen is added to every 26 nucleotides of DNA. The template activity of the modified DNA is completely lost when tested with DNA polymerase. Four methoxypsoralen molecules add to each tRNA molecule. The latter lost more than 80% of its amino acid accepting capacity necessary in protein biosynthesis. The photobinding of methoxypsoralen to tRNA is very specific, and it causes secondary structural changes in the tRNA. Dimethyoxycoumarin was also found to be reactive toward DNA.
Keywords: PSORALEN; PHOTOCHEMICAL REACTIONS; DNA; ULTRAVIOLET RADIATION; CARCINOGENESIS; SKIN; TRANSCRIPTION; INHIBITION; TRANSFER RNA.

34177 Radiation Repair of Normal Mammalian Tissues. Gillette, E.L. (Colorado State University, Fort Collins, CO, 80523). **Project number:** ICA-13899-6. **Contract:** R01-CA-13899-06. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects..

Effects of radiation of fine vasculature may determine the response of dependent tissues late after a course of radiotherapy. Additional stress to irradiated tissues may cause injury to fine vasculature leading to degeneration and necrosis. It is difficult to study radiation dose response and repair capability of nonproliferating or slowly proliferating mammalian tissues. However, knowledge about radiation repair by normal tissues becomes critical when considering use of radiotherapy techniques which may alter this capability. The primary objective of this research is to determine single-dose and split-dose radiation survival curves for endothelial cells. Injury to the cornea of the eye will cause proliferation of capillary endothelial cells at the limbus. Irradiation prior to and following induction of capillary proliferation permits evaluation of response of both slowly and rapidly proliferating capillary endothelial cells. Morphometric analysis of capillary volume has permitted dose-response assays. The D/sup 0/ values obtained were 376 rads for 60-Co gamma radiation, 314 rads for neutrons, and 214 rads for negative pi mesons. The RBE's determined by comparing doses required to reduce capillary volume to 1% of control values were 1.96 for neutrons and 1.55 for pions.
Keywords: COBALT 60; GAMMA RADIATION; FAST NEUTRONS; PIONS MINUS; BIOLOGICAL RADIATION EFFECTS; BLOOD VESSELS; PATIENTS; RADIOTHERAPY; SIDE EFFECTS; RBE; BIOLOGICAL REPAIR; ACUTE IRRADIATION; FRACTIONATED IRRADIATION; EYES; CORNEA; CAPILLARIES; DOSE-RESPONSE RELATIONSHIPS.

34178 Actions of Chemical Carcinogen on Cultured Cells. Schwartz, A.G. (Temple University, 3223 North Broad St., Philadelphia, PA, 19122). **Project number:** ICA-14661-5. **Contract:** R01-CA-14661-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

We have found that estrogenic steroids and the adrenal steroid, dehydroepiandrosterone, protect cultured rodent cells against DMBA- and aflatoxin B1-induced cytotoxicity and malignant transformation, and also inhibit metabolism of (3H)DMBA to water-soluble products. Our observations are consistent with certain clinical findings in humans: (1) a much reduced incidence of cancer in a group of 737 hysterectomized women on long-term estrogen replacement therapy; and (2) evidence that women with subnormal plasma levels of dehydroepiandrosterone may be predisposed to develop breast cancer. Others have shown that estradiol-17 beta is a competitive inhibitor of benzo(a)pyrene hydroxylase, and our hypothesis is that this steroid may protect in our system by competitively inhibiting carcinogen activation. Dehydroepiandrostcrone has been shown to be a potent non-competitive inhibitor of glucose-6-phosphase dehydrogenase, the enzyme primarily responsible for generating extra-mitochondrial NADPH. We have also found that 7,8-benzoflavone, as well as several naturally occurring flavones protect cultured rat liver cells against DMBA and aflatoxin B1-induced cytotoxicity, possibly by competitively inhibiting carcinogen activation.
Keywords: CELL CULTURES; SOMATIC CELLS; LIVER; RATS; CARCINOGENS; BIOLOGICAL EFFECTS; DIMETHYLBENZANTHRACENE; AFLATOXIN; CARCINOGENESIS; ESTROGENS; METABOLISM; ANDROSTERONE; INHIBITION.

34179 Role of Repair Pathogenesis of Liver Cancer. VanLancker, J.L. (University of California, 405 Hilgard Avenue, Los Angeles, CA, 90024). **Project number:** ICA-14840-4. **Contract:** R01-CA-14840-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The working hypothesis at the basis of this application is that cancer is caused by one or more somatic mutations resulting from the combination of DNA damage and DNA repair. Because the liver is a primary target for carcinogens in animals, the correlation between DNA damage, DNA repair and liver cancer will be investigated. A combination of morphological radioautographic and biochemical techniques will be used to approach the problem.
Keywords: LIVER; NEOPLASMS; BIOLOGICAL REPAIR; PATHOLOGY; SOMATIC MUTATIONS; DNA; MORPHOLOGY; AUTORADIOGRAPHY; BIOCHEMISTRY.

34180 Bioassay--In Vitro Models of Human Ongenesis. Thilly, W.G. (Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139). **Project number:** ICA-15010-4. **Contract:** R01-CA-15010-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The objectives are: (1) to study the processes of chemically-induced mutagenesis and carcinogenesis using human cells in culture; (2) to characterize our new human cell gene-locus mutation assay by examining the behavior of cell lines derived from additional human donors, additional gene loci in our MIT-2 line, and classes of chemical mutagens and carcinogens not yet examined; (3) to use our human cell mutation assay in studies of mutation caused by multigenerational exposure to low concentrations of mutagens; and (4) to use split-dose protocols to discover to which classes of chemical mutagens and carcinogens human cells respond with DNA repair. In the area of drug metabolism, we propose to continue our studies of the post-mitochondrial supernatant as a drug metabolizing element, building on our present ability to prepare an active, sterile and nontoxic element compatible with human cell mutations assay with the aim of developing techniques for the routine use of stored preparations of human liver.
Keywords: CELL CULTURES; ANIMAL CELLS; MAN; CARCINOGENESIS; MUTAGENESIS; METABOLISM; DNA; BIOLOGICAL REPAIR; DRUGS; IN VITRO; BIOASSAY; MUTAGEN SCREENING.

34181 Mode of Action of Chemical Carcinogenesis. Chen, C. (Northwestern University, 303 East Chicago Avenue, Chicago, IL, 60611). **Project number:** ICA-15030-4. **Contract:** R01-CA-15030-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

We propose to study the mechanism of oxygenation of selected types of compounds by liver P-450 oxygenase. It is felt that our present knowledge on this subject deserves considerable supplementation and clarification. From previous findings in our laboratories we concluded that an oxygen molecule instead of an atom could enter into the substrate to yield, initially, hydroperoxide or peroxide. Hydroperoxides and peroxides can react spontaneously with the genetic appratus either by covalent binding or alteration which might initiate cancer. The oxygenation step appears to be radical in nature. The position specificity resides largely in the substrate molecules as opposed to the enzyme. Our aim is to show that the O2 mechanism is indeed operative with chemical carcinogenesis. We would like to extend our knowledge on the reactions of hydroperoxides and peroxides with genetic apparatus.
Keywords: CARCINOGENESIS; PEROXIDES; OXYGEN; CHEMICAL BONDS; BIOCHEMISTRY; ENZYMES; ANIMAL CELLS.

34182 DNA Repair and Carcinogenesis. Cox, R. (University of Tennessee, 800 Madison Avenue, Memphis, TN, 38163). **Project number:** ICA-15189-5. **Contract:** R01-CA-15189-05. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The proposed research is concerned with the interaction of chemical carcinogens with DNA and the consequence (damage and repair) of DNA in vivo will be monitored by an alkaline sucrose gradient method that uses a fluorometric determination of DNA in the gradient fractions. DNA damage and repair will be studied in euchromatin versus heterochromatin. The specificity of different carcinogens to induce damage and then the repair of damage will be compared in the chromatin fractions. The loss of specific alkylated products will be compared between euchromatin and heterochromatin.

Keywords: DNA; CARCINOGENESIS; BIOLOGICAL REPAIR; CARCINOGENS; SACCHAROSE; FLUORESCENCE SPECTROSCOPY; CHROMATIN.

34183 Chemotherapeutic Agents and Ultraviolet Carcinogenesis. Epstein, J.H. (University of California, 551 Parnassus Ave., San Francisco, CA, 94122). **Project number:** ICA-15605-4. **Contract:** R01 CA 15605-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34184 Oncogenic Mechanisms: SV40 and Host Genetic Analysis. Wilson, J.H. (Baylor Univ., College of Medicine, 1200 Moursund Avenue, Houston, TX, 77025). **Project number:** ICA-15743-4. **Contract:** R01-CA-15743-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

It is proposed to develop the potential of the SV40 genetic system so that it may become a useful probe into eucaryotic recombination mechanisms. As a basis for those studies, fine-structure genetic analysis of SV40 will be carried out using a novel two-step approach. This combined in vitro-in vivo approach to recombination should permit fine-structure genetic analysis of SV40 that rivals any procaryotic system; the approach lends itself to 3-factor as well as 2-factor crosses, has a resolving power of 0.01% recombination per nucleotide, should not require a mapping function to relate percent recombination to genetic distance, and is expected to yield intermutation distances directly in terms of nucleotides. In addition, it is proposed to use in vitro-contructed SV40 heteroduplexes to assess the efficiency, symmetry, and independence of cellular repair of mismatched bases. Finally, it is proposed to screen cells that are defective in repair of uv damage for any that are mismatch-repair and/or recombination deficient. Taken together, these studies constitute the beginning of a molecular characterization of recombination in cultured mammalian cells.
Keywords: CELL CULTURES; ANIMAL CELLS; MAMMALS; MUTAGENESIS; GENE RECOMBINATION; VIRUSES; GENETIC MAPPING; DNA; BIOLOGICAL REPAIR.

34185 Modification of Procarcinogen Enzymatic Activation. Franklin, M.R. (Utah Higher Education System, 1400 E. 2nd Street, Salt Lake City, UT, 84112). **Project number:** ICA-15760-4. **Contract:** R01 CA 15160-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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, lung, and small intestine). 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. 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.

34186 Human Macrophages and Other Cells in Carcinogenesis. Martin, R.R. (Baylor Univ., Coll. of Medicine , 1200 Moursund Ave., Houston, TX, 77025). **Project number:** ICA-15784-4. **Contract:** R01 CA 15784-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The detoxification and elimination of foreign material entering the lung is a primary role of the pulmonary macrophage. The fate of chemical carcinogens (including the polycyclic aromatic hydrocarbons) is not known. The enzyme system (aryl hydrocarbon hydroxylase, or AHH) which metabolizes these hydrocarbons is induced to high levels in pulmonary macrophages of cigarette smokers, and can be induced in vitro in cultured, mitogen-stimulated lymphocytes when culture medium contains an aromatic hydrocarbon. We propose to continue to study the induction of AHH in these cells and in tissue from surgically-resected lung from lung cancer patients and from patients with other medical problems requiring diagnostic bronchoscopy or pulmonary surgery. Responsiveness of lymphocytes from lung cancer and noncancer patients to mitogens will also be studied to determine if any abnormalities of AHH induction can be attributed to problems of lymphocyte proliferation. Both pulmonary macrophages and cultured lymphocytes from lung cancer and noncancer patients will be studied to determine profiles of metabolites of benzo(alpha)pyrene generated during detoxification. By studying the ability of these cells to process carcinogenic hydrocarbons, constitutional differences may be delineated which relate to the pathogenesis of lung cancer in some patients. In addition, the detection of a dissociation between pulmonary macrophage and lymphocyte AHH induction may aid in documenting cancer in those cases where bronchoscopy fails to establish the diagnosis.
Keywords: CARCINOGENESIS; LUNGS; MAN; MICROORGANISMS; MACROPHAGES; POLYCYCLIC AROMATIC HYDROCARBONS; METABOLISM; DIAGNOSIS; HYDROXYLASE; METABOLITES; BENZOPYRENE; NEOPLASMS; ENZYME ACTIVITY; BIOLOGICAL FUNCTIONS; LYMPHOCYTES; CELL CULTURES; PATHOGENESIS.

34187 Residual Postnatal Injury from Prenatal X Irradiation. Christensen, G.M. (University of Washington, 500 17th Avenue, Seattle, WA, 98122). **Project number:** ICA-15844-3. **Contract:** R01-CA-15844-3. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This project is designed to study the relative lack of repair of radiation injury from fetal exposure which persists in the adult mouse. Pregnant female mice will be given a priming exposure of x irradiation at various times during gestation. The radiosensitivity of the following tissues and organs will then be measured at various ages throughout postnatal life: hematopoietic system, gastrointestinal tract, spleen, thymus, and small intestine. A comparison of radiation sensitivity of these systems between mice irradiated in utero and unexposed controls will provide measurement of irreparable injury from fetal irradiation.
Keywords: X RADIATION; WHOLE-BODY IRRADIATION; PRENATAL IRRADIATION; MICE; PREGNANCY; FETUSES; BIOLOGICAL RADIATION EFFECTS; HEMATOPOIETIC SYSTEM; GASTROINTESTINAL TRACT; SPLEEN; THYMUS; SMALL INTESTINE; RADIOSENSITIVITY; BIOLOGICAL REPAIR; RADIOSENSITIVITY EFFECTS.

34188 Mutagenesis and Carcinogenesis. Chambers, R.W. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** ICA-16319-3. **Contract:** R01-CA-16319-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

No methods are available for investigating directly cause and effect relationships between an initially observed chemical lesion in some macromolecules and development of a tumor. The immediate goal of this research is to develop a direct method for introducing a potentially carcinogenic, chemical change at a single, known, preselected position in a DNA molecule. By studying the biological effects of this change, it should be possible to establish whether or

not this particular change can lead to malignancy. A series of synthetic DNA's carrying site-specific modifications corresponding to changes known to be produced by different chemical carcinogens will be synthesized and tested for mutagenicity and carcinogenicity by transformation of suitable cell lines. This research has three long-range goals: (1) to determine which of the site-specific modifications that known carcinogens produce in DNA leads to mutations; (2) to determine the type of mutation produced by different premutational lesions in DNA; and (3) to determine whether or not any of these premutational lesions cause transformation of normal cells into malignant cells.
Keywords: CARCINOGENS; BIOLOGICAL EFFECTS; DNA; SYNTHESIS; CARCINOGENESIS; BIOLOGICAL INDICATORS; MUTAGENESIS.

34189 Effects of Radiation on Human Cells Cultured In Vitro. Kantor, G.J. (Wright State University, Dayton, OH, 45431). **Project number:** ICA-16477-3. **Contract:** R01-CA-16477-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The proposed research is designed to study the effects of low doses of ionizing and ultraviolet radiation on specific in vitro culture parameters of human diploid fibroblasts. Cell strains established from human embryos, humans of various ages, and humans with either progeria-like syndrome or xeroderma pigmentosum will be used. The specific culture parameters to be studied are growth rates, DNA and protein synthesis, in vitro age and transformation. Low doses are defined with respect to plating efficiencies and growth rates. The effect of repeated exposure to low doses over a period of time on irradiated populations will be quantitated with regard to the above mentioned parameters. Similar experiments will be done using cultures maintained in a non-proliferating state. Cell strains with normal and defective DNA excision repair mechanisms will be used to determine the significance of DNA repair on these parameters.
Keywords: HUMAN POPULATIONS; CELL CULTURES; IN VITRO; IONIZING RADIATIONS; ULTRAVIOLET RADIATION; EMBRYOS; DNA; BIOSYNTHESIS; BIOLOGICAL REPAIR; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL EFFECTS; BIOLOGICAL RADIATION EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS.

34190 DNA Repair in Cell Killing, Aging and Carcinogenesis. Williams, J.R. (Harvard University, 55 Shattuck Street, Boston, MA, 02115). **Project number:** ICA-16649-3. **Contract:** R01-CA-16649-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

The relationship between several observations of DNA repair activities in cells treated with radiations and selected chemical carcinogens, and the biological fate of treated cells will continue to be examined. The DNA repair activities which will be studied are: unscheduled DNA synthesis; gross rejoining kinetics of gamma-ray-induced DNA strain breaks; rapid kinetics of a cyclical DNA incisional process in gamma-irradiated cells; G2-repair of uvl-irradiated cells; and post-rejoining DNA disassembly in gamma-irradiated cells. The role these processes play in cell death, cell inactivation, transformation, and accelerated aging will be studied in several cell systems appropriate to each of these cellular endpoints.
Keywords: GAMMA RADIATION; ULTRAVIOLET RADIATION; IRRADIATION; CELL CULTURES; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; DNA; STRAND BREAKS; BIOLOGICAL REPAIR; DNA REPLICATION; BIOLOGICAL PATHWAYS; CELL KILLING; LIFE SPAN; CARCINOGENS; BIOLOGICAL EFFECTS.

34191 *Monoxygenase: Properties and Carcinogen Activation.* Yang, C.S. (College of Medicine and Dentistry of New Jersey, 100 Bergen Street, Newark, NJ, 07103). **Project number:** ICA-16788-41. **Contract:** R01-CA-16788-04S1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The cytochrome P-450-containing monoxygenase enzyme system is known to play key roles in the metabolism of drugs and the activation of carcinogens. The incorporation of purified cytochrome P-450 and reductase into the microsomal or other membranes will be studied to elucidate: (1) the mechanism of the incorporation; (2) the nature of the binding; (3) the organization and interaction of monoxygenase enzymes; and (4) the rate-limiting step of drug oxidations. The enzyme topography of the microsomes will be studied with cross-linking techniques. The properties of the nuclear monoxygenase system will be characterized and the metabolism of benzo(a)pyrene by this enzyme system will be studied, and the binding of the metabolically activated benzo(a)pyrene to nuclear DNA, RNA, histones, and nonhistone proteins will also be studied using isolated rat liver nuclei. The effect of microsomes on the binding will be studied systematically to assess the roles of microsomes and nuclei in carcinogen activation. Similar approaches will also be used to study the sites of activation of aflatoxin B1.
Keywords: RATS; LIVER; MICROSOMES; CELL MEMBRANES; OXIDOREDUCTASES; ENZYME ACTIVITY; CYTOCHROMES; CARCINOGENS; DRUGS; METABOLISM; BIOLOGICAL PATHWAYS; DNA; RNA; HISTONES; PROTEINS; BENZOPYRENE; AFLATOXIN.

34192 Mechanism of Chemical Carcinogenesis In Vitro. Moses, H.L. (University of Minnesota, Mayo Graduate School of Medicine, 200 1st St., S.W., Rochester, MN, 55901). **Project number:** ICA-16816-4. **Contract:** R01 CA 16816-04A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The mechanism of production of malignant transformation by carcinogenic polycyclic hydrocarbon in a cell culture model system will be explored in this project through the application of a series of specific, but highly interdependent, investigations. These studies will involve utilization of cloned cell lines derived from mouse embryos for induction of stable phenotypic changes by chemical carcinogens. Non-transformed and transformed populations of cells will be characterized with respect to chromatin template capacity for DNA-dependent RNA synthesis, and level of endogenous RNA polymerase activity. The studies on these cell culture model systems will examine macromolecular binding of carcinogenic and non-carcinogenic polycyclic hydrocarbons in the nucleus where binding to the various components of chromatin will be examined. An attempt will be made to identify the actual compounds bound to chromatin and to determine the transforming capabilities of these compounds extracted from chromatin in the presence and absence of aryl hydrocarbon hydroxylase inhibitors. The acute effects of these polycyclic hydrocarbons on nuclear endogenous RNA polymerase activities, chromatin template capacity, and nuclear acidic protein synthesis and degradation will be studied. The studies will also include an examination of the effects of carcinogen metabolism on intracellular macromolecular binding and induced alterations in transcriptional events.
Keywords: CARCINOGENS; IN VITRO; CARCINOGENESIS; POLYCYCLIC AROMATIC HYDROCARBONS; DNA; RNA; CELL CULTURES; HYDROXYLASE; ENZYME INHIBITORS; CLONE CELLS; BIOCHEMISTRY.

34193 13-C-Enriched Chemical Carcinogens. Daub, G.H. (University of New Mexico, University Hill NE, Albuquerque, NM, 87106). **Project number:** ICA-16871-2. **Contract:** R01-CA-16871-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objectives include: synthesis of 13-C-enriched benzo(a)pyrene derivatives; selectivity studies of the reactions of carcinogenic electrophiles with biomolecules; application of C-13 nmr to studies of the products of reactions of carcinogens with biomolecules; evaluation of the sensitivity of C-13 nmr for metabolism studies; synthesis of substrates for the generation of benzo(a)pyrenylmethyl cations in the bay region and certain non-bay regions; determination of kinetics of such cations with biomolecules; and studies of the photooxidation of benzo(a)pyrene.
Keywords: CARBON 13; CARCINOGENS; LABELLING; LABELLED COMPOUNDS; CHEMICAL PREPARATION; PROTEINS; NUCLEIC ACIDS; METABOLITES; ADDUCTS; BENZOPYRENE; PHOTOCHEMICAL REACTIONS.

34194 Follow-up Study of Irradiated Tinea capitis Cases. Shore, R.E. (New York University, 550 1st Avenue, New York, NY, 10016). **Project number:** ICA-17188-3. **Contract:** R01-CA-17188-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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.

34195 Nonenzymatic Reactions of Highly Reactive Epoxides. Whalen, D.L. (Univ. of Maryland, 1420 N. Charles St., Baltimore, MD, 21201). **Project number:** ICA-17278-3. **Contract:** R01 CA 17278-

03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Ecological/biological processes and effects.

The mechanisms by which highly reactive epoxides hydrolyze in aqueous media are often complex, and can vary as a function of the pH of the solution. The pH-rate profile for the hydrolysis of a given epoxide provides essential information for determining the mechanisms by which the hydrolyses occur. Many of the kinetic studies, however, have been carried out by determining the rates of epoxide hydrolysis in aqueous solutions held at constant ionic strength by addition of electrolytes such as potassium chloride. We have recently shown that potassium chloride induces specific effects in the hydrolysis of indene oxide and a K-region arene oxide, phenanthrene 9,10-oxide. The objective of this report is to study the hydrolysis reactions of several highly reactive epoxides (1,3-cyclopentadiene oxide and 1,3-cyclohexadiene oxide), and also initiate studies on the hydrolysis of several epoxydiol metabolites of the carcinogen benzo(a)pyrene. pH-rate profiles for the hydrolyses of these compounds will be generated in solutions held at constant ionic strength by potassum chloride and by other less-nucleophilic salts in order to test for the presence of specific salt effects. Such effects could lead to erroneous assignments of hydrolysis mechanisms if not taken into consideration.
Keywords: EPOXIDES; HYDROLYSIS; PH VALUE; HYDROLASES; CARCINOGENS; POTASSIUM CHLORIDES; AQUEOUS SOLUTIONS.

34196 Intercellular Contact and Cellular Radiobiology. Durand, R.E. (Johns Hopkins University, 725 North Wolfe Street, Baltimore, MD, 21205). **Project number:** ICA-17522-3. **Contract:** R01-CA-12389-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Chinese hamster V79-171 cells grown in vitro as multicell spheroids show a two-fold increase in the Dq of the radiation survival curve relative to cells grown as monolayers, whereas, a MNNG-induced mutant line, designated V79-M4D, does not show this effect. We intend to utilize both cell lines and both culture conditions to further elucidate the molecular processes contributing to radiation-induced mammalian cell death. Comparison of radiation-induced chromosome aberration rates for cells grown as monolayers vs spheroids should indicate whether such aberrations are directly involved in cell death. If different numbers of aberrations are observed, fidelity of DNA repair will be implicated as a differential process in the less-radioresponsive spheroids. Localized intracellular damage can be produced by target-specific agents or chemical crosslinking agents to similarly provide specific and nonspecific damage. A similar proliferative potential for monolayer or spheroid cells treated with a given target-specific agent will imply that the particular target is unaffected by intercellular contact, whereas differential responses should pinpoint the primary target(s). These unique culture systems seem to provide a previously-unavailable avenue for the study of contact-mediated radioresistance, as well as basic mechanisms of radiation-inactivation of mammalian cells.
Keywords: IONIZING RADIATIONS; IRRADIATION; CELL CULTURES; ANIMAL CELLS; HAMSTERS; CULTIVATION TECHNIQUES; BIOLOGICAL RADIATION EFFECTS; CELL KILLING; RADIOSENSITIVITY EFFECTS; RADIOINDUCTION; CHROMOSOMAL ABERRATIONS; SURVIVAL CURVES; DNA; BIOLOGICAL REPAIR; RADIOSENSITIVITY.

34197 Lung Cancer Microsomal Oxygenases and Their Genetics. Gurtoo, H.L. (New York State Dept. of Health, 84 Holland Ave., Albany, NY, 12208). **Project number:** ICA-17538-3. **Contract:** R01 CA 17538-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

We have studied benzo(a)pyrene (BP) metabolism in human lymphocytes and monocytes; lymphocyte aryl hydrocarbon hydroxylase (AHH) activity and inducibility in normal humans, twins, lung cancer patients, and their progeny; BP metabolism in human lymphocytes in long term culture; and the inducibility of the metabolic activation of BP in inbred strains of mice. Using these culture conditions, human population studies indicate that lymphocyte AHH inducibility is determined by a few genes and is heritable in human populations. Development of lung cancer, which may be related to metabolism of polycyclic aromatic hydrocarbons (PAHs), is unrelated to the heritability of lymphocyte AHH-inducibility. We also found that several PAHs and other compounds induce lymphocyte AHH activity. We have also developed a sensitive assay to study metabolite profiles of BP produced by as little as 10 x 10/sup 6/ cells and resolved by HPLC. Comparison between hepatic microsome-mediated AHH activity and DNA alkylation by BP metabolites in various inbred strains of mice shows very strong association between the two activities.
Keywords: OXYGEN; LUNGS; NEOPLASMS; BENZOPYRENE; HYDROXYLASE; POLYCYCLIC AROMATIC HYDROCARBONS; LYMPHOCYTES; MICE; METABOLITES; METABOLISM; ENZYME ACTIVITY; MAN; GENETICS.

34198 Photoaugmentation and Carcinogenesis. Willis, I. (Emory University, School of Medicine, 1364 Clifon Road NE, Atlanta, GA, 30322). **Project number:** ICA-17555-4. **Contract:** R01-CA-17555-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Xenon solar-simulating uvB plus uvA radiation in escalating, clinically non-severe doses will be utilized to rapidly induce squamous cell cancers in order to determine: (1) precise histologic and electronic microscopic changes that occur during induction, (2) alterations in chromosomes and cell kinetics during induction, (3) effects of known and potential chemotherapeutic drugs and agents during and after the induction of cancers, and (4) effects of immunotherapy in prevention and treatment. Knowledge from these studies will be utilized to gain better insight into the pathogenesis and treatment of cancer, develop a useful in vivo system for evaluating cancer chemotherapeutic and immunotherapeutic drugs, and determine and develop more effective sunscreening drugs and agents.
Keywords: CARCINOGENESIS; ULTRAVIOLET RADIATION; HISTOLOGY; CHROMOSOMES; MICROSCOPY; CHEMOTHERAPY; DRUGS; NEOPLASMS; THERAPY.

34199 DNA Repair Mechanisms: Regulation and Cancer Relevance. Yielding, K.L. (University of Alabama, School of Medicine, 1919 7th Avenue South, Birmingham, AL, 35233). **Project number:** ICA-17629-3. **Contract:** R01-CA-17629-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The overall objective of this project is to determine the importance of DNA repair to both the development of cancer and cancer therapy. Specifically, we are studying a variety of DNA repair inhibitors to localize their effects with respect to repair pathway inhibited and the specific steps inhibited so that these agents may be used as tools to study the biological significance of DNA repair. Goals for the current year include: the use of photoaffinity labeling as a new technique for studying DNA repair; localization of the specific repair steps with respect to pathway and enzyme involved; and the clear identification of the loci of inhibitor effects.
Keywords: DNA; BIOLOGICAL REPAIR; NEOPLASMS; THERAPY; ENZYMES; ENZYME INHIBITORS.

34200 Carcinogen-Induced Rat Mammary Hyperplasias. Rivera, E.M. (Michigan State University, 243 Natural Science Building, East Lansing, MI, 48824). **Project number:** ICA-17862-3-1. **Contract:** R01-CA-17862-0351. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The overall objective is to characterize the DMBA-induced hyperplastic lesions of the rat mammary gland and to examine their neoplastic potential. One major approach is to compare several transplantable outgrowth lines of hyperplastic lesions with regard to stability, morphology, growth patterns, tumor producing potential, and hormone-dependence and responsiveness. The second major approach involves the use of the mammary hyperplasias by DMBA. This latter approach should facilitate analysis of the interactions of carcinogen, hormones, and isolated mammary target tissue and may elucidate mechanisms and control of cell transformation.
Keywords: RATS; MAMMARY GLANDS; CARCINOGENESIS; BIOLOGICAL MODELS; NEOPLASMS; BIOCHEMICAL REACTION KINETICS; EPIDEMIOLOGY; XYLENES; METABOLISM; TOXICITY.

34201 Mechanism of Carcinogen--Cocarcinogen Interaction. Hart, R.W. (Ohio State University, School of Medicine, 370 W. 9th Ave., 102 Adminstration Bldg., Columbus, OH). **Project number:** ICA 17917-3. **Contract:** R01 CA 17917-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The ultimate goal of these studies is to contribute to the understanding of how chemical carcinogens interact with co-carcinogens to yield enhanced cell transformation in vivo and how the effect of these interactions may be reversed or prevented. The specific aim of this project is to evaluate at the molecular and cellular levels the effect of chemical co-carcinogens on the repair of DNA damage induced by various chemical carcinogens. These studies will permit an evaluation of the ability of co-carcinogens to inhibit the repair of the genetic damage induced by a selected number of chemical and physical carcinogenic agents. Concurrently, it will be determined whether modification of DNA repair results in a corresponding change in the frequency of transformation induced by biological, chemical, or physical oncogenic agents. A determination of the amount of unrepaired DNA damage of specific physical chemical forms required to produce an oncogenic event will be

determined. These comparisons are vital to the working hypothesis that the underlying events leading to malignant transformation involve unrepaired alterations in cellular DNA.
Keywords: CARCINOGENS; BIOLOGICAL EFFECTS; ANIMAL CELLS; DNA; STRAND BREAKS; BIOLOGICAL REPAIR; BIOCHEMICAL REACTION KINETICS; INHIBITION; SYNERGISM; DRUGS; CARCINOGENESIS.

34202 Radiation Effects: DNA Template Inactivation and Repair. Gorelic, L.S. (Wayne State University, School of Liberal Arts, 4841 Case Avenue, Detroit, MI, 48202). **Contract:** R01-CA-18046-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The principal objective of the proposed program is to obtain an understanding, at a molecular level, of the effects of ultraviolet radiation on the ability of living organisms to synthesize proteins and nucleic acid molecules. The development of such an understanding will be achieved by determining the effects of ultraviolet radiation on the chemical compositions and physiological properties of nucleic acid and protein components of the cellular machinery for nucleic acid and protein synthesis; and elucidation of possible cellular mechanisms for reversal of these effects.
Keywords: DNA; BIOLOGICAL REPAIR; BIOLOGICAL EFFECTS; BIOCHEMICAL REACTION KINETICS; ULTRAVIOLET RADIATION; BIOLOGICAL REPAIR.

34203 Radiosensitization by Specific DNA Repair Control. Johnson, R.C. (Medical University of South Carolina, School of Dentistry, Charleston, SC, 29401). **Project number:** ICA-18205-2. **Contract:** R01-CA-18205-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The primary objectives of this study are: (1) to analyze the degree of potentiation of uv and x-ray induced lethality in a genetically well-defined strain of Escherichia coli; (2) to measure the effects on forward mutation; and (3) to correlate different methods as to degree of potentiation with the type of physical-chemical alterations of the repair DNA intermediate. Effective potentiators of lethality but low mutation inductors originating from low intensity radiation would be determined. Classification as to the mode of repair alteration and correlation with successful potentiation of lethality will provide a criteria for further productive investigations. Control and understanding of low intensity radiation-induced damage potentiation through specific alteration of repair should provide explicit procedure for low intensity radiation therapy of cancer tissue.
Keywords: DNA; BIOLOGICAL REPAIR; RADIOSENSITIVITY; BACTERIA; ANIMAL CELLS; MAMMALS; ULTRAVIOLET RADIATION; X RADIATION; BIOLOGICAL EFFECTS; BIOLOGICAL RADIATION EFFECTS; ESCHERICHIA COLI; MUTAGENESIS; BIOLOGICAL MODELS.

34204 Skin Photobiology--Photochemistry of Urocanic Acid. Morrison, H.A. (Purdue University, School of Science, Executive Bldg., Lafayette, IN, 47907). **Project number:** ICA 18267-1. **Contract:** RO1 CA 18267-01A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

A complete study of the photochemistry of urocanic acid is proposed. This compound is a natural sunscreen important to the protection of the epidermis from erythemal irradiation. Photolyses will be conducted primarily in aqueous media and studied as a function of concentration, pH, temperature, and wavelength of incident light. All products will be isolated, identified, and tested for carcinogenic activity. A complete spectroscopic and mechanistic study is also envisaged.
Keywords: UROCANIC ACID; PHOTOCHEMISTRY; AQUEOUS SOLUTIONS; PHOTOLYSIS; RADIOSENSITIVITY EFFECTS; PH VALUE; TEMPERATURE DEPENDENCE; FREQUENCY DEPENDENCE; EPIDERMIS; REACTION INTERMEDIATES; CARCINOGENESIS; RADIOSENSITIVITY; MAN; ULTRAVIOLET RADIATION.

34205 Enzymology of Radiation-Induced Intestinal Carcinoma. Osborne, J.W. (Univ. of Iowa, School of Medicine, Jessup Hall, Iowa City, IA, 52240). **Project number:** ICA 18327-2. **Contract:** R01 CA 18327-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34206 Host-Mediated Assay of Carcinogenic and Mutagenic Agents. Ninanadangapura, T. (State University of New York, Main Street and Young Road, Buffalo, NY, 14221). **Project number:** CA-18478-2. **Contract:** R01-CA-18478-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This research proposal is aimed at developing a useful host-mediated assay system for screening potential mutagenic and carcinogenic agents, using human hemopoietic cell lines as a test system. The methods consist of growing human cells in diffusion chambers, implanting them in the peritoneal cavities of mice injected with the test chemicals, and allowing these cells to proliferate for a few days. These cells would then be taken out and cultured in RPMI 1640 medium, and analyzed for chromosome damage as well as their transformability using SV40 virus. An in vitro study to find the dose-effect curves of these cells, using the pesticides, would also be initiated. The criteria for transformability would be: (1) chromosome constitution study; (2) cell cycle time study; and (3) colony formation study, using agar plate technique. Correlations of mutagenicity and transformability would hopefully be obtained, which would reinforce the hypothesis that the primary carcinogenic action involves a mutagenic event, brought about by environmental mutagens, such as pesticides.
Keywords: CARCINOGENS; MUTAGENS; PESTICIDES; SCREENING; MUTAGEN SCREENING; BIOLOGICAL EFFECTS; ANIMAL CELLS; MAN; CHROMOSOMAL ABERRATIONS; DOSE-RESPONSE RELATIONSHIPS; ONCOGENIC VIRUSES; MUTAGENESIS; CARCINOGENESIS; CORRELATIONS; BIOLOGICAL INDICATORS.

34207 Metabolism of Carcinogens in Senescent Tissues. Baird, M.B. (Masonic Foundation for Medical Research, 71 W. 23rd St., New York, NY, 10010). **Project number:** ICA-18486-2. **Contract:** R01 CA 18486-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The incidence of cancer markedly increases with advancing age. We hypothesize that this increase is in part, a result of age-related alterations in the metabolism of omnipresent chemical carcinogens. Previous work from our laboratory has shown that the rate of metabolism of the carcinogen 3,4-benzo(alpha)pyrene (BP), as determined by fluorimetric methods, declines with advancing age. However, the metabolites of both BP and 2-aminofluorene, generated by hepatic tissues obtained from senescent rats, are of greater mutageneity in a Salmonella test system than are those metabolites generated by tissue samples obtained from younger animals. We wish to expand these studies to determine whether these potentially very important findings are of general applicability. Therefore, we propose to study the effects of senescence upon the metabolism of BP in other rat tissues, such as skin and lung, which are more relevant target organs for polycyclic aromatic hydrocarbons (PAH) carcinogenesis. We will also determine the kinetics of metabolism of BP in various tissues obtained from C57BL/6J male mice of different ages. Finally we shall examine the effects of aging upon aryl hydrocarbon hydroxylase (AHH) activity in cultured human lymphocytes.
Keywords: CARCINOGENS; METABOLISM; LIVER; SKIN; LUNGS; RATS; MICE; AGE DEPENDENCE; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; HYDROXYLASE; ENZYME ACTIVITY.

34208 Separation and Determination of Carcinogens. Pietrzyk, D.J. (University of Iowa, School of Liberal Arts, Jessup Hall, Iowa City, IA, 52240). **Project number:** ICA-18555-3. **Contract:** R01-CA-18555-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

A series of porous, high surface area polystyrene-divinylbenzene copolymers are to be examined as adsorbents for stripping and concentrating carcinogens and potential carcinogens in biological and environmental samples. Subsequently, the compounds will be identified and/or determined. Both liquid and gas samples will be studied. Specific type compounds to be looked for will be aromatic hydrocarbons, their chlorinated derivatives, chlorinated phenoxyacetic acids, plasticizers, and compounds that would be present as a

result of the presence of tumors. High pressure chromatographic, gas chromatographic, and thin layer chromatographic separation techniques will be identified.
Keywords: CARCINOGENS; SAMPLING; GASES; LIQUIDS; ADSORPTION; COPOLYMERS; GAS CHROMATOGRAPHY; HYDROCARBONS; AROMATICS; ORGANIC ACIDS; ORGANIC CHLORINE COMPOUNDS; POLYSTYRENE; DIVINYLBENZENE; NEOPLASMS.

34209 Repair of X-Irradiated DNA in Normal and Cancer Cells. Goidthwait, D.A. (Case Western Reserve University, School of Medicine, 2109 Adelbert Road, Cleveland, OH, 44106). **Project number:** ICA-18747-2. **Contract:** R01-CA-18747-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Endonuclease II of E. coli will be used to examine the nature of some form of radiation damage in DNA. A definition of the chemical nature of the damaged base recognized by the enzyme is the long term goal.
Keywords: DNA; GENETIC RADIATION EFFECTS; BIOLOGICAL REPAIR; TUMOR CELLS; NEOPLASMS; ANIMAL CELLS; ESCHERICHIA COLI.

34210 Benzo(rst)pentaphene and Fluoro Derivatives. Boger, E. (Boston College, School of Arts and Sciences, 140 Commonwealth, Chestnut Hill, MA, 02167). **Project number:** ICA-18959-3. **Contract:** R01-CA-18959-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Our current studies on the fluoro derivatives of benzo(rst)pentaphene have contributed to the determination of the active sites of the parent hydrocarbon, where metabolic activation leading to carcinogenesis takes place. The decrease in carcinogenicity by fluorine-substitution at position 3 and its disappearance in the 2,10-difluoro derivative provide evidence for the participation of the bay-region benzo-rings in this metabolic activation. The relative abilities of the compounds to bind with chromatin support this hypothesis. Preliminary nmr studies of the kinetics of deuteriodeprotonation of 2-fluorobenzo(rst)pentaphene suggest that a reactive free peri position adjacent to the benzo-ring is essential to the process of carcinogenesis. We propose to continue our investigations on the binding of these compounds to chromatin, to study their intercalation with DNA, to determine the rates of D-exchange in the parent carcinogen and its 3-fluoro and 2,10-difluoro derivatives, and to test the carcinogenic activity of the compounds by skin application and their mutagenic activity by the Wood-Levin procedure. We also plan to synthesize 5- and 5,8-fluorine-substituted benzo(rst)pentaphene (peri positions) and 7-fluorobenzo(a)pyrene as well as its homologous 4,9-difluorobenzo(rst)pentaphene. We propose to extend our investigtions and methodology to the various fluoro derivative of benzo(a)pyrene and of other important carcinogenic polycyclics as a program for the coming years.
Keywords: CARCINOGENESIS; CONDENSED AROMATICS; FLUORINATED AROMATIC HYDROCARBONS; CHROMATIN; BIOCHEMICAL REACTION KINETICS; MUTAGENESIS; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENS; MUTAGENS; SYNTHESIS; METABOLITES.

34211 Reproductive Age and Mammary Carcinogenesis. Moon, R.C. (IIT Research Institute, 10 West 35th Street, Chicago, IL, 60616). **Project number:** ICA-18968-2. **Contract:** R01-CA-18968-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Studies of the effect of reproductive age on the incidence of mammary cancer induced in the rat by 7,12-dimethylbenz(a)anthracene (DMBA) will be initiated. Furthermore, a method developed in our laboratory for the enzymatic separation of mammary parenchymal tissue from the adipose tissue of the mammary gland fat pad of the rat will be used in these studies to provide mammary gland parenchymal and tumor cells. Both the in vivo and in vitro uptake and retention of DMBA by the mammary parenchymal cells of animals will be determined as an indication of an alteration in carcinogen susceptibility of parenchymal cells of animals undergoing their first pregnancy at different ages. Additional in vivo and in vitro studies to determine the hormonal responsiveness of mammary parenchymal and tumor cells will be undertaken. Moreover, studies to determine the effect of pregnancy and estrogens on mammary cancer in animals exposed to DMBA transplacentally are also proposed.
Keywords: MAMMARY GLANDS; CARCINOGENESIS; NEOPLASMS; AGE DEPENDENCE; ENZYMES; DIMETHYLBENZANTHRACENE; RATS.

34212 Reaction of Carcinogens and Cell Extracts with RF-DNA. Taylor, W.D. (Pennsylvania State University, School of Science, 211 Whitmore Lab., University Park, PA, 16802). **Project number:** ICA-18970-2. **Contract:** R01-CA-18970-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

In the proposed experiments, we will determine the potential of two series of chemical carcinogens for producing nucleotide damage in DNA in vitro. We will utilize phiX174 Replicative Form (RF) I DNA. The carcinogens to be used are: (1) acetylaminofluorene (AAF) and its derivatives, N-hydroxyacetylaminofluorene (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. Following reaction of the chemical with the RFI DNA, the unbound carcinogen will be removed and the RF DNA directly assayed for nucleotide damage and strand breaks or further treated by alkali, near uv light, or exposure to extracts of human embryonic lung cells, followed by sucrose gradient sedimentation. The gradients will be fractionated, and the biological activity of the fractions assayed by the ability of the RF DNA to infect host bacterial spheroplasts. Spheroplasts from a series of well defined radiation repair mutants will be used to determine the ability of specific repair systems to act on carcinogen-treated DNA, and to detect the presence of unrepairable nucleotide damage which may be responsible for the carcinogenesis of normal cells.
Keywords: DNA; BIOLOGICAL REPAIR; CARCINOGENESIS; BIOLOGICAL MODELS; CARCINOGENS; IN VITRO; CELL CULTURES; HYDROCARBONS; MAN; LUNGS; EMBRYOS; BIOLOGICAL EFFECTS.

34213 Microbial Degredation of Carcinogenic Hydrocarbons. Gibson, D.T. (University of Texas, School of Natural Sciences, 200 West 21st Street, Austin, TX, 78712). **Project number:** ICA-19078-2. **Contract:** R01-CA-19078-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The purpose of this research project is to elucidate the mechanisms used by microorganisms to oxidize carcinogenic aromatic hydrocarbons. Particular emphasis is placed on the degradation of benzo(a)pyrene and methylcholanthrene by fungi. The latter organisms apparently use a cytochrome P-450 enzyme system and produce metabolites that are similar to those formed by mammalian liver. Such studies will provide information relative to the possible mechanisms of chemical carcinogenesis and the fate of polycyclic hydrocarbons in the environment. Specifically, the metabolites produced from benzo(a)pyrene and methylcholanthrene by intact cells and microsomal preparations of Cunninghamella elegans will be separated by high-pressure liquid chromatography and identified by conventional techniques. A bacterium Beijerinckia B8/36 has also been shown to oxidize polycyclic aromatic hydrocarbons. The metabolites produced from methylcholanthrene by this organism will be isolated and identified. Studies will also be conducted to characterize the properties of the fungal cytochrome P-450 enzyme system.
Keywords: HYDROCARBONS; BIODEGRADATION; MICROORGANISMS; OXIDATION; BENZOPYRENE; FUNGI; METABOLITES; ENZYMES; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENESIS; CHROMATOGRAPHY; CYTOCHROMES.

34214 Cell Cycle Related DNA Repair Mechanisms. Humphrey, R.M. (University of Texas, Cancer Center, P.O. Box 20036, Houston, TX, 77025). **Project number:** ICA-19281-2. **Contract:** R01-CA-19281-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The object of this research is to determine the extent to which mammalian cells repair or tolerate damage to their DNA following treatment with mutagenic and/or carcinogenic agents at different phases of the cell cycle. Two mechanisms for handling DNA damage are known. Excision repair involves the removal of the damaged bases and resynthesis of the DNA strand (repair replication). Recombination repair occurs during S phase and results in a bypass of the damaged region. The extent of these two processes following different mutagenic treatments is unknown. Using agents that produce different known types of lesions in DNA we intend to follow the loss of such lesions in the absence (during G1) or presence (during S) of DNA replication. This process is assumed to be associated with repair replication and this will be assayed at different phases of the cell cycle. In addition, by comparing replicated and non-replicated DNA it will be possible to determine if this is a prerequisite for DNA replication. In this case we intend to test two possibilities: DNA replication may be interrupted; or excision repair may be part of the replication process and enhanced at the DNA growing fork.
Keywords: CELL CYCLE; DNA; BIOLOGICAL REPAIR; BIOCHEMICAL REACTION KINETICS; MUTAGENS; CARCINOGENS; DNA REPLICATION; SYNCHRONOUS CULTURES; ANTIMETABOLITES; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS.

34215 Nature and Repair of a New Form of DNA Damage. Feldborg, R.S. (Tufts University, School of Liberal Arts, Medford, MA, 02155). **Project number:** ICA 19419-2. **Contract:** R01 CA 19419-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The objective of the proposed project is to understand the role of non-pyrimidine dimer damage in the biological effects of ultraviolet irradiation. This study will make use of a DNA-binding protein isolated from human placenta and specific for non-dimer uv- or x-ray-induced damage. This protein will be employed to protect this non-dimer damage while the DNA is digested with DNase I. Oligonucleotide fragments containing damage will be separated from undamaged fragments by nitrocellulose fltration. Damage-containing fragments will be digested enzymatically and isolated bases from thin layer chromatograms will be analyzed. In addition, the fate of the non-dimer damage in irradiated cells will be examined by using the binding protein as a probe for the presence of such damage in the DNA. This work will be carried out with human fibroblasts as well as with bacterial cells.
Keywords: ULTRAVIOLET RADIATION; X RADIATION; IRRADIATION; CELL CULTURES; FIBROBLASTS; BACTERIA; BIOLOGICAL RADIATION EFFECTS; DNA; STRAND BREAKS; RADIOINDUCTION; BIOLOGICAL REPAIR; PROTEINS; RADIOSENSITIVITY EFFECTS; RADIATION INJURIES; BIOLOGICAL INDICATORS.

34216 Cancer and Error Prone DNA Repair in Animal Cells. Rossman, T.G. (New York University, School of Medicine, 550 1st Avenue, New York, NY, 10016). **Project number:** ICA-19421-2. **Contract:** R01-CA-19421-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Our main objective is to study the relationship between mutagenesis, carcinogenesis, and DNA repair in animal cells. Error-prone DNA repair pathways in animal cells exposed to uv light and chemical carcinogens will be identified and the genetic, physiological, and pharmacological factors which control these processes will be ascertained. The effects of heavy metals on DNA repair in E. coli shall be studied, as well as the role of proteases in error-prone repair. Using Chinese hamster ovary cell, a series of DNA-repair-deficient mutants will be isolated, which will allow analysis of the various DNA repair pathways. Error-prone repair will be measured as the mutation frequency, using ouabain resistance as a marker, in cells exposed to a known uv fluence. It is hoped that this system will be useful as a screen for both carcinogens and co-carcinogens.**Keywords:** ULTRAVIOLET RADIATION; IRRADIATION; CELL CULTURES; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; DNA; BIOLOGICAL REPAIR; CARCINOGENESIS; MUTATION FREQUENCY; BIOLOGICAL INDICATORS; CARCINOGENS; SCREENING; MUTAGENESIS; BIOLOGICAL PATHWAYS; ERRORS; METALS; BIOLOGICAL EFFECTS; PEPTIDE HYDROLASES.

34217 Synthesis of Metabolites of 7,12-Dimethylbenz(a)anthracene. Weber, W.P. (University of Southern California, School of Letters, Arts and Sciences, 3551 University Avenue, Los Angeles, CA, 90007). **Project number:** ICA-19444-2. **Contract:** R01-CA-19444-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

7,12-Dimethylbenz(a)anthracene (DMBA) is a highly active chemical carcinogen. Metabolites of 7,12-dimethylbenz(a)anthracence will be prepared. Isomeric arene oxides, the related phenols, and trans-1,2-dihydro-1,2-diols will be synthesized. The availability of these compounds may permit elucidation of the mechanism by which DMBA triggers the production of tumors. 7,12-Dimethylbenz(a)anthracence derivatives will be prepared from 7,12-benz(a)anthraquinone (BaQ) derivatives. The conversion of BaQ to DMBA is well worked out. A new approach for BaQ derivatives has been developed which makes isomeric BaQ derivatives more accessible.
Keywords: CARCINOGENESIS; CONDENSED AROMATICS; METABOLITES; NEOPLASMS; CHEMICAL PREPARATION; POLYCYCLIC AROMATIC HYDROCARBONS.

34218 Activation of Chemical Carcinogens by Different Species. Schwartz, A.G. (Temple University, School of Medicine, 3223 North Broad Street, Philadelphia, PA, 19122). **Project number:** ICA-19445-2. **Contract:** R01-CA-19445-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The probability of developing cancer increases progressively with age in mammalian species. According to the multi-stage hypothesis of carcinogenesis, this marked dependence of cancer incidence rates on age may result from the prolonged exposure to environmental carcinogens that is necessary to produce the cellular mutations leading to malignancy. It follows from this hypothesis that shorter-lived species should be more susceptible to environmental carcinogens than longer-lived species. We have reported previously that in cultured fibroblasts from six different mammalian species, there was a good inverse correlation between species life span and capacity of fibroblasts to activate DMBA to a mutagenic form. We have since isolated three fibroblast strains from each of six mammalian species of widely differing life spans (rat, guinea pig, rabbit, cow, elephant, and human) and have found a good inverse correlation between species life span and the rate at which cultured fibroblasts bind 3H-DMBA to their DNA.
Keywords: TRITIUM COMPOUNDS; DIMETHYLBENZANTHRACENE; BINDING ENERGY; DNA; RATS; GUINEA PIGS; RABBITS; COWS; MAN; MAMMALS; CELL CULTURES; FIBROBLASTS; LIFE SPAN; SPECIES DIVERSITY; GENETIC VARIABILITY; CARCINOGENESIS.

34219 Synthesis of Metabolites of Carcinogenic Hydrocarbons. Harvey, R.G. **Project number:** ICA 19448-2. **Contract:** R01 CA 19448-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The principal objective of this program is to develop novel, more efficient synthetic approaches to the oxidized metabolites of carcinogenic hydrocarbons. The traditional methods have involved either (1) direct introduction of a functional group at the position(s) favored for substitution, or (2) laborious total synthesis of the polycyclic ring system. The former is limited to a small fraction of the total isomers, while the latter necessitates a complex multistep synthesis for feasibility of potentially more efficient and more general approaches based upon employment of the parent hydrocarbon as the starting compound and utilization of blocking groups, activating groups, selective hydrogenation, and other techniques to direct substitution. The hydrocarbons (BaP, BA, DMBA, etc.) to be employed are chosen for their importance as carcinogens whose metabolism has been partially elucidated and as model compounds to illustrate solutions to the synthetic problems anticipated.
Keywords: HYDROCARBONS; CARCINOGENESIS; METABOLISM; POLYCYCLIC AROMATIC HYDROCARBONS; METABOLITES; SYNTHESIS.

34220 Human Radiation Carcinogenesis Study. Hempelmann, L.H. (University of Rochester, 601 Elmwood Avenue, Rochester, NY, 14642). **Project number:** ICA-19764-1. **Contract:** R18-CA-19764-01A1. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This research program focuses on three well defined, irradiated populations: (1) persons whose thymus glands were irradiated in infancy; (2) women whose breasts were treated with x rays for acute post-partum mastitis; and (3) persons given x-ray treatments to the head during childhood. Longitudinal studies of reported morbidity and mortality in these populations and their controls have been ongoing for over 15 yrs. This application proposes continuation of the longitudinal studies and, in addition, expansion of the program of clinical investigation to include screening for early detection of cancer. The objectives of the program are: (1) to elucidate the nature of radiation-induced neoplastic processes and conditions with abnormal immunological features; (2) to quantify the cancer risks of three irradiated populations; and (3) to effect by screening the early diagnosis and treatment of breast and thyroid cancer within the high-risk populations. Screening examinations will include thyroid scans of thymus-irradiated subjects and high-risk head-irradiated subjects, and mammographic-thermographic studies of breast-irradiated subjects. Laboratory studies to evaluate immune status will be conducted in selected individuals in the thymus-irradiated population.
Keywords: X RADIATION; LOCAL IRRADIATION; PARTIAL BODY IRRADIATION; RADIOTHERAPY; SIDE EFFECTS; DELAYED RADIATION EFFECTS; PATIENTS; NEOPLASMS; RADIOINDUCTION; CARCINOGENESIS; RISK ASSESSMENT; THYMUS; INFANTS; THYROID; SCINTISCANNING; MAMMARY GLANDS; WOMEN; BIOMEDICAL RADIOGRAPHY; THERMOGRAPHY; HEAD; NECK; CHILDREN; THYROID.

34221 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:** ICA-19948-2. **Contract:** R01-CA-19948-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

To determine the pathways of benzo(a)pyrene (BP) oxidation in hamster embryo cell cultures, it is necessary to be able to analyze the many water-soluble benzo(a)pyrene metabolites that are formed. We have shown that a major portion (more than 3%) of the total BP metabolites formed in these cells were glucuronic acid conjugates of two BP-phenols, 9-hydroxy-BP and 3-hydroxy-BP. In contrast to the organic solvent-soluble metabolites that were mainly BP-dihydrodiols, the glucuronide conjugates were almost entirely BP-phenols

and BP-guinones. Thus, the metabolite profile obtained by beta-glucuronidase treatments allows a considerably more accurate determination of the pathways of BP oxidation in these cells. Preliminary studies of the effects of various tumor promoters and cocarcinogens on BP metabolism in these cells suggest that tumor promoters do not significantly alter BP metabolism, but that cocarcinogens do.
Keywords: CARCINOGENESIS; ANIMAL CELLS; BENZOPYRENE; OXIDATION; HAMSTERS; EMBRYOS; METABOLITES; PHENOLS; CELL CULTURES.

34222 Metabolism of Polycyclic Hydrocarbons in Skin. Slaga, T.J. (University of Tennessee, W. Cumberland Avenue SW, Knoxville, TN, 37916). **Project number:** ICA-20076-2. **Contract:** R01-CA-20076-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The goal of this project is to determine the role of the aryl hydrocarbon hydroxylase in mouse skin tumorigenesis by benzo(a)pyrene (BP) and 7,12-dimethylbenz(a)anthracene (DMBA). Pursuant to this coal, we examined the effects of 7,8-benzoflavone (7,8-BF), 5,6-benzoflavone (5,6-BF), butylated hydroxytoluene (BHT), estradiol and 1,1,1-trichloropropene 2,3 oxide (TCPO) on DMBA and BP mouse skin tumorigenesis and metabolism. The conversion of radioactive DMBA and BP by epidermis to organic solvent-soluble metabolites separated by high pressure liquid chromatography (HPLC) was used as the overall assessment of the metabolizing system. The effects of the modifying agents on the epidermally-mediated covalent binding of various polycyclic aromatic hydrocarbons (PAH) to DNA was also determined. A correlation appears to exist between the tumor initiating ability of several PAH and their ability to covalently bind to DNA in vitro using mouse epidermal homogenates and NADPH as the electrophile generating system. 7,8-BF, 5,6-BF and estradiol are potent inhibitors of the covalent binding of various PAH to DNA and the overall metabolism of BP and DMBA as revealed by HPLC. Results to date suggest that BP-7,8-diol is a proximate carcinogen of BP and BP-7,8-diol-9,10-epoxide (anti) the ultimate carcinogenic form. Similar studies are underway for DMBA.
Keywords: SKIN; METABOLISM; POLYCYCLIC AROMATIC HYDROCARBONS; HYDROXYLASE; MICE; CARCINOGENESIS; BENZOPYRENE; AROMATICS; TRACER TECHNIQUES; ENZYMES; LIQUID COLUMN CHROMATOGRAPHY.

34223 Modification of Radiation Damage in Hypoxic Cells. Djordjevic, B. (Sloan-Kettering Institute of Cancer Research, 410 E. 68th Street, New York, NY, 10021). **Project number:** ICA-20470-2. **Contract:** R01-CA-20470-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The radiosensitivity of hypoxic mammalian cells in culture can be increased close to the level of well oxygenated cells, under certain cultural conditions. Using a system of dense cultures of HeLa cells, we observed a potentiation of the radiation effect when plating of irradiated cells was postponed for several hours; in cells irradiated under oxygenated conditions, there was no potentiation due to delayed plating. While hypoxia seems to be essential for the radiation potentiating effect, other features in the system such as waste accumulation may play a role. We plan to evaluate the potentiating effect of post-irradiation hypoxia by varying cultural conditions, access to oxygen, size of irradiation dose, and length of post-irradiation treatment both in asynchronous and later in synchronous HeLa cells. In another approach, also aimed at selective inactivation, hypoxic synchronous HeLa cells will be irradiated in the presence of two nitroimidazole compounds, metronidazole and Ro 7-0582, which have radiosensitizing properties in the absence of oxygen. In addition to their oxygen mimicking activity in radiosensitization, their synergistic effect with irradiation through toxicity to hypoxic cells will also be examined. The effect of post-irradiation hypoxia will also be studied in synchronous Chinese hamster cells. Split-dose irradiations will be conducted in order to discern how repair of sublethal radiation damage may be effected under limited oxygen supply and in the presence of hypoxic sensitizers.
Keywords: X RADIATION; GAMMA RADIATION; IRRADIATION; CELL CULTURES; SYNCHRONOUS CULTURES; HELA CELLS; ANIMAL CELLS; HAMSTERS; FRACTIONATED IRRADIATION; GENETIC RADIATION EFFECTS; MUTATIONS; RADIOINDUCTION; RADIOSENSITIVITY; ANOXIA; METRONIDAZOLE; NITRO COMPOUNDS; IMIDAZOLES; RADIOSENSITIVITY EFFECTS; TOXICITY; SYNERGISM; MUTAGENESIS; RESPONSE MODIFYING FACTORS.

34224 Chemical Carcinogen-Induced DNA Repair in Human Cells. Lieberman, M.W. (Washington University, 660 S. Euclid Ave., St. Louis, MO, 63110). **Project number:** ICA-20513-2. **Contract:** R01 CA 20513-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The major objective of our research is to understad how damage to DNA by chemical carcinogens is repaired by normal cultured human diploid fibroblasts and fibroblasts from individuals with increased risk of cancer and defects in DNA repair (xeroderma pigmentosum, xeroderma pigmentosum variants, Fanconi's anemia, and ataxia telangiectasia). In the coming year we plan to continue our work on the intragenomal distribution of damage and repair (both removal of damage and DNA repair synthesis). Efforts are underway to develop subcellular systems for analyzing the repair process.
Keywords: CELL CULTURES; FIBROBLASTS; SOMATIC CELLS; PATIENTS; XERODERMA PIGMENTOSUM; XP CELLS; ANEMIAS; TELANGIECTASIS; DNA; STRAND BREAKS; BIOLOGICAL REPAIR; CARCINOGENS; BIOLOGICAL EFFECTS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS.

34225 Mammary Cancer and Hormone Induced Responses. Clark, J.H. (Baylor Univ., School of Medicine, 1200 Moursund Ave., Houston, TX, 77025). **Project number:** ICA-20605-1. **Contract:** R01 CA 20605-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The interactions and mechanism by which dimethylbenzanthracene (DMBA) causes mammary carcinoma will be examined by a technique which involves the implantation of DMBA directly on the mammary gland of the rat. This method of local tumor induction results in the production of cancers at predictable sites, and hence provides a model system for the analysis of preneoplasia in the mammary gland. The method will permit the determination of the critical period for cancer induction and establish the appropriate time periods for further examination of the biochemical and cellular responses that are correlated with cancer induction. The interactions of various steroid hormones, especially estrogens and progestagens, with DMBA and the binding of H3-DMBA to cellular components will be assessed during the critical period. In addition, estrogen receptor binding and hormone induced responses will be studied during the preneoplastic and neoplastic periods. These binding and response patterns will be compared to those oserved in the non-cancerous tissue. This proposal is designed to define the important biochemical and cellular events that are taking place during cancer induction and to establish the relationships between steroid hormone receptor binding and steroid induced responses in normal and abnormal mammary tissue.
Keywords: MAMMARY GLANDS; HORMONES; NEOPLASMS; DIMETHYLBENZANTHRACENE; CARCINOGENESIS; STEROID HORMONES; ESTROGENS; PROGESTERONE; CHEMICAL BONDS; COMPLEXES; BIOCHEMISTRY; CARCINOGENS.

34226 Polycyclic Hydrocarbon Metabolism and Carcinogenesis. Bresnick, E. (University of Vermont, College of Agriculture, 85 S. Prospect St., Burlington, VT, 05401). **Project number:** ICA-20711-2. **Contract:** R01 CA 20711-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Carcinogenesis as a consequence of polycyclic hydrocarbon administration may represent at least in part the end result of an imbalance among several genetically-determined processes occurring within a tissue--activation to epoxides, detoxification of the latter to diols, interaction with macromolecules, conjugation of epoxides with glutathione, and the extent of the DNA repair process. Furthermore, the metabolism of polycyclic hydrocarbons is markedly elevated by administration of a number of pollutants, and the extent of the induction appears also genetically-determined. The objectives of the proposal are to ascertain: (1) the nature of metabolites of 3,4 Benzpyrene (BP) and 3-methylcholanthrene (3MC) produced by microsomal preparations of mouse and rat liver, lung, and skin; (2) the specific activities of epoxide hydrase, epoxidase, and glutathione S-epoxide transferase in these tissues; (3) the variation in the nature of metabolites and in the levels of these enzymes as a result of prior exposure (administration) of inducers such as 3MC, phenobarbital, beta-naphthoflavone, and pregnenolone 16-alpha carbonitrile; (4) the extent of alkylation of DNA by labelled polycyclic hydrocarbons; and (5) the skin tumorigenicity (in mice) of 3MC as influenced by blockade of epoxide hydrase and inducers. In addition, we wish to obtain some information relative to the range of specific activities of epoxidase, epoxide hydrase, aryl hydrocarbon hydroxylase, and the glutathione S-epoxide transferase in human tissues, the magnitude of induction of these enzymes after exposure to 3 MC and other inducers, and the range of the extent of alkylation of DNA by labelled polycyclic hydrocarbons.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; BENZOPYRENE; METABOLISM; MICROSOMES; LIVER;

LUNGS; SKIN; RATS; LYASES; OXIDASES; TRANSFERASES; ENZYME ACTIVITY; METABOLITES; VARIATIONS; DNA; ALKYLATION; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL REPAIR; GENETIC VARIABILITY.

34227 Activated Mutagenic and Carcinogenic Hydrocarbons. Voilhardt, K.P. (University of California, Berkeley, CA, 94720). **Project number:** ICA-20713-1. ***Contract:*** R01-CA-20713-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW. **Related energy source:** fossil fuels(100). **R and D categories:** Health effects.

The mechanism of carcinogenesis by polycyclic hydrocarbons is one of the important unsolved problems of cancer research. Controversial evidence points to the occurrence of active olefinic K-regions that are primarily responsible for the carcinogenetic potential of certain benzenoid compounds. The synthesis of polycyclic hydrocarbons fused to or incorporating activating rings is proposed, to enable the study of the physical and chemical properties of these novel compounds. The activating ability of such rings will be related to their strain and electronic make up. In larger systems, fusion will be designed such as to activate remote K-regions of known carcinogens. Novel synthetic routes developed in our laboratory will be applied to attain this goal. The new hydrocarbons will be made available for physiological testing and arrangements have been made to this effect. The carcinogenic and mutagenic potential of these new compounds will be compared with the activity of the known parent compounds.

Keywords: HYDROCARBONS; MUTAGENESIS; CARCINOGENESIS; CHEMICAL ACTIVATION; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENS.

34228 Cancer and Vitamin A. Ong, D.E. (Vanderbilt University, 21st Avenue South, Nashville, TN, 37203). **Project number:** ICA-20850-2. **Contract:** R01-CA-20850-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

R and D categories: Health effects.

The objective of the proposed research is to investigate the mechanism(s) of the therapeutic action of vitamin A on neoplasia with particular attention to the cellular binding proteins, which appear to mediate the action of vitamin A-active compounds. Alterations in vitamin A metabolism caused by neoplasia will be investigated by comparison to normal tissue. Areas of interest include changes in the levels of binding proteins, ability of retinol to enter the tissue as measured by the degree of saturation of the cellular retinol binding protein, and ability of tissue to convert retinol to retinoic acid. The investigations will be carried out using dimethylbenz(alpha)anthracene induced skin papillomas of mouse, which are subject to the inhibitory action of vitamin A and its analogs, as well as human tumors obtained at the time of surgery or necropsy.

Keywords: NEOPLASMS; VITAMIN A; THERAPY; PROTEINS; ANIMAL CELLS; CHEMICAL BONDS; BIOCHEMISTRY; DIMETHYLBENZANTHRACENE; CARCINOGENESIS.

34229 Characterization of Carcinogen--Nucleic Acid Complexes. Geacintox, N.E. (New York Univ., 421 1st Ave., New York, NY, 10012). **Project number:** ICA-20851-1. **Contract:** R01 CA 20851-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34230 Mutagen Induced Antinucleoside Immunoreactivity. Bases, R.E. (Yeshiva University, 1300 Morris Park Avenue, Bronx, NY, 10461). **Project number:** ICA-20879-2. **Contract:** R01-CA-20879-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

R and D categories: Health effects.

Immunoreactivity to antinucleoside antibodies is the basis of our rapid quantitative means to score DNA damage and repair in fixed animal cells. These antibodies are specific for denatured or single-stranded nucleic acids. Nuclear immunoreactivity in G-1 HeLa cells correlates well with DNA damage. In normal S-phase this is temporally related to DNA synthesis. Chemical carcinogens induce DNA damage which is readily detectable by our method. The method may provide a rapid novel means to test for carcinogen action on cells, including those from exposed humans. Diagnostic ultrasound induced immunoreactivity in G-1 HeLa cells. Repair synthesis and cell transformation were found after exposure to diagnostic ultrasound. This is under further study to learn if ultrasound has potential hazard for the human fetus. Protein synthesis inhibitors induce immunoreactivity in nuclei of G-1 HeLa cells. Unlike results with carcinogens, DNA breaks do not result and immunoreactivity induction is readily reversible upon removal of the inhibitor. It is an important exception to the apparent general correlation of immunoreactivity induction and mutagenicity. It may signal changes in the state of the chromatin in animal cells, i.e., uncovering of (immunoreactive) denatured regions of the chromatin.

Keywords: MUTAGENS; DNA; CARCINOGENS; ULTRASONIC WAVES; DIAGNOSTIC TECHNIQUES; HEALTH HAZARDS; IMMUNE REACTIONS; ANTIBODIES; FLUORESCEIN; PEROXIDASES; HELA CELLS; FETUSES; PROTEINS; BIOSYNTHESIS; STRAND BREAKS; BIOLOGICAL EFFECTS.

34231 Effects of Dietary Factors on uvl-Carcinogenesis. Black, H.S. (Baylor Univ., Coll. of Medicine, 1200 Moursund Ave., Houston, TX, 77025). **Project number:** ICA-20907-1. **Contract:** R01 CA 20907-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

R and D categories: Health effects.

The predisposition of experimental animals receiving high levels of dietary fat to certain types of chemically-induced cancers now seems well established. However, the measure of response evoked by different types of fats appears to be related to factors other than degree of saturation - notably antioxidant content. Likewise, the role of dietary cholesterol in ultraviolet light (uvl)-induced skin cancer seems clouded by variations in diet not properly controlled in earlier studies. Although dietary cholesterol involvement in skin cancer was suggested over 40 years ago, recent evidence, although indirect, lends new concern for the involvement of this natural constituent in actinic carcinogenesis. This proposal is designed to: (1) evaluate the effect of nutritional stress, i.e., high cholesterol and quantitative and qualitative alterations in dietary fat, upon the incidence of uvl-induced skin cancer; and (2) determine whether dietary antioxidants have a mollifying effect upon potential predisposition to carcinogenesis by dietary lipids.

Keywords: DIET; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; SYNERGISM; LIPIDS; METABOLISM; ANTIOXIDANTS; CARCINOGENESIS; BIOLOGICAL MODELS; NUTRITIONAL DEFICIENCY; BIOLOGICAL STRESS; TOXICITY; CHOLESTEROL.

34232 Chemical Carcinogens in the Pancreas. Epstein, S.S. (University of Illinois, Box 4348, Chicago, IL, 60680). **Project number:** ICA-20914-2. ***Contract:*** R26-CA-20914-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

R and D categories: Health effects.

Studies are proposed to investigate the uptake, in vivo metabolism, and excretion of 3H-benzo(a)pyrene in the rat pancreas, and to characterize BP metabolites in the pancreas and pancreatic excretions of control and methylcholanthrene (MC)-pretreated rats. Parallel studies will be undertaken in the liver and bile for comparative purposes. Cellular distribution of BP and/or its metabolites in the pancreas will also be investigated. Studies are also proposed to investigate the selective uptake of carcinogenic nitrosamines in the pancreas, relative to the liver, and the excretion profile in pancreatic juice and bile from control and induced animals.

Keywords: NITROSO COMPOUNDS; BENZOPYRENE; AMINES; METABOLISM; PANCREAS; RATS; LIVER; METABOLITES; TISSUE DISTRIBUTION; BILE; BODY FLUIDS; COMPARATIVE EVALUATIONS; CARCINOGENS; TRITIUM COMPOUNDS.

34233 Molecular Events in Chemical Carcinogenesis. Weinstein, I.B. (Columbia University, 630 W. 168th Street, New York, NY, 10032). **Project number:** ICA-21111-1. **Contract:** P01-CA-21111-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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.

34234 Interaction of Carcinogens with DNA: Repair of Lesions. Maher, V.M. (Michigan State University, East Lansing, MI, 48823). **Project number:** ICA-21253-2. **Contract:** R01-CA-21253-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Our previous research on the interaction of chemical carcinogens with transforming DNA has demonstrated conclusively that ultimate carcinogens are mutagenic. With this system and the naturally-synchronous plasmodium, Physarum polycephalum, we have obtained clear physicochemical and genetic evidence of repair of lesions induced in DNA by such carcinogens. We will investigate the following actions of carcinogens: (1) the effect of carcinogen treatment of normally-repairing diploid human cells or repair-deficient human cells on the expression of viral specific information and/or the ability to be transformed by exposure to DNA tumor viruses, DNA of such viruses, or exogenous DNA containing viral sequences of RNA tumor viruses; (2) the relationship between carcinogens and co-carcinogens in interacting with human cells to cause cytotoxic and mutagenic effects and induce DNA repair; (3) the role of cell cycle phase on the interaction of carcinogens with synchronized populations of diploid human cells; and (4) the ability of agents which induce activating enzymes to increase the extent of cytotoxic and mutagenic interaction of carcinogens with these cells.
Keywords: DNA; BIOLOGICAL REPAIR; CARCINOGENESIS; BIOLOGICAL MODELS; SYNCHRONOUS CULTURES; NEOPLASMS; EPIDEMIOLOGY; HUMAN POPULATIONS; CELL CYCLE; DYNAMIC FUNCTION STUDIES; ANIMAL CELLS; XP CELLS; ONCOGENIC TRANSFORMATIONS; CARCINOGENS; BIOLOGICAL EFFECTS; MUTAGENESIS.

34235 Biological Effects of DNA-Protein Crosslinks. Larcom, L.L. (Clemson University, Clemson, SC, 29631). **Project number:** ICA-21479-1. **Contract:** R01-CA-21479-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The crosslinking of proteins to DNA has been demonstrated in cells treated by ultraviolet radiation, x rays, and various chemicals. The natural accumulation of this type of damage has also been proposed as a mechanism for aging and carcinogenesis. Although crosslinks have been detected by physical-chemical techniques in irradiated DNA and in DNA extracted from the tissues of aged animals, the biological significance of such crosslinks has not been adequately investigated. This research will: (1) evaluate the significance of uv-induced DNA-protein crosslinks in the biological inactivation of viral DNA; (2) determine the extent to which the open breathing regions of DNA affect its uv sensitivity and, in particular, its sensitivity to protein crosslink formation; (3) examine the effects of carcinogens and mutagens on the uv sensitivity of DNA-protein complexes and evaluate the transfection system as a possible simple assay system for potential carcinogens and mutagens; and (4) attempt to identify a bacterial enzyme system capable of detecting and repairing regions of DNA crosslinked to proteins.
Keywords: ULTRAVIOLET RADIATION; IRRADIATION; VIRUSES; BIOLOGICAL RADIATION EFFECTS; DNA; PROTEINS; CROSS-LINKING; RADIOSENSITIVITY; MUTAGENS; CARCINOGENS; RADIOSENSITIVITY EFFECTS; ADDUCTS; BIOLOGICAL EFFECTS; BIOLOGICAL REPAIR; ENZYME ACTIVITY; BACTERIA.

34236 Mechanism of Carcinogen-Induced Frameshift Mutations. Kleid, D.G. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** ICA-21593-1. **Contract:** R01-CA-21593-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The mechanism by which chemicals such as carcinogens induce frameshift mutations is not well understood. This lack of knowledge is especially evident in the determination of what structural features of the chemicals are required for high mutagenic activity and why certain sites on the DNA are especially sensitive to frameshift mutagens. Several events are required for such a mutation to occur: uptake of the chemical into the cell; activation, if not already reactive, to an electrophilic species by enzymes; transport to and association with the DNA; formation of a covalent bond or complex with the DNA; recognition of the lesion by repair or replication enzymes; and misrepair or misreplication of the lesion, resulting in the induction of a frameshift mutation. We plan to investigate the last three steps of this process using newly developed methods of in vitro biochemistry. These new methods are: direct DNA sequencing for determination of nucleoside and sequence specificity of the reaction forming a mutagen--DNA covalent bond; cloning of DNA fragments contaning specific DNA lesions produced in vitro; and treatment of DNA fragments containing covalently bound mutagens with isolated repair endonucleases. Using these tools, we will be able to study the molecular events leading to a frameshift mutation at a much higher resolution than was previously possible.
Keywords: MUTAGENS; CARCINOGENS; MUTATIONS; DNA; ENZYMES; BIOLOGICAL REPAIR; CHEMICAL ACTIVATION; BIOCHEMISTRY.

34237 Mutagenesis and Repair of DNA. Walker, G.C. (Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA). **Project number:** ICA-21615-2. **Contract:** R01-CA-21615-02. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The goal of the proposed research is to understand the cellular molecular mechanisms by which chemical damage to DNA is converted into a stably inherited mutation. The drug-resistance plasmid, pKM101, causes a striking enhancement of radiation and chemical mutagenesis when present in bacterial screening systems used to detect carcinogens and mutagens. Preliminary work has suggested that the plasmid enhances mutagenesis by enhancing the activity of the hypothesized error-prone repair pathway(s) and this relationship will be further examined. The genetics of the system will be characterized by obtaining and studying mutations in both plasmid and chromosomal genes involved in the process. The plasmid-coded protein(s) responsible for the enhancement of mutagenesis will be identified. The effect of the plasmid on branches of both excision and postreplicational-DNA repair will be examined. Restriction fragments of the plasmid, pKM101, will be cloned in a plasmid vector. Results of these studies will be applied to improving the Ames' Salmonella/microsomal screening system. It is hoped that elucidation of the molecular mechanisms of chemical mutagenesis in enteric bacteria will provide a model for similar processes in eucaryotes and will lead to an understanding of the origin of diseases such as cancer.
Keywords: MUTAGENESIS; DNA; BIOLOGICAL REPAIR; BIOLOGICAL MODELS; PLASMIDS; CELL CONSTITUENTS; GENES; GENETIC RADIATION EFFECTS; RADIATION EFFECTS; CARCINOGENESIS; EPIDEMIOLOGY; BACTERIA; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS.

34238 Photochemistry of Dimethoxycoumarin. Shim, S.C. (Korean Advanced Institute of Science, Seoul, Republic of Korea). **Project number:** ICA-21729-1. **Contract:** R01-CA-21729-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Psoralens (furocoumarins) are potent photosensitizing agents for eliciting skin erythema and skin cancer. The molecular mechanism of the psoralen photosensitization is likely to involve photochemical modifications of DNA via covalent photo-coupling of psoralens to pyrimidine bases. The structures of psoralen-pyrimidine photoadducts have not been chemically established due to lack of a method for preparative scale production of the photoadducts and the diversity of a number of different photoproducts. We propose to study the photochemistry of dimethoxycoumarin-pyrimidine systems as a simple model in order to establish the structural aspect of the photoadducts relevant to the skin sensitizer-DNA photoaddition process; in particular, structural elucidation of the cycloaddition between the excited DMC and well-defined (in terms of number of different products) photoadducts at relatively high yields than psoralens for chemical structure and stereochemical investigations. DMC as a model photosensitizer is also biologically relevant, since it is only one of the many coumarin derivatives which shows a significant photolethal effect in Bacillus subtilis mutants. Preliminary results also indicate that DMC intercalates and photochemically crosslinks to DNA, contrary to other coumarins.
Keywords: LACTONES; PYRANS; RADIOSENSITIVITY EFFECTS; ULTRAVIOLET RADIATION; SKIN; RADIOSENSI-

TIVITY; ERYTHEMA; NEOPLASMS; RADIOINDUCTION; RADIOSENSITIZERS; PHOTOCHEMICAL REACTIONS; DNA; PHOTOCHEMISTRY; PYRIMIDINES; CROSS-LINKING.

34239 Interactions of Drugs, Radiation and Hormones. Weichselbaum, R.R. (Harvard University, 25 Shattuck Street, Boston, MA, 02215). **Project number:** ICA-21848-1. **Contract:** R01-CA-21848-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34240 *Metabolic Activation of the* Polycyclic Hydrocarbons. Sims, P. (University of London, Gower Street, London, England, WC1E 6BT). **Project number:** ICA-21959-1. **Contract:** R01-CA-21959-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34241 Normal and Neoplastic Development of the Mammary Gland. Dulbecco, R. (Salk Institute for Biological Studies, 10010 North Torry Pines Blvd., San Diego, CA, 92112). **Project number:** ICA-21993-1. **Contract:** R01-CA-21993-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Studies of the normal mammary gland of rats or mice will be directed at identifying stem cells in the mammary epithelium by pulse labelling with H3TdR and reconstruction from sections; their role in the physiological evolution of the gland will be examined. Markers for identification for various cell types at the level of individual cells will be developed. Various aspects of growth control of mammary epithelium will be investigated in vivo and in vitro. This will include the determination of a minimal and an optimal hormone complement for the growth of mammary epithelial cells in vitro, as well as a search for growth regulatory substances produced by the mammary fat pad and by the mammary ducts. These studies will be extended to cancer induction by determining growth control in various kinds of cancers. The role of enzymes metabolizing chemical carcinogens and of DNA repair in cancer induction. Mechanisms of carcinogenesis will be investigated especially how the first pregnancy or a high fat diet affect the risk of DMBA-induced cancer in rats.
Keywords: MAMMARY GLANDS; NEOPLASMS; EPIDEMIOLOGY; RATS; MICE; STEM CELLS; EPITHELIUM; IN VITRO; CARCINOGENESIS; BIOLOGICAL MODELS; LIPIDS; DIET; XYLENES; TOXICITY; BIOLOGICAL REPAIR; DNA.

34242 Biological and Chemical Studies of New DMBA Compounds. Morreal, C.E. (New York State Department of Health, 84 Holland Avenue, Albany, NY, 12208). **Project number:** ICA-22001-1. **Contract:** R01-CA-22001-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Studies concerning the chemical synthesis and biological properties of 7,12-dimethylbenz(a)anthracene (DMBA) derivatives are proposed. DMBA-dihydrodiols, DMBA-epoxides and DMBA-diolepoxides of this hydrocarbon will be synthesized via the Stobbe reaction and via substituted methoxyphthalic anhydrides. Binding to DNA and to polyribonucleotides will be measured and the carcinogenicity of the synthetic compounds will be assessed. The synthesis and estrogenicity of DMBA-3,9-diol will also be studied.
Keywords: XYLENES; METABOLISM; TOXICITY; BIOCHEMICAL REACTION KINETICS; BIOSYNTHESIS; CHEMICAL BONDS; DNA; RNA; CARCINOGENESIS; BIOLOGICAL MODELS.

34243 Experimentally-Induced Pancreatic Adenocarcinoma. Bockman, D.E. (Medical Coll. of Georgia, 1459 Gwinnett St., Augusta, GA, 30902). **Project number:** ICA-22063-1. **Contract:** R26 CA 22063-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The goals of this study are twofold: (1) to verify and extend an experimental animal model for the study of pancreatic adenocarcinoma in which tumors are induced by the direct implantation of 7,12-dimethylbenz(a)anthracene; and (2) to test other chemicals for their carcinogenic potential when implanted into the pancreas. The morphology and behavior of the tumors will be characterized and evidence of invasiveness and metastatic capabilities of the tumors will be examined. The cell(s) of origin of the tumors will be sought by studying early stages of tumor induction. The implantation model has distinct advantages over those models employing systemic administration of large quantities of carcinogen. These advantages include: the high incidence of tumors (80%); the relatively sort induction time (119 days); and the absence of primary tumors in other organs. There is no administration of large amounts of carcinogen with its attendant systemic toxicity, there is no impairment of immune and host defenses by systemic toxicity, and there is no impairment of immune and host defenses by systemic poisoning of the host animal. Several parameters of tumor induction will be investigated, including dosage level, method of implantation, alterations with increasing time, age of animals at the time of implantation, species differences, and the effects of different carcinogens.
Keywords: PANCREAS; CARCINOMAS; ELECTRON MICROSCOPY; MICROSCOPY; DIMETHYLBENZANTHRACENE; CARCINOGENESIS; CARCINOGENS; TESTING; MORPHOLOGY; BIOLOGICAL MODELS; DOSE-RESPONSE RELATIONSHIPS; IMPLANTS; TIME DEPENDENCE; AGE DEPENDENCE; GENETIC VARIABILITY; COMPARATIVE EVALUATIONS.

34244 Ultraviolet Light Radiation and Immunoregulation. Daynes, R.A. (Utah Higher Education System, 1400 E. 2nd St., Salt Lake City, UT, 84112). **Project number:** ICA-22126-1. **Contract:** R01 CA 22126-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Ultraviolet radiation (uv) has recently been shown to modify murine immune responses to certain transplants: most uv-induced skin tumors, although killing their autochthonous hosts, are rejected by syngeneic hosts unless the latter have been immunosuppressed. Apparently the uv giving rise to the tumor has also immunosuppressed the autochthonous host, thereby permitting progressive tumor growth. Interestingly, uv exposure of prospective syngeneic hosts also results in progressive growth of tumor transplants, thereby confirming the impression of uv as an immunosuppressant. The nature of this immunosuppressive mechanism is not understood; neither is it known whether the carcinogenic and the immunosppressive effect are related. We propose to elucidate these questions using a broad spectrum of immunologic assays, applied to a variety of genetic combinations. Examples of the immunologic assays are the transplantation of skin and other tissues and cells, responses of immunologically active cells to specific and nonspecific stimuli, and serum antibody responses. Examples of pharmacologic modifiers which might affect the immune responses and cast light on the immune pathways involved are the E series prostaglandins and histamine.
Keywords: ULTRAVIOLET RADIATION; IRRADIATION; MICE; BIOLOGICAL RADIATION EFFECTS; IMMUNE REACTIONS; TUMOR CELLS; TRANSPLANTS; IMMUNOSUPPRESSION; RADIOINDUCTION; CARCINOGENESIS; PROSTAGLANDINS; HISTAMINE; IMMUNOLOGY; BIOLOGICAL EFFECTS.

34245 Adrenal Carcinogen Metabolism. Colby, H.D. (University of Virginia, Box 246, Charlottesville, VA, 22901). **Project number:**

ICA-22152-1. **Contract:** R01 CA 22152-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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-hydroxylase activity. Using the guinea pig as the experimental animal, adrenal conversion of BP to activated metabolites that covalently bind to cellular macromolecules (DNA, RNA, protein) will be evaluated and compared with hepatic activation. Effects of epoxide hydrase and/or BP hydroxylase inhibitors will be assessed simultaneously. The identity of BP metabolites produced by adrenal tissue will be determined and compared with those produced by hepatic microsomes. The effects on BP metabolism and the formation of active metabolites of various factors known to influence adrenal mixed function oxidases, will be investigated. Using human adrenals obtained from breast carcinoma patients, we will determine if adult adrenal tissue, like that in the human fetus, metabolizes BP. If so, we will also determine if DNA, RNA, or protein-binding metabolites are formed and attempt to identify BP metabolites produced by human adrenal tissue.
Keywords: BENZOPYRENE; METABOLISM; ADRENAL GLANDS; MAN; FETUSES; GUINEA PIGS; CYTOCHROMES; HYDROXYLASE; ENZYME ACTIVITY; METABOLITES; LYASES; AGE DEPENDENCE; SEX DEPENDENCE; ACTH; ANDROGENS; BIOLOGICAL EFFECTS; DNA; RNA; PROTEINS; CHEMICAL REACTIONS; CARCINOGENS.

34246 Repair and Mutagenesis of DNA. Tessman, I. (Purdue Univ., Executive Blvd., Lafayette, IN, 47907). **Project number:** ICA-22239-1. **Contract:** R01 CA 22239-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34247 Antioxidant Reversed Cytotoxicity and Carcinogenesis. Chan, J.T. (Baylor Univ., Coll. of Medicine, 1208 Moursund Ave., Houston, TX, 77025). **Project number:** ICA-22261-1. **Contract:** R01 CA 22261-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Suppression of ultraviolet light (uvl)-induced squamous cell carcinomas in skin of hairless mice by dietary antioxidants is well established. However, the mode of action of antioxidants and the mechanism of uvl-induced skin carcinogenesis are not clearly understood. Recently, in Chinese hamster cells, reversal of uvl-induced cytotoxicity by certain antioxidants was demonstrated for the first time in our laboratory. This proposal is designed to use several cell lines of different animal origin to characterize this antioxidant mediated reversal of uvl-induced cytotoxicity. Subsequently this property of antioxidants will be established as a model system for studying the prophylactic role of antioxidants in actinic carcinogenesis as well as the mechanism of uvl-induced skin carcinogenesis. Using a C3H/10TI/2CL8 mouse cell line which others have shown to be transformed by exposure to uvl and subsequent promotion by tetradecanoyl phorbol acetate (TPA), antioxidants will be examined for their possible role in inhibiting uvl-induced transformation. Studies will also be initiated to determine if cytotoxicity induced by chemical carcinogens may be reversed by antioxidants.
Keywords: CARCINOGENESIS; SKIN; NEOPLASMS; BIOLOGICAL MODELS; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; SENSITIVITY; HAMSTERS; ANIMAL CELLS; TOXICITY; MICE; RESPONSE MODIFYING FACTORS; ANTIOXIDANTS; DIET; METABOLISM.

34248 Neurospora DNA Repair. Schroeder, A.L. (Washington State University, Pullman, WA, 99163). **Project number:** ICA-22587-1. **Contract:** R01-CA-22587-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Likely differences in DNA repair between eukaryotes and prokaryotes in the role of DNA polymerases and the nature of cytoplasmically inherited radiation sensitivity will be examined using radiation-sensitive mutants of the fungus, Neurospora crassa. Prokaryote and eukaryote DNA polymerases differ in nuclease association, cellular placement, and sulfhydryl group requirements. At least two DNA polymerase activities can be separated in Neurospora. After examining their purity, the enzymes will be characterized by their metal, salt, pH, and sulfhydryl group requirements, activity with templates, molecular weight, and nuclease activity. To detect repair polymerases, changes in specific activity during the life cycle and in radiation-sensitive mutants, and induction of enzyme activity by DNA damage will be examined. Mutants with cytoplasmically inherited uv sensitivity show that the cytoplasm affects uv sensitivity. New mutants will be isolated and heterokaryons used to study complementation and the segregation of nuclear and cytoplasmic traits. They will be compared to nuclear mutants in uv and gamma-ray sensitivity.
Keywords: NEUROSPORA; DNA; BIOLOGICAL REPAIR; POLYMERASES; ENZYMES; ULTRAVIOLET RADIATION; RADIOSENSITIVITY; ENZYME ACTIVITY.

34249 Diol Epoxide: Structure-Activity Relationship. Lehr, R.E. (University of Oklahoma, 660 Parrington Oval, Norman, OK, 73069). **Project number:** ICA-22985-01. **Contract:** R01-CA-22985-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Studies of benzo(a)pyrene (BP) and benzo(a)anthracene (BA) derivatives have strongly implicated diol epoxides as intermediates in the mutagenesis and carcinogenesis of these compounds. A quantum mechanical approach has been developed that predicts the relative reactivity and mutagenicity of diol epoxides and successfully rationalizes the high reactivity and mutagenicity of the bay region diol epoxides of BA and BP and the much lower reactivity of their isomers. The theoretical approach clearly predicts which of these compounds are expected to exhibit substantial activity and which are not. The proposed research entails the synthesis of diol epoxides of selected hydrocarbons and a comparison of their chemical reactivity and biological activity with expectations based upon the calculations. Specifically, the synthesis of dihydrodiols and diol epoxides derived from benzo(e)pyrene, dibenzo(a,h)anthracene, benzo(a)naphthacene, and dibenzo(a,i)pyrene will be effected and the compounds tested for biological activity. The biological testing will entail studies of the ability of the dihydrodiols to be metabolically activated (presumably to diol epoxides) to species mutagenic to mutant Salmonella strains as well as examination of the intrinsic mutagenicity of the diol epoxides. Selected derivatives will be examined for carcinogenicity depending upon the mutagenicity results.
Keywords: EPOXIDES; BENZOPYRENE; BENZANTHRACENE; MUTAGENESIS; CARCINOGENESIS; CONDENSED AROMATICS; MUTAGEN SCREENING; SALMONELLA; POLYCYCLIC AROMATIC HYDROCARBONS.

34250 Study of the Electrophilic Nature of Chemical Carcinogenesis. Olah, G.A. (University of Southern California, 3551 University Avenue, Los Angeles, CA, 90007). **Project number:** ICA-23031-1. **Contract:** R01-CA-23031-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Miller's concept of electrophilic chemical carcinogenesis will be studied in four selected classes of significant pro-carcinogens: (1) polycyclic aromatic hydrocarbons; (2) aromatic amines and nitro compounds; and (3) nitrosamines and related compounds. The nature of the active electrophilic agents will be determined under conditions allowing observations of stable long-lived carbocationic intermediates with methods previously developed in our laboratories, i.e., 1H, 13C nmr ESCA (photoelectron) spectroscopy. The alkylating ability of carbocationic electrophiles formed by chemical activation of pro-carcinogens will also be studied particularly in the case of nitrosamines. Under electrophilic conditions they were found to readily form immonium ions, which display (by cmr spectroscopy) ambient character showing significant contribution of their aminocarbenium ion forms.
Keywords: CARCINOGENS; ELECTRON TRANSFER; ELECTRONIC STRUCTURE; POLYCYCLIC AROMATIC HYDROCARBONS; AMINES; NITRO COMPOUNDS; HETEROCYCLIC COMPOUNDS; NITROSO COMPOUNDS; REACTION INTERMEDIATES; CATIONS; NUCLEAR MAGNETIC RESONANCE; ELECTRON SPECTROSCOPY; ALKYLATING AGENTS; MOLECULAR STRUCTURE.

34251 DNA Repair: Human Escherichia coli Photoreactive Enzymes. Sutherland, B.M. (Brookhaven National Lab., Upton, NY,

11973). **Project number:** ICA-23096-1. **Contract:** R01-CA-23096-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The photoreactivating enzyme, which repairs DNA by the exclusive monomerization of dimers in a light-dependent reaction, is central to two phases of the problem of uv-damage, repair and carcinogenesis: (1) as a repair enzyme which may participate in DNA repair in normal cells, and (2) as a specific analytical tool for evaluating the role of the dimer in the induction of abnormal growth by ultraviolet light. We shall study the mechanism of action of the enzyme by identifying the cofactor, determining the identity of the moiety responsible for the absorption of photoreactivating light and delineating the mechanism of dimer monomerization. We shall determine the amino acid composition, peptide maps and active site peptides of enzyme from E. coli, normal human fibroblasts and xeroderma pigmentosum fibroblasts. We shall determine the substrate range and specificity of the human photoreactivating enzyme. These studies will form the biochemical cornerstone of our determination of the role of dimers in carcinogenesis in man by ultraviolet light and of the role of the photoreactivating enzyme in repairing such damage.
Keywords: DNA; BIOLOGICAL REPAIR; ESCHERICHIA COLI; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; SKIN; NEOPLASMS; MAN; PYRIMIDINES; THIAMINE; METABOLISM; FIBROBLASTS; AMINO ACIDS; PEPTIDES; PHOTOSENSITIVITY; CARCINOGENESIS; BIOLOGICAL MODELS; BIOCHEMICAL REACTION KINETICS.

34252 Radiation Oncogenesis and Actinomycin D. Dangio, G.J. (Children's Hospital of Philadelphia, 34th Street and Civic Center Blvd., Philadelphia, PA, 19104). **Project number:** ICA-23111-1. **Contract:** R01-CA-23111-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.
Keywords: IONIZING RADIATIONS; CARCINOGENESIS; NEOPLASMS; RADIOINDUCTION; MAN; MUTAGENESIS; MUTATIONS; ACTINOMYCIN; RADIOSENSITIVITY EFFECTS.

34253 Carcinogen Testing: A Mouse Lymphoma Mutation System. Coffino, P. (University of California, 551 Parnassus Avenue, San Francisco, CA, 94122). **Project number:** ICA-23218-1. **Contract:** R01-CA-23218-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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. 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.

34254 Radiation-Induced Mutagenesis and Carcinogenesis. Evans, H.H. (Case Western Reserve University, 2109 Adelbert Road, Cleveland, OH, 44106). **Project number:** ICA-23427-1. **Contract:** R01-CA-23427-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34255 DNA Repair After Polycyclic Hydrocarbon Administration. Bresnick, E. (University of Vermont, State Agricultural College, 85 S. Prospect Street, Burlington, VT, 05401). **Project number:** ICA-23514-1. **Contract:** R01-CA-23514-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34256 Pulmonary Metabolism of the N-Heterocyclic Aromatics. Warshawsky, D. (University of Cincinnati, Eden and Bethesda Avenue, Cincinnati, OH, 45221). **Project number:** ICA-23515-1. **Contract:** R01-CA-23515-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34257 Activation and Reactivity of Nitroheterocyclics. Olive, P.I. (Johns Hopkins University, 725 North Wolfe Street, Baltimore, MD, 21205). **Project number:** ICA-24519-1. **Contract:** R01-CA-24519-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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.

34258 Carcinogenic Potential of Phototherapy. Speck, W.T. (Case Western Reserve University, 2109 Adelbert Road, Cleveland,

OH, 44106). **Project number:** ICA-23692-1. **Contract:** R01-CA-23692-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This project involves determining the mutagenic, carcinogenic, and/or teratogenic potential of an environmental agent commonly utilized for the treatment of neonatal hyperbilirubinemia; high intensity illumination with visible light or phototherapy. The proposed research will characterize the DNA-modifying potential of phototherapy by analyzing the physical-chemical properties of several species of DNA exposed to photosensitizing agents and visible light in vitro. We will then determine if similar intracellular DNA modification occurs when prokaryotic and eukaryotic cells are exposed to light by analyzing the effect of light-induced reactions on mutation frequency and the physical chemical properties of isolated DNA molecules. We will also determine if similar DNA modification occurs in the intact animal following exposure to high intensity visible light with and without added photosensitizing agents. Once the potential hazards of phototherapy have been identified, techniques will be developed to minimize these hazards and protect normal infants from potentially serious untoward sequelae.
Keywords: VISIBLE RADIATION; CARCINOGENESIS; MUTAGENESIS; TERATOGENESIS; DNA; PHOTOSENSITIVITY; GENETIC VARIABILITY.

34259 Risk-Assessment Studies. Hellman, A. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-248-7. **Contract:** Z01-CP-04805-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The goals of this project are designed to contribute technical information on which to estimate risk assessment in man when exposed to oncogenic viruses, chemical carcinogens and environmental carcinogens. Model systems consisting of rodents, feline and primates are being used to evaluate risk based on modification of the normal physiological status of the host. In particular, the influence of pregnancy, hormonal imbalance and exposure to ultraviolet light and the subsequent DNA repair process are being investigated. The expression of xenotrophic virus during hormonal imbalance, DNA repair and other fluctuations in host and cellular functions is being studied to further ascertain the risk of such states to the laboratory worker.
Keywords: RISK ASSESSMENT; TUMOR CELLS; VIRUSES; CHEMICAL EFFLUENTS; BIOLOGICAL MODELS; CARCINOGENESIS; ULTRAVIOLET RADIATION; BIOLOGICAL REPAIR; DNA; BIOCHEMICAL REACTION KINETICS; SYNERGISM; DOGS; CATS; RODENTS.

34260 Biology of Natural and Induced Neoplasias and Their Endogenous Tumor Viruses. Arnstein, P. (National Cancer Inst., Bethesda, MD, 20014). **Project number:** ZXC-259-7. **Contract:** Z01-CP-04930-06 LRTV. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Tumors induced by transplants, viruses, chemicals and radiation are studied in mice. Prevention of these tumors by various vaccines is subsequently tested. Mouse strains of low spontaneous cancer incidence, resembling the human experience are used in most studies. Evidence of xenotrophic Type C virus has been found in all murine tumors. Vaccines prepared from tumors and cultured cells have produced promising protection from challenge. New methods of producing killed vaccines are compared to the standard formalin inactivation. Experimental xenografting to athymic nude mice (which are hereditarily immunodeficient) continues to prove an excellent measure of cell malignancy and transformation.
Keywords: NEOPLASMS; TUMOR CELLS; VIRUSES; CARCINOGENESIS; IONIZING RADIATIONS; CHEMICAL EFFLUENTS; TRANSPLANTS; BIOLOGICAL EFFECTS; BIOLOGICAL MODELS.

34261 Repair of Sublethal Radiation Injury in Mice. Smith, W.W. (National Cancer Inst., Bethesda, MD, 20014). **Project number:** ZXC-353-6. **Contract:** Z01-CB-00936-07 LPP. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

In mice given sublethal whole-body irradiation it appears that persisting hematopoietic rather than intestinal damage is responsible for the reduction in ability to tolerate a second irradiation.
Keywords: RADIATION INJURIES; MICE; BIOLOGICAL REPAIR; CARCINOGENESIS; WHOLE-BODY IRRADIATION; BIOLOGICAL MODELS.

34262 Transplacental and Neonatal Carcinogenesis. Rice, J.M. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-421-6. **Contract:** Z01-CP-04687-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The roles of metabolism, immune processes, DNA repair, and other factors related to susceptibility to transplacental carcinogenesis in rodents and primates are investigated, with emphasis on nitrosamine and aromatic hydrocarbon carcinogens and utilizing both whole animal and in vitro culture techniques.
Keywords: NEONATES; PLACENTA; CARCINOGENESIS; BIOLOGICAL MODELS; TERATOGENESIS; METABOLISM; IMMUNOLOGY; DNA; BIOLOGICAL REPAIR; RODENTS; ANIMALS; AROMATICS; HYDROCARBONS; ANIMAL CELLS; ORGANIC NITROGEN COMPOUNDS; MEMBRANE TRANSPORT.

34263 Studies of DNA Repair in Normal Human Cells and in Cells from Xeroderma Pigmentosum Patients. Robbins, J.H. (National Cancer Inst., Bethesda, MD, 20014). **Project number:** ZXC-498-5. **Contract:** Z01-CB-03638-08. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Studies in this laboratory are designed to elucidate the role of DNA repair processes in human diseases, carcinogenesis, and aging. Most studies have been conducted with cells from patients with Xeroderma pigmentosum (xp), all of whom have defective DNA repair plus the clinical abnormalities of premature aging of the skin and cutaneous malignancies. We measure the DNA excision repair process by assays of uv-induced unscheduled DNA synthesis and are using these assays to study the uv dose response of the excision system and the effect of in vitro aging on this system. We assessed the biological effectiveness of DNA repair with assays of post-irradiation colony-forming ability and have found a striking correlation between the level of effectiveness of DNA repair in xp and the severity of xp-associated neurological abnormalities. We are studying the relationship of uv-induced sister chromatid exchanges to the repair defects of xp. We are extending our work to include cells from patients with other diseases in which DNA repair defects are claimed or suspected, such as Cockayne's syndrome, ataxia telangiectasia, Werner's syndrome, Rothmund Thompson syndrome and progeria. We have established lymphocyte cell lines (long-term lymphoblast lines) from all six genetic forms of xp. These lines are useful in radiation-sensitivity and biochemical tests.
Keywords: DNA; BIOLOGICAL REPAIR; MAN; ANIMAL CELLS; PATIENTS; XERODERMA PIGMENTOSUM; XP CELLS; PHOTOCHEMICAL REACTIONS; DISEASES; CARCINOGENESIS; AGE DEPENDENCE; SKIN; SENSITIVITY; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS.

34264 Effects of Gamma Irradiation on Nucleic Acids and Proteins (Interactions of Cancer Chemotherapy Agents and Radiation). Biesz, P. (National Cancer Inst., Bethesda, MD, 20014). **Project number:** ZXC-760-4. **Contract:** Z01-CB-00942-18. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The effects of ionizing and ultraviolet radiation on nucleic acids and proteins and their constituents are being studied. The mechanism of the interaction of cancer chemotherapy agents with radiation is of interest, since such knowledge can be potentially useful in radiation therapy. The present report includes electron spin-resonance studies of radicals produced by gamma-irradiation and ultra-violet photolysis of nucleic acids, proteins, their constituents, and of chemotherapy agents of the intercalating type (e.g., actinomycin D, adriamycin).
Keywords: GAMMA RADIATION; NUCLEIC ACIDS; PROTEINS; CHEMOTHERAPY; ULTRAVIOLET RADIATION; CELL CONSTITUENTS; RADIOTHERAPY; DRUGS; BIOLOGICAL RADIATION EFFECTS; BIOLOGICAL EFFECTS.

34265 Carcinogenesis Studies in Human Tissues. Harris, C. (National Cancer Inst., Bethesda, MD, 20014). **Project number:** ZXC-861-3. **Contract:** Z01-CP-04567-04. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Operational safety; Health effects.

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 EF-

FLUENTS; BENZOPYRENE; MUTAGENESIS; RISK ASSESSMENT; RESPONSE MODIFYING FACTORS.

34266 Relationship Between In Vitro Mutagenesis and Chemical Carcinogenesis. Myhr, B.C. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-874-3. **Contract:** Z01-CP-04575-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

It is the long range purpose of this project to determine whether mutational processes are involved in in vitro malignant transformation of mammalian cells by diverse chemical and physical carcinogens. Research efforts during the past year have centered on: (1) determination of cell culture conditions necessary to maintain morphological differences between transformed and normal cells; (2) standardization of the survival responses of Chinese hamster V79 cells to chemical carcinogens, caffeine, and uv light; and (3) study of assay conditions necessary for quantitative measurements of induced mutation frequencies in cultured X. pigmentosum human cells. Future efforts will be directed toward simultaneous mutagenesis and transformation assays utilizing both human and Syrian hamster embryo cells in culture.
Keywords: IN VITRO; MUTAGENESIS; CARCINOGENESIS; HAMSTERS; BIOLOGICAL MODELS; CARCINOGENS; CAFFEINE; ULTRAVIOLET RADIATION; XERODERMA PIGMENTOSUM; ANIMAL CELLS.

34267 Factors Effecting Malignant Transformation by Chemical Carcinogenesis. Kakunaga, T. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-930-2. **Contract:** Z01-CP-04555-03. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

It is the long range purpose of this work to clarify the mechanism of cell transformation by studying the genetic, biological, and biochemical factors affecting carcinogenesis by chemical carcinogens. This work also aims to clarify the role of these factors in the etiology of human cancer incidence. The topics of present interest are: (1) the effects of physiological conditions of cells on the transformation; (2) the mechanism of fixation of transformation, in particular the role of DNA repair; and (3) the characterization of cell variants which shows the different sensitivity to chemical transformation.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; GENETIC EFFECTS; BIOLOGICAL EFFECTS; ETIOLOGY; PHYSIOLOGY; SENSITIVITY.

34268 Mechanism of Chemically Induced Hepatomas and Ovarian Tumors. Thorgeirsson, S.S. (National Cancer Inst., Bethesda, MD, 20014). **Project number:** ZXC-1040. **Contract:** Z01 CM 06137-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The long range purpose of this project is to study the mechanism of chemically induced hepatomas and ovarian tumors in rodents and non-human primates. These tumors, at various time points during their development, will then be used as models for evaluating chemotherapeutic agents and other drugs which might be of therapeutic value. Topics of present interest are: (1) the role of metabolic activation, as well as the genetic control of activating enzymes, in the chemical initiation of hepatoma and ovarian tumors; (2) the time course of hepatoma and ovarian tumor initiation with particular emphasis on the changing enzyme patterns as the cells become increasingly dedifferentiated; (3) the role of nucleophilic agents such as N-acetylcysteine, L-cysteinine, and cysteamine in preventing the chemical initiation of hepatomas and ovarian tumors; and (4) the characterization of cAMP and the beta-receptor involvement in the chemical induction of hepatomas as well as the possible use of beta-blockers and/or beta-agonists in preventing the occurrence of these hepatomas.
Keywords: NEOPLASMS; OVARIES; HEPATOMAS; CARCINOGENESIS; POLYCYCLIC AROMATIC HYDROCARBONS; CHEMOTHERAPY; DRUGS; NITROSO COMPOUNDS; RODENTS; PRIMATES.

34269 Mutagenicity and Carcinogenity of Antitumor Agents and Chemicals. Thorgeirsson, S.S. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1041. **Contract:** Z01-CM-06138-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This project was initiated to evaluate the relationship between chemically induced mutagenesis and carcinogenesis. The primary emphasis is placed on antitumor agents and known environmental contaminants and model chemical carcinogens. A sensitive in vitro bacterial test system is used for the detection of chemical mutagens. The research is directed at present to determine: (1) the role, if any, of metabolic activation in the mutagenesis caused by antitumor agents and chemical carcinogens; (2) the effect of structural modification on the mutagenicity of both antitumor agents and model chemical carcinogens; and (3) the feasibility of using nucleophiles such as L-cysteine, N-acetyl-cysteine and cysteamine to inhibit muta genicity of the above mentioned compounds.
Keywords: MUTAGENESIS; CARCINOGENESIS; CHEMICAL EFFLUENTS; BIOLOGICAL MODELS; FEASIBILITY STUDIES.

34270 Analysis of DNA Damage In Vivo by Alkylating Agents and Ionizing Radiation. Hilton, T. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1073. **Contract:** Z01-CM-06965-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

A modification of the alkaline elution method of the analysis of single-strand breaks and cross-links in DNA allows the universal application of the method to tissues containing unlabelled DNA. DNA damage by multifunctional alkylating agents and ionizing radiation has been demonstrated in rat brain, brain tumor, liver, kidney, muscle and small intestine.
Keywords: DNA; IN VIVO; ALKYLATING AGENTS; IONIZING RADIATIONS; BIOLOGICAL REPAIR; BIOLOGICAL RADIATION EFFECTS.

34271 Pulmonary Carcinogenesis: Testing and Examining the Mechanisms Through Animal Models. Stanton, M.F. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1100. **Contract:** Z01-CB-00505-07. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This program is designed to investigate the major cases and mechanisms of pulmonary cancer in man through the study of lung cancer induced in animals. We are studying the carcinogenic potential of subfractions of air pollutants and cigarette smoke condensate with our system of wax-retaining pulmonary implants in rats. Currently, the aim is to determine what other factors, deficiencies, et al, will effect responses. Secondly, we are investigating the critical factors responsible for fiber carcinogenesis in the lung and pleura which depend on structural configuration of the particles of fibers such as the gypsums, metal whiskers, talcs, asbestoses, and fibrous glasses and a variety of other durable fibers. An effort to develop a workable hypothesis on the primary effect of the fiber on cells is in progress.
Keywords: LUNGS; NEOPLASMS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; ANIMALS; BIOLOGICAL MODELS; PARTICLES; FIBERS; AEROSOLS; AIR POLLUTION; SMOKES; RATS; RESPONSE MODIFYING FACTORS; HEALTH HAZARDS; METABOLISM; PLEURA; GYPSUM; ASBESTOS; ANIMAL CELLS; MAGNESIUM SILICATES.

34272 Special Nonmelanoma Skin Cancer Incidence Survey and Epidemiology Study. Scotto, J. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1174. **Contract:** Z01-CP-4475-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

This project was initiated to provide more data relative to skin cancer and harmful solar ultraviolet. An urgent need for these data has existed since recent scientific reports have warned about the decomposition of stratospheric ozone by nitrogen oxides and chlorofluoromethanes (CFM's). Federal regulatory agencies have already recommended bans on the use of aerosol spray cans which use CFM's as propellants. In the near future, there will be critical reviews of all pertinent information by government as well as individual interests concerned with the threat of increased human skin cancer due to excess amounts of uv-B reaching the earth's surface, as its protective ozone shield is depleted.
Keywords: SKIN; NEOPLASMS; EPIDEMIOLOGY; SOLAR FLUX; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; OZONE; NITROGEN OXIDES; ORGANIC CHLORINE COMPOUNDS; ORGANIC FLUORINE COMPOUNDS; AEROSOLS; ENVIRONMENTAL EFFECTS.

34273 Studies of Radiation-Induced Cancer. Land, C.E. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1175. **Contract:** Z01-CP-0448-101. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The objective of this project is to examine cancer incidence and mortality among populations exposed to varying amounts of ionizing and non-ionizing radiation. Groups from which useful data can be obtained include the Japanese A-bomb survivors, patients exposed to high-dose medical diagnostic radiation and to therapeutic radiation, workers with histories of occupational exposures to radiation, and the populations of SEER reporting areas with different levels of solar uv radiation. The listed project members all have individual research interests in radiation-induced cancer. One of the

aims of establishing this new project is to provide a framework for increased interaction and cross-fertilization of ideas.
Keywords: CARCINOGENESIS; RADIOINDUCTION; BIOLOGICAL MODELS; HUMAN POPULATIONS; A-BOMB SURVIVORS; PATIENTS; OCCUPATIONAL SAFETY; NUCLEAR MEDICINE.

34274 Studies on the Control of Benzo(a)pyrene Metabolism in Cells from Animal and Human Sources. Okano, P. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1183. **Contract:** Z01-CP-04982-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Blood monocytes and lymphocytes, a readily available source of human tissue, are used to assess in vitro an individual's ability to metabolize benzo(a)pyrene, a model compound of the class of polycyclic aromatic hydrocarbon carcinogens. Rat liver cells are used to obtain a correlation between the relative AHH activity and inducibility and the pattern of benzo(a)pyrene metabolites as seen by high pressure liquid chromatography (HPLC).
Keywords: BENZOPYRENE; METABOLISM; ANIMAL CELLS; TISSUES; POLYCYCLIC AROMATIC HYDROCARBONS; CHROMATOGRAPHY; HUMAN POPULATIONS; MAN; ANIMALS.

34275 Cellular and Molecular Effects of Psoralen Plus Ultraviolet Light. Kraemer, K.H. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1184. **Contract:** Z01-CP-04516-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

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 cutaneous 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.

34276 DNA Repair in Human Cancer-Prone Genetic Diseases. Kraemer, K.H. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1185. **Contract:** Z01-CP-04517-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Radiation and carcinogen-induced DNA damage and repair in human cancer-prone genetic diseases is being studied. Attention is presently focused on Xeroderma pigmentosum (xp), a disease with ultraviolet sensitivity, and Ataxia telangiectasia (AT), a disease which recently has been found to exhibit x-ray sensitivity. Cell fusion studies have demonstrated AT least 5 different DNA repair defects among xp fibroblast strains. Similar studies to demonstrate possible genetic heterogeneity of DNA repair defects among AT strains are planned. A detailed comparison of the clinical features of these diseases is being made. Cell fusion studies are also planned to attempt to detect persons heterozygous for xp or AT. Correlation of clinical features of xp and AT with in vitro DNA repair defects may lead to further understanding of the link between DNA repair and cancer.
Keywords: DNA; BIOLOGICAL REPAIR; GENETIC EFFECTS; CARCINOGENESIS; XERODERMA PIGMENTOSUM; ULTRAVIOLET RADIATION; SENSITIVITY; X RADIATION; RADIOSENSITIVITY; IN VITRO; HEMIC DISEASES; BIOLOGICAL MODELS.

34277 Aryl Hydrocarbon Hydroxylase in Cultured Monocytes from Monozygotic and Dizygotic Twins. Okuda, T. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1186. **Contract:** Z01-CP-04985-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Interindividual and intraindividual variations in the basal and benz(a)anthracene-induced levels of aryl hydrocarbon hydroxylase (AHH) were investigated in cultured monocytes obtained from 10 sets of monozygotic and 17 sets of dizygotic normal adult twin volunteers. The values for basal levels, and therefore, induction ratios were more variable than those of the induced level. The mean values for the induced levels ranged from 4.26 to 17.49. Intratwin differences in the induced levels were quite small within both the monozygotic and most of the dizygotic twins. However, a few sets of dizygotic twins had much greater intratwin differences than did the monozygotic twins, providing heritability indices between 0.57 (uncorrected) and 0.71 (corrected). Thus, genetic factors accounted for approximately half to two-thirds of the interindividual variations in AHH inducibility in this study. The small intratwin differences among most of the dizygotic twins suggests that a relatively small number of genes are involved in regulating the induced AHH levels.
Keywords: HYDROCARBONS; HYDROXYLASE; CELL CULTURES; METABOLISM; BIOCHEMICAL REACTION KINETICS; BENZANTHRACENE; GENETIC VARIABILITY; MAN.

34278 Modification of DNA by Chemical Carcinogens and Mutagens. Kakzeuda, T. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1188. **Contract:** Z01-CP-04983-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The topic of the present study is the structural modification of DNA double helix caused by binding of carcinogens and mutagens. It was found that there were three different types of in vitro binding of benzo(a)pyrene (BaP) metabolite, 7,8-diol 9,10-epoxide BaP, to superhelical circular DNA of plasmid Col El and SV40 virus: (1) the covalent binding which does not cause severe steric hindrance on the DNA double helix (the binding with guanine belongs in this category); (2) the binding which causes local denaturation resulting in conformational change of DNA (the binding with adenine is mostly responsible for this change); and (3) the binding which breaks phosphodiester bonds (this is caused by the binding with either DNA basis and/or phosphate). The latter is stimulated by the presence of certain metal ions such as lanthanum. The binding characteristics were studied by using double-stranded synthetic polymers. The results supported the previously described binding forms. The binding of BaP metabolites in culture cells is under investigation.
Keywords: DNA; CELL CONSTITUENTS; CARCINOGENESIS; MUTAGENS; CHEMICAL EFFLUENTS; HYDROCARBONS; METABOLISM; CHEMICAL BONDS; BENZOPYRENE; VIRUSES; GUANINE; LANTHANUM; POLYMERS; CELL CULTURES.

34279 Detoxification Processes of Benzo(a)pyrene (BP). Nemoto, N. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1190. **Contract:** Z01-CP-04981-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The enzymes, which produce water-soluble materials by conjugating with glutathione, glucuronic acid and sulfate, were investigated for their activities with various kinds of BP metabolites and derivatives. The processes have implications in the excretion of chemical carcinogens from the body.
Keywords: BENZOPYRENE; TOXICITY; METABOLISM; EXCRETION; ENZYMES; BIOCHEMICAL REACTION KINETICS.

34280 Benzo(a)pyrene and (-)Trans-7,8-diol Metabolism by Highly Purified Forms of Cytochrome P-450. Deutsch, J. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1196. **Contract:** Z01-CP-04579-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The long range purpose of this project is to study the mechanism of the activation and detoxification of benzo(a)pyrene by mixed function oxidase. For this purpose highly purified cytochrome P-450's from rabbit liver in a reconstituted system were used for the metabolism and DNA binding of benzo(a)pyrene and (-)trans-7,8-diol.
Keywords: BENZOPYRENE; TOXICITY; METABOLISM; BIOCHEMICAL REACTION KINETICS; RABBITS; LIVER; DNA; CHEMICAL BONDS; RESPONSE MODIFYING FACTORS; GLYCOLS; CYTOCHROMES; CYTOCHROME OXIDASE.

34281 Mutagenesis Mediated by Human Tissues and Cells. Hsu, I. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1200. **Contract:** Z01-CP-04485-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Since most chemical carcinogens are also mutagens, assays of mutagenesis are useful as screening tests for chemical carcinogens. A mutagenesis assay has now been developed in which promutagens (procarcinogens) are metabolically activated by explants of human target tissues, e.g., bronchus. Mutation frequency (resistance to either 8-azaguanine or ouabain) is measured in mammalian cell line, V-79 Chinese hamster cells, which do not metabolically activate polynuclear aromatic hydrocarbons into mutagens. When human bronchial explants are cocultivated with V-79 cells in medium containing either benzo(a)pyrene (BP) or its proximate carcinogen, 7,8-diol, a marked increase in mutation frequency is observed. This

increase is dependent upon dose of either BP or 7,8-diol, duration of cocultivation, and amount of human bronchus. At equimolar concentrations, 7,8-diol was activated to at least a 5-fold more potent mutagen than its parent compound BP. This human tissue-mediated mutagenesis test has potential as a: (1) screening test for chemical carcinogens; and (2) biological assay to be used with biochemical assays in an effort to determine oncogenic susceptibility among individuals as well as among different target tissues in a single individual.
Keywords: MUTAGENESIS; MAN; TISSUES; ANIMAL CELLS; BIOLOGICAL MODELS; MUTAGEN SCREENING; BRONCHI; HAMSTERS; POLYCYCLIC AROMATIC HYDROCARBONS; BENZOPYRENE; GLYCOLS; CHEMICAL EFFLUENTS; METABOLISM.

34282 Metabolism of Chemical Carcinogens in Cultured Human and Rat Colon. Autrup, H. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1202. **Contract:** Z01-CP-04488-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Explant cultures of both human and rat colon have the ability to enzymatically convert various classes of chemical carcinogens, such as polycyclic aromatic hydrocarbons, N-nitrosamines, mycotoxins and hydrazines, into metabolites which react with cellular macromolecules. The effect of various co- and anticarcinogens of colon carcinogenesis on the metabolism of benzo(a)pyrene (BP) and of 1,2-dimethylhydrazine (DMH) by the rat colon has been studied. Different segments of the rat colon metabolize BP and DMH to varying extents. The metabolism of BP, less in the colon was approximately 10% of the level found in the human bronchus; the major metabolites extractable with ethylacetate, were quinones, a peak containing 9,10-diol and 7/8,9-triol and 7,8-diol. The metabolite pattern of BP in human and rat colon were quite similar. Secondary bile acids significantly decreased the binding of DMH to rat colon, while enhancing the binding level of BP to DNA in human colon. Benz(a)anthracene did not enhance either activity of aryl hydrocarbon hydroxylase or BP binding to DNA in human and rat colon.
Keywords: CELL CULTURES; MAN; RATS; LARGE INTESTINE; METABOLISM; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENS; ORGANIC NITROGEN COMPOUNDS; BENZOPYRENE; GLYCOLS; DNA; BENZANTHRACENE; HYDROLASES; BRONCHI; BIOCHEMICAL REACTION KINETICS.

34283 Metabolism of Chemical Carcinogens in Cultured Human Pulmonary Alveolar Macrophages. Autrup, H. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1203. **Contract:** Z01-CP-04481-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The metabolism of benzo(a)pyrene (BP) by human bronchus and pulmonary alveolar macrophages (PAM) from the same donor was studied to investigate whether the PAM might be useful as an indicator cell for the human bronchus. PAM were able to enzymatically convert BP into metabolites which bound to cellular macromolecules. Negative correlation was observed between aryl hydrocarbon hydroxylase and binding of BP to cellular protein. A 9-fold interindividual variation was found in the binding to DNA. The majority of the metabolites of BP were water-soluble, while 7,8-dihydro-7,8-dihydroxy BP (7,8-diol), 9,10-dihydro-9,10-dihydroxy BP, triols and tetrols were the major metabolites in the ethyl extractable fraction. PAM metabolize BP into its proximate carcinogenic form, 7,8-diol, which is released into the extracellular space. No correlation of AHH activity and binding to DNA or protein between PAM and bronchus was found.
Keywords: CHEMICAL EFFLUENTS; METABOLISM; CARCINOGENESIS; CELL CULTURES; LUNGS; MACROPHAGES; BENZOPYRENE; GLYCOLS; BIOLOGICAL INDICATORS; PROTEINS; CHEMICAL BONDS; DNA; BIOLOGICAL MODELS; HYDROXYLASE.

34284 Effect of Irradiation of Tumors in Mastomys natalensis. Goodman, D.G. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1205. **Contract:** Z01-CP-04492-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Mastomys natalensis develop a high incidence of spontaneous thymomas and gastric carcinoids in addition to a variety of other neoplasms. The animals were irradiated at an early age to study the effect of irradiation on the development of tumors in this species. Currently, the treated animals are showing clinical signs of early aging. However, it is too early to evaluate the effect of treatment on the development of tumors.
Keywords: TUMOR CELLS; RADIOSENSITIVITY; NEOPLASMS; ANIMALS; RADIOTHERAPY.

34285 Explant and Cell Culture of Human and Bovine Pancreatic Duct. Stoner, G. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-1208. **Contract:** Z01-CP-04486-01. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Model systems for the study of carcinogenesis in cultured human and bovine pancreatic duct tissues are being developed. Explants of human and bovine pancreatic duct have been maintained in culture for periods of 60 to 85 days respectively. The metabolism of polycyclic aromatic hydrocarbons is being investigated in cultured human pancreatic duct. Cells with an epithelial morphology have been cultured from the bovine pancreatic duct and attempts are being made to transform the cells with chemical carcinogens. It is anticipated that these model systems will be useful for: (1) identification of environmental carcinogens for the pancreatic duct; (2) determination of the metabolic pathways for carcinogens in the pancreatic duct; (3) identifying host factors determining susceptibility to chemically induced pancreatic cancer; and (4) evaluating new methods of prophylactic intervention in populations at high risk of developing pancreatic cancer.
Keywords: CARCINOGENESIS; CELL CULTURES; ANIMAL CELLS; CATTLE; MAN; PANCREAS; POLYCYCLIC AROMATIC HYDROCARBONS; NEOPLASMS; MORPHOLOGY; HUMAN POPULATIONS; CARCINOGENS.

34286 Studies of Cancer Incidence and Related Etiologic Factors. Young, J.L. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-680374-9. **Contract:** Z01-CP-04258-09. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

Work during the past year has included the following activities: studies of migrant populations have continued and their contributions to the development of large bowel cancer epidemilogy have been summarized; the relationship between cancer and living habits has received attention and is reported under the general heading of cancer risk and life style; a case-control study of reserpine and breast cancer has been reported; a protocol for the classification and staging of pancreatic cancer has been prepared; staff has participated in development of the Ninth Revision of the International Classification of Diseases--Neoplasm Section; and staff had responsibility for analyzing data on ultraviolet radiation and skin cancer, a project initiated because of the Department of Transportation's concern over the depletion of stratospheric ozone. Work has begun with the World Health Organization to analyze trends in cancer mortality in forty countries.
Keywords: NEOPLASMS; EPIDEMIOLOGY; HUMAN POPULATIONS; MORTALITY; ETIOLOGY.

34287 Mechanism of Cell Transformation. Dipaolo, J.A. (National Cancer Institute, Bethesda, MD, 20014). **Project number:** ZXC-680412-9. **Contract:** Z01-CP-04629-12. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
R and D categories: Health effects.

The conditions which are responsible for or can alter in vitro transformation will be investigated further, with specific emphasis on the use of uv, x-rays, combinations of carcinogens of different classes, the combination of in vivo--in vitro systems, and the effect of stimulators and inhibitors of mixed function oxidases on toxicity and transformation. Studies on the mechanisms of early events of carcinogen--cell interaction will be continued, as well as investigation of different proximate carcinogens and metabolic inhibitors. Special emphasis will be given to the requirements necessary to obtain neoplastic transformation of human fetal cells. The testing for the tumorigenicity of cells exposed to different agents for different time intervals will continue.
Keywords: ANIMAL CELLS; IN VITRO; X RADIATION; ULTRAVIOLET RADIATION; CARCINOGENS; SYNERGISM; CARCINOGENESIS; MAN; FETUSES.

34288 Molecular Mechanisms of Mutagenesis and Carcinogenesis. Yang, N.C. (University of Chicago, School of Physical Sciences, 5801 South Ellis Avenue, Chicago, IL, 60637). **Project number:** ICA-10220-10. **Contract:** R01-CA-10220-10. **Supported by:** National Cancer Inst., Bethesda, MD (USA). **Funding:** HEW.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

A multiple fact approach including synthesis, reactions, esr and fluorescence spectroscopy, biological testing (in collaboration with other scientists) and theoretical treatment on the structure-activity relationship of chemical carcinogens will be used to study the molecular mechanisms of mutagenesis and carcinogenesis.
Keywords: MUTAGENESIS; CARCINOGENESIS; BIOCHEMISTRY; MOLECULES; FLUORESCENCE SPECTROSCOPY; ELECTRON SPIN RESONANCE.

35101 Liver Function, CO Toxicity and Oxygen Toxicity. Roberts, R.J.; Tephly, T.R. (University of Iowa, Department of Pharmacology, Iowa City, IA, 52240). **Project number:** 5-P50-GM-12675-130014. **Contract:** 5-P50-GM-12675-13. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA); National

Inst. of General Medical Sciences, Bethesda, MD (USA). **Funding:** HEW-$40,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project investigates the effects of carbon monoxide on liver metabolism, cerebral neurotransmitters, and development in young rats. The experimental strategies and methods are those of biochemical pharmacological toxicology. Preliminary results indicate changes in dopamine content and turnover, but not in norepinephrine.
Keywords: LIVER; DYNAMIC FUNCTION STUDIES; CARBON MONOXIDE; OXYGEN; TOXICITY; PHYSIOLOGY; INFANTS; PEDIATRICS; RATS.

35111 Chromosomal Flow Cytometry: DNA and Centromeres. Van Dilla, M.A. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** GM-25076-01. **Contract:** 1 R01 GM25076-01. **Supported by:** National Institutes of Health, Bethesda, MD (USA); National Inst. of General Medical Sciences, Bethesda, MD (USA). **Funding:** NIH-$145,000.
Related energy source: fossil fuels(80); nuclear fission(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

The objective is to design and build a new slit-scan chromosomal flow cytometer specifically for the high-speed quantitative analysis of DNA content, centromere location and centromere number of isolated metaphase human chromosomes. Our current cell-oriented system can measure the DNA content of one thousand fluorescently stained human chromosomes per second at coefficients of variation of 2 percent. The new system will operate at the same rate and with much tighter control of the trajectory and velocity of the chromosomes; in a major departure from previous design, it will excite fluorescence as the oriented chromosomes flow lengthwise through the narrow dimension of a thin ribbon of laser light, and will collect and process a time-dependent fluorescence profile from each chromosome. A dip in the profile will be used to identify and locate the centromere for metacentric chromosomes larger than human 13. DNA content will be measured with a coefficient of variation of 2 percent or less, and this, in conjunction with the centromeric index, will identify and give the relative frequency of 20 of the 24 human chromosome types. Detection of dicentric and multicentric chromosomes will also provide data on the incidence of a representative class of chromosomal aberrations. The evolving performance of the machine will be tested on uniform microspheres, rod-shaped abalone sperm, and in chromosomes of the Chinese hamster, muntjac, and human--whose centromeric properties can be predicted from their DNA content.
Keywords: CHROMOSOMES; DNA; CYTOCHEMISTRY; EQUIPMENT; CHROMOSOMAL ABERRATIONS; HAMSTERS; MUTAGENESIS; CARCINOGENESIS; BIOLOGICAL MODELS.

35451 Respiratory Diseases Due to Occupational Exposure. Craighead, J.E. (University of Vermont, Burlington, VT, 05401). **Project number:** P60-HL-17292. **Contract:** P60-HL-17292. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$1,139,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This project is part of a broader program (HL 17292-03) whose summary states: The Vermont Lung Center has as its major objectives: (1) integration into a cohesive operational system of existing lung programs in research, education, clinical demonstration, and regional disease management, including dissemination of information and technical assistance, health statistics and prevention and control; (2) interdisciplinary study, prevention and control of pneumoconiosis; (3) research in the pathology and management of acute pulmonary trauma, in basic methodology of computer-assisted instruction in pulmonary physiology in the pathology, pathogenesis, biochemistry, immunology, and cell physiology of diffuse interstitial lung disease (Vermont SCOR); (4) clinical demonstration and rapid application of new research findings in lung disease using the Problem Oriented Medical Information System (PROMIS); (5) regional management of specified lung disease problems utilizing an interhospital computer network; (6) graduate and post-graduate education using audio-visual aids and regional interactive television; (7) public education and information geared to lung disease problems specified by the regional Lung Disease Management Committee; (8) provision of a broadly based, multi-disciplinary Training Environment for undergraduate, graduate and post-graduate scientists, physicians, nurses, and allied health professionals in the various facets of research, clinical practice, teaching and continuing education in the biology of the lung, disease of the lung, and health care management of categorical problems related to the lung.
Keywords: RESPIRATORY SYSTEM DISEASES; LUNGS; DYNAMIC FUNCTION STUDIES; ETIOLOGY; INFORMATION SYSTEMS; THERAPY; PATHOLOGICAL CHANGES; PHYSIOLOGY; PUBLIC OPINION; EDUCATION.

35455 Immunology and Interstitial Fibrosis of the Lung Hyperbaric Oxygen, O2, Ozone or Peroxide Toxicity. Fishman, A.P. (University of Pennsylvania, Philadelphia, PA, 19104). **Project number:** P50-HL-15061. **Contract:** P50-HL-15061. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$342,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

This project is part of a broader program (HL 15061-06) whose summary states: A proposal is made for a supplement to the Specialized Center of Research (SCOR) at the University of Pennsylvania. As in the original proposal, the topic is The Response of the Lung to Injury. Six additional programs are outlined and described either as extensions of work currently in progress or as direct off-shoots of current research. The proposal not only describes these projects separately but also demonstrates their relationship to existing projects.
Keywords: IMMUNOLOGY; RESPIRATORY SYSTEM DISEASES; OXYGEN; PHYSIOLOGY; LUNGS; CHEMICAL COMPOSITION; TOLERANCE; CARBON MONOXIDE; TOXICITY; PEROXIDES; OZONE; RATS; METABOLISM; LIPIDS; INFLUENZA VIRUSES; NEONATES; FETUSES.

35457 Tolerance to Respiratory Gases in Health and Disease. Lambertson, C.J. (University of Pennsylvania, Philadelphia, PA, 19174). **Project number:** P01-HL-08899. **Contract:** P01-HL-08899. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$703,000.
Related energy source: fossil fuels(25); coal(25); oil and gas(25); wind(25). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

Investigations of the biological effects of metabolically active and inert respiratory gases were performed by dose-response methods to elaborate limits of tolerance to increasing partial pressures or density. Adaptations and deteriorations of sensory, cognitive, neuromuscular, pulmonary, respiratory, cardiovascular and exercise functions were determined to provide bases both for elucidating mechanisms of gas effects and prediting the consequences of complex exposures. Investigation of inert gas exchange in organs and tissues provided the basis for systems of decompression and aids understanding of biophysical factors in bubble formation and resolution. A major area of investigation concerns oxygenation and oxygen tolerance. Within the narrow range of oxygen pressures tolerated by living cells, the processes of cellular oxidation and energy metabolism depend upon effective delivery of oxygen to the metabolic site and the balance of oxidant-antioxidant processes. Inadequate tissue oxygenation limits the ultimate oxidation process. Excessive oxygenation, as in therapeutic or other use of high oxygen pressures, disrupts the enzyme activity upon which oxidation itself depends. Both oxygenation and oxidation processes, and even the poisoning by hypoxia, are affected by exposures to extreme alterations of carbon dioxide, inert gases, and certain respired toxic gases.
Keywords: METABOLISM; TOLERANCE; GASES; CARBON DIOXIDE; TOXIC MATERIALS; RESPIRATORY SYSTEM; DYNAMIC FUNCTION STUDIES; TOXICITY; HEALTH HAZARDS; DISEASES.

35458 Center for the Study of Chronic Airway Diseases. Bouhuys, A. (Yale University, School of Medicine, New Haven, CT, 06510). **Project number:** P50-HL-14179. **Contract:** P50-HL-14179. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Our SCOR program concerns the highly prevalent groups of diseases--termed chronic airway diseases in this proposal--which have as common features: (1) the presence of wheezing, sputum production, or cough, or a combination of these, often combined with shortness of breath, as principal symptoms; (2) the presence of airway obstruction as defined by lung function tests, varying in degree, duration, age of onset and amenability to drug treatment; (3) airway smooth muscle contraction, secretion of mucus in the bronchial tree, inflammation of the airway mucosa, or loss of structural support of the airways or any combination of these, re the main underlying pathological processes; and (4) an increased susceptibility--specific or nonspecific--to inhaled irritants, air pollutants and infectious agents affecting the respiratory tract.
Keywords: CHRONIC EXPOSURE; RESPIRATORY SYSTEM DISEASES; RESPIRATORY SYSTEM; LUNGS; DYNAMIC

FUNCTION STUDIES; ETIOLOGY; THERAPY; PATHOLOGICAL CHANGES; PHYSIOLOGY; HYDROCARBONS.

35459 Immune and Fibrotic Responses to Occupational Environment. Weill, H. (Tulane University, 1430 Tulane Avenue, New Orleans, LA, 70112). **Project number:** P50-HL-15092. **Contract:** P50-HL-15092. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$417,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The goal of this SCOR program is to provide the scientific basis for the prevention of fibrotic and immunologic lung diseases which are related to the occupational environment. A multidisciplinary approach is utilized in order to establish causal relationships, dose-response curves, and threshold levels of exposure in lung disorders which are related to the inhalation of mineral and organic dusts, and chemical vapors and gases. Disciplines incorporated in this center include pulmonary physiology, epidemiology, biostatistics, immunology, chest roentgenography, bioengineering, environmental chemistry and industrial hygiene. Significant emphasis is placed on newer methods of characterizing the inhaled environment which should lead to establishment of those methods which relate best to the indexes of an altered biologic response, and therefore most closely estimate the true exposure dose.
Keywords: RESPIRATORY SYSTEM DISEASES; ETIOLOGY; LUNGS; PATHOLOGICAL CHANGES; RESPIRATORY SYSTEM; PHYSIOLOGY; PERSONNEL; HEALTH HAZARDS; HAZARDOUS MATERIALS; STANDARDS; RECOMMENDATIONS.

35460 Bio-Organic Chemistry of Ozone, NO2 and Tobacco Smoke. Pryor, W.A. (Louisiana State University, Baton Rouge, LA, 70803). **Project number:** R01-HL-16092. **Contract:** R01-HL-16029. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$72,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

We propose to continue our study of the reactions of the airborne pollutants ozone, nitrogen dioxide, and cigarette smoke. All of these toxic pollutants either are free radicals or cause the formation of free radicals when they react with organic materials. We have chosen initially to concentrate our study on the reactions of these toxic agents with polyunsaturated fatty acids (PUFA) in a series of model systems of increasing complexity, starting with simple chemical model systems such as PUFA esters and lipids, then to aqueous systems such as liposome, and finally to biological membranes, in pulmonary alveolar macrophages.
Keywords: OZONE; NITROGEN DIOXIDE; TOBACCO SMOKES; TOXICITY; RADICALS; AIR POLLUTION; MACROPHAGES; BIOLOGICAL EFFECTS; BIOCHEMISTRY.

35461 Pulmonary Tissue Injury and Repair. Evans, M.J. (Stanford Research Institute, Menlo Park, CA, 94025). **Project number:** R01-HL-16330. **Contract:** R01-HL-16330. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$32,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The proposed research is a continuation of ongoing studies concerning pulmonary cell renewal as related to tissue injury and repair. Three areas of study are proposed. In the first, we will determine if the proliferative response following injury is a quantitative measure of the amount of injury. This will be accomplished by correlating the proliferative response with morphometric measurements of the amount of tissue damage following exposure to NO2. In the second area, we will test the ability of dietary vitamin E and selenium to alter the amount of lung damage. This will be accomplished by quantitating the amount of injury following exposure to NO2 of rats with diets supplemented and deficient in these antioxidants. In the third area, We will determine if tolerance in the epithelium of rats exposed to NO2 is associated with increased turnover or accumulation of cells. This will be accomplished by measuring the proliferative response and differentiation of Type 2 cells to Type 1 cells and nonciliated bronchiolar cells to ciliated cells in the epithelium tolerant to NO2.
Keywords: LUNGS; BIOLOGICAL REPAIR; TOLERANCE; INJURIES; NITROGEN DIOXIDE; DIET; VITAMIN E; SELENIUM; BRONCHI; PHYSIOLOGY; BIOLOGICAL EFFECTS.

35462 Airborne Metals and Lung Permeability. Gatzy, J.T. Jr. (University of North Carolina, School of Medicine, Chapel Hill, NC, 27514). **Project number:** R01-HL-16674-04. **Contract:** R01-HL-16674-04. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$31,000.
Related energy source: fossil fuels(25); coal(25); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objectives of this project are twofold: (1) to determine the factors that control the movement of solute and water across the lung epithelium; and (2) to elucidate the effects of airborne metals such as mercury and cadmium and of air pollutants such as ozone, sulfates, nitrates, and cigarette smoke on these control mechanisms. Two biological reparations, the amphibian lung and the perfused, microlavaged, mammalian alveolar sac, will be utilized to pursue the objectives. Fluxes of ions, water and heavy metals across the entire lung wall and luminal membrane of the alveolar epithelial cells will be measured in the excised bullfrog lung mounted as a planar sheet or as a sac. The effect of sulfhydryl compounds, EDTA, imidazoles and antioxidants on metal binding and on metal and ozone induced permeability changes will be measured in the intact, excised lung and in epithelial cells separated by enzymatic procedures. Similar measurements will be made by miropuncture techniques on the mammalian alveolar sac. Differences in the patterns of heavy metal protection afforded by luminal and blood-borne complexing agents may make it possible to differentiate between vascular and epithelial sites of metal action. In addition, changes in the pattern of response to heavy metals in lungs from animals with a surfeit of deficit of essential substances such as zinc, selenium and vitamin E may help identify cellular constituents that protect against lung damage.
Keywords: LUNGS; MEMBRANE TRANSPORT; MERCURY; CADMIUM; OZONE; SULFATES; NITRATES; TOBACCO SMOKES; EPITHELIUM; PHYSIOLOGY; PERMEABILITY.

35463 Mucocillary Transport Mechanisms. Sackner, M.A. (Mt. Sinai Medical Center, Miami Beach, FL, 33140). **Project number:** R01-HL-17816-03. **Contract:** R01-HL-17816. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$66,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

This study will extend observations made with a roentgenographic technique for measuring tracheal mucous velocity in unanesthetized sheep, normal humans and patients with chronic obstructive lung disease. Investigations will be made of the effects of environmental pollutants, drugs, and cigarette smoking on tracheal mucous velocity. The recovery of tracheal mucous velocity from oxygen suppression will also be determined. An in vivo technique for measuring rheology of mucus will be applied to the study of pathologic conditions. Modifications by pharmacologic agents and air pollutants of tracheal mucous velocity will be investigated.
Keywords: SHEEP; TRACHEA; MUCOUS MEMBRANES; PHYSIOLOGY; RESPIRATORY SYSTEM DISEASES; ETIOLOGY.

35464 Evaluation of Anti-Fibrotic Agents in Pulmonary Fibrosis. Giri, S. (University of California, School of Veterinary Medicine, Davis, CA, 95616). **Project number:** R01-HL-19720. **Contract:** R01-HL-19720. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$70,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The aim of the proposed investigation is to develop a scientific basis for screening a potentially desirable antifibrotic agent which could be of therapeutic value against the pulmonary fibrotic lesions. In this regard, first, attempts will be made to develop an acceptable model of pulmonary fibrosis in rats similar to humans by administering the herbicide paraquat. Thereafter, the effectiveness of anticollagenous agents such as zinc, beta-amino propionitrile and D-penicillamine against the pulmonary fibrosis will be tested. The ability of each antifibrotic agent to prevent and/or reverse the lung fibrosis will be evaluated by histopathological, biochemical and pulmonary function test studies.
Keywords: RATS; LUNGS; FIBROSIS; THERAPY; DRUGS; PHARMACOLOGY; ZINC.

35465 Effect of Pollutants on Organotypic Lung Cultures. Douglas, W.H. (Jones (W. Alton) Cell Science Center, Lake Placid, NY, 12946). **Project number:** R01-HL-21008. **Contract:** R01-HL-21008. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$30,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Utilizing an organotypic in vitro system, which shares many characteristics with lungs in whole animals, we plan to examine the

toxicity of various gaseous and particulate air pollutants on the histotypic organization of the cultures and on the synthesis, storage and secretion of the pulmonary surfactant by the type II alveolar pneumonocytes. After demonstrating that certain ultrastructural, cytochemical and biochemical characteristics found in whole lung are also present in our organotypic systems, we will subject the system to pollutants and observe the changes. More specifically, we will monitor the effects of pollutants on surfactant production by determining the rates of incorporation of 14C-choline into saturated lecithin and the cytochemical distribution os esterases. Fine structure analysis will be by transmission and scanning electron microscopy.
Keywords: LUNGS; ANIMALS; AEROSOLS; TISSUE CULTURES; GASES; PARTICLES; PHYSIOLOGY; AIR POLLUTION; BIOLOGICAL EFFECTS; MORPHOLOGICAL CHANGES.

35466 Selective Synthetic Inhibitors for Urinary Kallikrein. Shaw, E.N. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 06920. **Contract:** Y01-HV-70021. **Supported by:** National Heart, Lung, and Blood Inst., Bethesda, MD (USA). **Funding:** HEW-$72,000.
R and D categories: Health effects.

This project is an attempt to apply structural information to obtain a small molecule with a desired biological activity. Urinary kallikrein is a trypsin-like enzyme. Specific inactivators for members of this group of physiologically important enzymes can be prepared by affinity labeling using peptides with C-terminal arginine chloromethyl ketone or substrate-like sulfonylating reagents. Specificity arises out of steric differences in the extended binding sites of individual trypsin-like enzymes. It is proposed to extend studies that have been successful with plasma kallikrein and enzymes of blood coagulation to human urinary (cellular) kallikrein. Synthetic work will be evaluated by appropriate bioassay. The proposed work is expected to provide useful irreversible inactivators of human urinary kallikrein and cellular kallikreins.
Keywords: ENZYME INHIBITORS; ENZYMES; KALLIKREIN; BIOCHEMICAL REACTION KINETICS; BIOASSAY.

35551 Relationships of Diet and Air Pollutants to Aging. Privett, O.S. (University of Minnesota at Austin, 801 16th Avenue, NE, Austin, MN, 55912). **Contract:** 2R01AG00174-04. **Supported by:** Department of Health, Education, and Welfare, Washington, DC (USA). **Funding:** HEW-$32,000.
Related energy source: nuclear fuels(general)(50); solar(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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 degress 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 glycine were investigated.
Keywords: DIET; AGING; AGE DEPENDENCE; LIFE CYCLE; AIR POLLUTION; METABOLISM; RATS; KIDNEYS; LIPIDS; OZONE; BIOLOGICAL EFFECTS; TOXICITY; BIOLOGICAL MODELS.

36000 FDA Medical X-Ray Dose Estimation. Ford, M.R.; Warner, G.G. (Oak Ridge National Laboratory, Bldg. 4500-S, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 40-323-72. **Supported by:** Food and Drug Administration, Rockville, MD (USA). **Funding:** HEW-$25,000.
R and D categories: Health effects.

Approximately 200 absorbed dose/exposure ratios for a variety of mammography techniques will be calculated based on specifications for these techniques provided by BRH. Approximately 100 other calculations will be made for diagnostic radiology conditions using oblique incidence and for existing organs other than those for which the current data base in BRH is adequate (using specific values provided by BRH).
Keywords: X RADIATION; BIOMEDICAL RADIOGRAPHY; RADIATION DOSES; ORGANS; PATIENTS; SAFETY STANDARDS; X-RAY DOSIMETRY; COMPUTER CALCULATIONS.

36001 Food and Drug Administration (FDA) Employment of Mammalian Somatic Cell System. Hsie, A.W. (Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 40-589-76. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** HEW-$100,000.
R and D categories: Health effects.

Employing a mammalian cell gene mutational assay, CHO/HGPRT, our studies have focused on the structure-activity relationship of ethyl methanesulfonate and its congeners and the estimation of potential genetic hazard of major pesticides. The mutagenicity of alkylating agents decreases with the size of alkyl group. Based on mutants induced per unit mutagen concentration, the relative mutagenic potency is methyl methanesulfonate > ethyl methanesulfonate > isopropyl methanesulfonate. Similarly, dimethyl sulfate is more cytotoxic and mutagenic than ethyl sulfate. The relative mutagenic potency of five nitroso compounds is N-methyl-N'-nitroso-guanidine > N-ethyl-N'-nitro-N-nitrosoguanidine > N-methyl-N-nitrosourea > N-ethyl-N-nitrosourea > N-butylnitrosourea. A carcinogenic pesticide, captan, is also cytogenic and mutagenic. Although folpet has been shown to be noncarcinogenic, it is mutagenic in this system. Determination of the mutagenicity and cytotoxicity of other pesticides including bromacil, dinoseb, simazine, chloropyrifos, monuron and monocrotophos is progressing. These studies will continue pending new funding from the Environmental Protection Agency.
Keywords: SULFONIC ACID ESTERS; GENE MUTATIONS; PESTICIDES; NITROSO COMPOUNDS; SOMATIC CELLS; MUTAGENS; BIOASSAY; HEALTH HAZARDS; ALKYLATING AGENTS.

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50001 Department of Interior, Office of Water Research and Technology, Ecological Sciences Information Center, Assistance to Water Resources Scientific Information Center. Pfuderer, H.A. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** DOE-IA40(m)-47-7. **Supported by:** Department of the Interior, Washington, DC (USA). **Funding:** DOI-$15,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

Literature on the environmental effects of energy technologies is abstracted and indexed for the Water Resources Scientific Information Center. The subject areas of radioecology and effects of power plant cooling are emphasized.
Keywords: INFORMATION CENTERS; ENVIRONMENTAL EFFECTS; ENERGY SOURCES; WATER POLLUTION; RADIOECOLOGY; WATER RESOURCES; RADIOACTIVE EFFLUENTS; CHEMICAL EFFLUENTS; THERMAL EFFLUENTS; ENERGY; ENVIRONMENT.

51005 Ecological and Physiological Effects of Oil on Birds. Stickel, L.F. (Patuxent Wildlife Research Center, Laurel, MD, 20810). **Project number:** 77 EAV. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** EPA-$300,000; ECE-$50,000; FWS-$40,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to test and adapt analytical methods for identification of oil in tissues and eggs, to evaluate the effects of oil on viability of eggs and on survival, to assess the prevalence of oil ingestion by wild birds and relate tissue levels of oil to damage, and to assess the joint effects of oil and chemicals on survival. Realistic dietary dosage with measurements of egg production, fertility, hatchability and survival of chicks using ducks will be undertaken. Adult male and female ducks are fed sublethal and lethal dosages of oil, with measurements of mortality, pathology, and blood enzymes being collected. Oil is introduced artificially and by light oiling of incubating hens. Kinetics of oil are followed when ingested directly and secondarily through food items.
Keywords: PETROLEUM; BIOLOGICAL EFFECTS; BIRDS; ECOLOGY; PHYSIOLOGY; BIOASSAY; INGESTION; CHEMICAL EFFLUENTS; SYNERGISM; DIET; MORTALITY; PATHOLOGICAL CHANGES; BLOOD; ENZYMES; BIOCHEMICAL REACTION KINETICS; NATURAL GAS INDUSTRY; METABOLISM; OIL SPILLS.

51006 Ecological Characterization of the Chenier Plain of Southwest Louisiana and Southeast Texas. Johnston, J. (National Space Technology Labs., Coastal Ecosystems Team, NSTL Station, MS, 39529). **Project number:** 14-16-0008-2052. **Supported by:** Fish and Wildlife Service, NSTL Station, MS (USA). Office of Biological Services. **Funding:** EPA-$100,000; FWS-$30,000.

Related energy source: coal(20); oil and gas(60); hydroelectric(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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 understanding of the Chenier Plain ecosystem. The characterization will include a comprehensive analysis and description of the environmental features of the ecosystem, the major study segments being divided into physical, socioeconomic and biological features. This will provide a predictive potential to allow decisionmakers to quickly test and evaluate impacts. It will also allow the identification of areas with data deficiencies.

Keywords: BASELINE ECOLOGY; TERRESTRIAL ECOSYSTEMS; AQUATIC ECOSYSTEMS; ENVIRONMENTAL IMPACTS; SOCIO-ECONOMIC FACTORS; BIOLOGICAL EFFECTS; DECISION MAKING; FOSSIL FUELS; MATHEMATICAL MODELS; BIOLOGICAL MODELS; LOUISIANA; TEXAS.

51007 Fish and Wildlife Impact of Energy Development in the Four Corners Region. Kneese, A.V. (University of New Mexico, Department of Economics, Albuquerque, NM, 87103). **Project number:** 14-16-0008-2015. **Contract:** 14-16-0008-2015. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI. **Related energy source:** fossil fuels(20); nuclear fuels(general)(20); hydroelectric(20); geothermal(20); solar(20). **R and D categories:** Integrated assessment.

The objectives of this project are: (1) to assess the impact of continued energy development in the Four Corners Region on fish and wildlife resources by investigating the implications of increased population resulting from southwestern energy resource development; (2) to examine the institutional and substantive problems associated with managing these impacts, and provide management alternatives under various southwestern development scenarios; (3) to develop a plan integrating biology and economics--economic analysis of energy development to be translated into biological impacts on fish and wildlife; and (4) to provide energy development scenarios and recreation dispersion models.

Keywords: ARIZONA; COLORADO; NEW MEXICO; UTAH; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; ECONOMIC IMPACT; BIOLOGICAL EFFECTS; FISHES; WILD ANIMALS; POPULATION DYNAMICS; MANAGEMENT; BIOLOGY; ECONOMICS; ECOSYSTEMS; MATHEMATICAL MODELS.

51013 Trace Substances in Wildlife Food Chains. Nagy, J.G. (Colorado State Univ., Office of Sponsored Research, Fort Collins, CO, 80523). **Project number:** 14-16-0008-2111. **Contract:** 14-16-0008-2111. **Supported by:** Fish and Wildlife Service, Fort Collins, CO (USA). Western Energy and Land Use Team. **Funding:** DOI-$125,000.

Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to produce a computer-accessible information bank on the known or suspected adverse effect on wildlife of toxic elements; collect information on the occurrence, distribution, and food habits and major food chains of the fauna occupying the various ecological units of the oil shale region; produce baseline information on the natural levels of potentially toxic elements in plant parts; and produce similar information for fauna. Data will be collected on trace element concentrations in animal tissues and in selected plant materials, and on actual/likely sources of trace mineral contaminations. Interim, literature review, progress, and final reports will be expected from this project.

Keywords: FOOD CHAINS; CONTAMINATION; TRACE AMOUNTS; WILD ANIMALS; TOXINS; OIL SHALE INDUSTRY; CHEMICAL EFFLUENTS; ENVIRONMENTAL IMPACTS; BIOLOGICAL EFFECTS; ECOLOGICAL CONCENTRATION; MINERALS; NUTRIENTS; FISHES.

51014 Techniques for Predicting Entrainment and Impingement at Power Plants. Eraslan, A.H.; Kim, K.H. (University of Tennessee, Office of the Vice Chancellor for Graduate Studies and Research, Knoxville, TN, 37916). **Project number:** 14-16-0008-2094. **Contract:** 14-16-0008-2094. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** FWS-$6,000.

Related energy source: hydroelectric(100). **R and D categories:** Characterization, measurement, and monitoring.

This project was undertaken to develop a model to predict the numbers of organisms and the proportion of the populations of these organisms that will be withdrawn with cooling water at power plants. Entrainment, impingement, and entrapment losses cannot be adequately predicted prior to operation of power plants utilizing existing analytical techniques. Such losses are considered to be most serious impacts of power plants on fishery resources.

Keywords: THERMAL POWER PLANTS; COOLING SYSTEMS; SURFACE WATERS; AQUATIC ORGANISMS; IMPINGEMENT; FORECASTING; MATHEMATICAL MODELS; ENVIRONMENTAL EFFECTS; RESEARCH PROGRAMS; ENTRAINMENT.

51015 Evaluation of Density-Dependent Mortality in Fish Populations as It Relates to the Impact of Entrainment and Impingement Losses at Power Plants. Tipton, A.R.; Lackey, R. (Virginia Polytechnic Inst. and State University, Blacksburg, VA, 24061). **Project number:** 14-16-0008-2068. **Contract:** 14-16-0008-2068. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI.

The objectives are to: (1) summarize, analyze, and evaluate existing evidence of compensation in fish populations; (2) provide a list of all known forms of density-dependent mechanisms in fish populations and determine how these mechanisms could interact singly or in combination to offset power plant induced stresses or fish populations; and (3) present scientifically and statistically reliable guidelines for measurement of compensation in fish populations. Utility companies currently assume that the operation of density-dependent processes will offset or compensate for the increases in mortality rates in aquatic populations that result from entrainment and impingement at power plants. For the most part, regulatory agencies cannot evaluate the degree to which such processes may offset power plant induced mortalities because the operation of such mechanisms is not supported by documentation in the field or literature.**Keywords:** FISHES; POPULATION DENSITY; ENTRAINMENT; IMPINGEMENT; THERMAL POWER PLANTS; MORTALITY; ENVIRONMENTAL IMPACTS.

51017 Management of Transmission Line Rights-of-Way for Fish and Wildlife. Galvin, M.T. (Asplundh Environmental Services, Inc., Blair Mill Road, Willow Grove, PA, 19090). **Project number:** 14-16-0008-2150. **Contract:** 14-16-0008-2150. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** FWS-$72,000; NRC-$5,000.

The objective is to prepare a technical assistance manual which integrates fish and wildlife management techniques and special problems in transmission line ROW management into comprehensive management strategies for land used as ROW by electric utilities throughout the United States. Utilities presently own or control vast acreages of land as a result of the production, transformation, and transmission of energy resources. Electric utilities operate over 300,000 miles of overhead electric transmission lines which require an estimated 4 million acres of land for rights-of-way (ROW). For the most part these lands represent potential fish and wildlife habitats that are not being fully utilized because of a lack of comprehensive fish and wildlife resources management plans.**Keywords:** POWER TRANSMISSION LINES; RIGHTS-OF-WAY; MANAGEMENT; WILD ANIMALS; MANUALS; FISHES; LAND USE; HABITAT; RANGELANDS; ELECTRIC UTILITIES; ELECTRIC POWER.

51021 Assessment of Oil and Gas Development on Federal Refuges Along the Gulf Coast. Brown, W. (Research Planning Consultants, P.O. Box 13517, Austin, TX, 78711). **Project number:** 14-16-0008-2152. **Contract:** 14-16-0008-2152. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI-$15,000.

Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

A program is in progress to develop a report which describes and documents the management of oil and gas development on wildlife refuges along the Louisiana and Texas coasts through an analysis of guidelines, standards, and stipulations imposed on development activities in these areas. The work consists of a series of case study surveys comparing the effects of oil and gas operations on fish and wildlife on Gulf coastal refuges where regulations and stipulations are in effect, with selected comparable Gulf coastal areas where oil and gas activities are conducted under less regulated conditions.

Keywords: LOUISIANA; TEXAS; COASTAL REGIONS; WILD ANIMALS; HOME RANGE; NATURAL GAS FIELDS; OIL FIELDS; EXPLOITATION; ENVIRONMENTAL IMPACTS.

51023 Technical Assistance on Strategy for Assessing Impacts of Power Plants on Populations of Fishes and Shellfishes. Muraka, I.P. (Argonne National Lab., 9700 S. Cass Ave. (EIS-10), Argonne, IL, 60439). **Project number:** 14-16-0009-78-934. **Supported by:** Fish and Wildlife Service, Ann Arbor, MI (USA). **Funding:** DOI-$42,000. **Related energy source:** fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The National Power Plant Team has embarked on developing strategies with an attempt to prepare manuals that would present descriptive, comparative and/or predictive methods on how to identify relevant hypotheses, how to test relevant hypotheses, and how to determine the statistical basis for obtaining useful data by the field measurements. We are providing the statistical expertise in this project. Out tasks are to review several existing assessment reports and then arrive at strategies and broad base methodologies.
Keywords: POWER PLANTS; ENVIRONMENTAL IMPACTS; FISHES; MOLLUSCS; POPULATION DYNAMICS; MANUALS; COMPARATIVE EVALUATIONS; RISK ASSESSMENT; MEASURING METHODS.

51024 Ecological Implications of the Use of Coal in Electric Power Generation Plants. Dvorak, A.J. (Argonne National Laboratory, 9700 South Cass Avenue, EIS-10, Argonne, IL, 60439). **Project number:** 14-16-0009-77-952. **Supported by:** Fish and Wildlife Service, Ann Arbor, MI (USA). **Funding:** DOI-$60,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

This project assesses expected impacts to biota and their habitat associated with the operation of coal-fired power plants. The scope is limited to impacts from the point at which coal is delivered to the plant site through final disposal of waste products. In order to provide a comparison of the environmental trade-offs of substituting coal for petroleum products or natural gas in electric generating stations, those impacts associated with oil-fired stations, natural-gas-fired stations, and stations converted from oil- or natural-gas-fired to coal-fired that are different from coal-fired stations are addressed. The impacts of features that are not unique to steam-electric stations--e.g., condenser cooling systems, cooling-water intakes and discharges, cooling towers and other off-stream methods of cooling and cooling-water treatment, and transmission lines--are not addressed. Additional data can be obtained from the principal investigator.
Keywords: FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; ECOSYSTEMS; BIOLOGICAL EFFECTS; AIR POLLUTION; WASTE DISPOSAL.

51025 Mississippi Deltaic Plain Region Characterization. Johnston, J. (U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, 20036). **Project number:** 14-16-0009-78-944. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). Office of Biological Services. **Funding:** BLM-$378,000; FWS-$10,000.
Related energy source: coal(20); oil and gas(60); hydroelectric(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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 ecosystems level of understanding for the Mississippi Deltaic Plain Region 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: MISSISSIPPI RIVER; LOUISIANA; DATA ACQUISITION; PETROLEUM; NATURAL GAS; TRANSPORT; FISHING INDUSTRY; FISHES; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; HABITAT; MAPPING; SOCIO-ECONOMIC FACTORS; ENVIRONMENTAL IMPACTS; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; DATA COMPILATION; RECREATIONAL AREAS; BASELINE ECOLOGY; CONTINENTAL SHELF.

51026 Ecological Characterization of the Coastal Region of Maine. Fefer, S. (U.S. Fish and Wildlife Service, One Gateway Center, Suite 700, Newton Corner, MA, 02158). **Project number:** 14-16-0009-77-021. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** FWS-$50,000.
Related energy source: coal(20); oil and gas(60); hydroelectric(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The ojective 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 understanding of the Maine coast ecosystem. The characterization will include a comprehensive analysis and description of the environmental features of the ecosystem; the major study segments being divided into physical, socio-economic and biological features. This will provide a predictive potentional to allow decisionmakers to quickly test and evaluate impacts. It will also allow the identification of areas with data deficiencies.
Keywords: COASTAL REGIONS; MAINE; INFORMATION SYSTEMS; PHYSICAL PROPERTIES; SOCIO-ECONOMIC FACTORS; BIOLOGICAL EFFECTS; POPULATION DYNAMICS; DECISION MAKING; BASELINE ECOLOGY; AQUATIC ECOSYSTEMS.

51027 Environmental Planning for Offshore Oil and Gas. Clark, J. (Conservation Foundation, 1717 Massachusetts Ave., NW, Washington, DC, 20036). **Project number:** 14-16-0008-962. **Contract:** 14-16-0008-962. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI-$15,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

A program is announced that is being conducted to understand and prepare for the full range of primary and secondary environmental effects of the five phases of petroleum development: pre-exploration, exploration, oil field development, production and transport. The sequential development for any Outer Continental Shelf (OCS) area with their corresponding environmental impacts will be assessed. Extensive literature search and synthesis, as well as interviews, interagency coordination, and other methods will be used to obtain information for reports. Tasks covered include OCS technology, secondary effects, regulatory functions in OCS process, regional analysis and environmental impacts.
Keywords: NATURAL GAS WELLS; OIL WELLS; OFFSHORE DRILLING; ENVIRONMENTAL IMPACTS; PLANNING; REGIONAL ANALYSIS.

51028 Marine Bird Information Synthesis for South Texas and South Atlantic OCS Lease Areas. Howe, M. (National Fish and Wildlife Lab., U.S. National Museum, Constitution Ave., Washington, DC, 20036). **Project number:** 14-16-0009-78-917. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** BLM-$88,000; FWS-$4,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objective is to prepare a synthesis of the available information about marine birds occurring on the South Texas and South Atlantic OCS lease areas. This is done by the accumulation, analysis, and synthesis of all available information and the preparation of a final report that discusses the biological and ecological aspects of marine birds that should be considered during an environmental assessment of the possible impact of oil and gas development.
Keywords: AQUATIC ECOSYSTEMS; TEXAS; OFFSHORE OPERATIONS; CONTINENTAL SHELF; DATA ANALYSIS; DATA COMPILATION; ENVIRONMENTAL IMPACTS; BASELINE ECOLOGY; ATLANTIC OCEAN; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; BIRDS; POPULATION DYNAMICS.

51029 Geothermal Development Implications. (University of Texas, Austin, TX). **Project number:** 14-16-0008-2141. **Contract:** 14-16-0008-2141. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI.
Related energy source: geothermal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The project objectives are to: (1) assess potential for development of geothermal energy resource; (2) identify fish and wildlife impacts to be anticipated from development; and (3) identify development alternatives, mitigation options, sensitive ecological areas and research needs.
Keywords: GEOTHERMAL RESOURCES; RESOURCE POTENTIAL; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; ECOLOGY; FISHES; WILD ANIMALS.

51030 Ecological Characterization of the Pacific Northwest Coastal Region. Proctor, C.M. (Ryckman, Edgerley, Tomlinson and Associates, Inc., 100 116th Avenue, SE, Bellevue, WA, 98004). **Project number:** 14-16-0009-77-019. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI-$42,000.
Related energy source: coal(20); oil and gas(60); hydroelectric(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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 understanding of the Pacific Northwest Coastal ecosystem. The characterization will include a comprehensive description and analysis of the environmental features of the ecosystem, the major study segments being divided into physical socio-economic and biological features. This

will provide a predictive potential to allow decisionmakers to quickly test and evaluate impacts. It will also allow the identification of areas with data deficiencies.
Keywords: PACIFIC NORTHWEST REGION; COASTAL REGIONS; BASELINE ECOLOGY; ENVIRONMENTAL IMPACTS; ECOSYSTEMS.

51031 Mitigation Goals for Oil Shale. Russell, K. (Colorado Cooperative Research Unit, Fort Collins, CO, 80523). **Project number:** 14-16-0008-2016. **Contract:** 14-16-0008-2016. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** FWS-$125,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

A program was funded to identify most significant fish and wildlife population reductions that will result from environmental changes caused by oil shale development; to formulate a list of candidate mitigation goal alternatives; and to evaluate the effectiveness of a sample of previous attempts to mitigate wildlife population reductions. The program comprises field studies, assembly of presently existing data, and expected communication with persons in key areas. Computer programs, progress and final reports are to be supplied.
Keywords: OIL SHALE MINING; ENVIRONMENTAL IMPACTS; WILD ANIMALS; FISHES; POPULATION DENSITY; MORTALITY.

51032 Survey of Seabirds of Alaska: OCS Environmental Studies. Lensink, C.J. (U.S. Fish and Wildlife Service, 1011 E. Tudor Rd, Anchorage, AK, 99507). **Project number:** RU 337;RU 341. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** BLM-$500,000; FWS-$4,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objective is to develop an information base about pelagic and marine birds in Alaska marine and coastal environments. The study will (a) determine seasonal density distribution, (b) catalogue colonies by location, species composition, colony size and area occupied, (c) determine migratory routes and dispersal patterns, (d) determine feeding ecology and trophic relationships, (e) determine population dynamics of selected species, and (f) conduct a review and analysis of the literature and unpublished data about Alaska marine birds relevant to evaluating potential impacts from OCS development.
Keywords: BIRDS; ALASKA; OFFSHORE OPERATIONS; ENVIRONMENTAL IMPACTS; POPULATION DYNAMICS; BASELINE ECOLOGY; CONTINENTAL SHELF; SEASONAL VARIATIONS; DATA COMPILATION; AQUATIC ECOSYSTEMS.

51033 Ecological Characterization of the Sea Islands and Coastal Plain of South Carolina and Georgia. Joseph, E.B. (South Carolina Marine Resource Division, P.O. Box 12559, Charleston, SC, 29412). **Project number:** 12-16-0009-77-016. **Supported by:** Fish and Wildlife Service, Washington, DC (USA). **Funding:** DOI-$42,000.
Related energy source: coal(20); oil and gas(60); hydroelectric(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is the structured synthesis of existing information and data into an information base identifying the functional relationships of matural processes and components of the ecosystem. This information base will reflect an ecosystem-level understanding of the Sea Islands ecosystem. The characterization will include a comprehensive description and analysis of the environmental features of the ecosystem, the major study segments being divided into physical, socio-economic and biological features. This will provide a predictive potential to allow decisionmakers to quickly test and evaluate impacts. It will also allow the identification of areas with data deficiencies.
Keywords: SOUTH CAROLINA; GEORGIA; COASTAL REGIONS; BASELINE ECOLOGY; ECOSYSTEMS; ENVIRONMENTAL IMPACTS.

52001 Ecological-Limnological Impact of Pumped Storage. LaBounty, J.F. (Bureau of Reclamation, Denver Federal Center, P.O. Box 25007, Denver, CO, 80205). **Project number:** DB-381. **Supported by:** Bureau of Reclamation, Denver, CO (USA). **Funding:** DOI-$74,000.
Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objective is to determine ecological impact of pumped storage project on Twin Lakes, Colorado. Twin Lakes is used as study area. Preoperational data have been obtained with postoperational data as next step.
Keywords: PUMPED STORAGE POWER PLANTS; BASELINE ECOLOGY; LIMNOLOGY; WATER RESERVOIRS; LAKES; HYDROELECTRIC POWER; ENVIRONMENTAL EFFECTS; MONITORING; AQUATIC ECOSYSTEMS; OPERATION.

52002 Ecological Assessment of Effects of Grand Coulee Dam--Banks Lake Pumped-Storage. Streber, O.J. (University of Washington, Fisheries Research Institute, Seattle, WA, 98195). **Project number:** R1-20. **Contract:** 14-06-100-7794. **Supported by:** Bureau of Reclamation, Denver, CO (USA). **Funding:** DOI-$55,000.
Related energy source: hydroelectric(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine impact of pumped-storage on fishery at Banks Lake. Lake and power plants are used as field site. Later phase of research will determine effectiveness of fish barrier.
Keywords: PUMPED STORAGE POWER PLANTS; HYDROELECTRIC POWER; WATER RESERVOIRS; FISHES; ENTRAINMENT; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; LAKES; IRRIGATION; POPULATION DYNAMICS; LIMNOLOGY; BASELINE ECOLOGY.

52501 Citrate Process--Evaluation and Selection of Materials. Henry, J.L. (Bureau of Mines Albany Metallurgy Research Center, P.O. Box 70, Albany, OR, 97321). **Project number:** 4555-1. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$200,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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 H2S--CO2--H2O mixtures under operating conditions. Corrosion rates of materials of construction under simultated operating conditions will be determined.
Keywords: FOSSIL-FUEL POWER PLANTS; FLUE GAS; DESULFURIZATION; CITRATE PROCESS; MATERIALS; MATERIALS TESTING; DEMONSTRATION PLANTS; CORROSION; CORROSION PROTECTION; SULFUR; CITRATES; SODIUM COMPOUNDS; SULFUR DIOXIDE; REMOVAL.

52502 Citrate Process Chemistry and Engineering. Nissen, W.I. (Bureau of Mines, 1600 East 1st South, Salt Lake City, UT, 84112). **Project number:** 9370-8. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$300,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this project are to define 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 flexibility, 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: GASEOUS WASTES; PURIFICATION; AIR POLLUTION ABATEMENT; SULFUR DIOXIDE; REMOVAL; DESULFURIZATION; CITRATE PROCESS; CHEMISTRY; DEMONSTRATION PLANTS; ECONOMICS; FOSSIL-FUEL POWER PLANTS; FLUE GAS.

52503 Analysis of Fire Safety Tests and Standards. Burgess, D. (National Bureau of Standards, Gaithersburg, MD, 20760). **Project number:** 03026. **Contract:** J0188042. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$180,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

The program is designed to complement an MSHA (Mine Safety and Health Administration) contract with the National Bureau of Standards to develop tests and standards for use by the Approval and Certification Center. Since this objective involves some pioneering research and MSHA is not authorized to fund research, the present Bureau funding is intended to provide such flexibility as NBS may require. The MSHA commitment is for a 5-year program; it is expected that the research aspect will continue through most, if not all, of this period of time.
Keywords: COAL MINING; SAFETY STANDARDS; HEALTH HAZARDS; SAFETY; FIRES; FIRE PREVENTION; EVALUATION.

52504 Roof Failure Analysis. Moebs, N. (Morehead State University, Morehead, KY, 40351). **Project number:** 03032. **Contract:** J0188002. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$69,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

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.
Keywords: KENTUCKY; COAL MINES; UNDERGROUND MINING; ROOFS; SAFETY; MAPS; GEOLOGIC FAULTS; HAZARDS; FAILURES.

52505 Coal Mine Combustion Products: Identification and Analysis. Christus, T. (Ultrasystems, Inc., Irvine, CA, 94538). **Project number:** 03154. **Contract:** H0133004. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$46,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

The aim of this program is to assess the potential hazard arising from the evolution of toxic products upon thermal oxidative decomposition of materials used in underground mining operations. In work accomplished thus far, the following materials have been studied: (1) polyvinyl chloride compositions, (2) neoprene compositions, (3) conveyor belts, (4) pure ingredients used in conveyor belt compounding, (5) urethane foams, (6) woods, (7) hydraulic fluids, and (8) halogenated compounds such as flame retardants, fire extinguishing agents, and solvents. The object of the present program is to prepare a composite report which can be used as a reference handbook. The report will contain an up-to-date bibliography for the entire program of research.
Keywords: COAL MINING; UNDERGROUND MINING; HEALTH HAZARDS; MATERIALS; PYROLYSIS; PVC; NEOPRENE; CONVEYORS; URETHANE; WOOD; HYDRAULIC EQUIPMENT; WORKING FLUIDS; ORGANIC HALOGEN COMPOUNDS; FIRE EXTINGUISHERS; ORGANIC SOLVENTS; MANUALS; BIBLIOGRAPHIES; FIRES; OXIDATION; SAFETY; HYDROCARBONS; GASES; TOXICITY.

52506 Theoretical Investigation of Seismic Waves Generated in Coal Mines. Durkin, J. (Pennsylvania State University, University Park, PA, 16802). **Project number:** 03529. **Contract:** G0155044. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$30,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

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 possibly 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 outline its application in detecting and locating trapped miners. To date, work on 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: COAL MINING; UNDERGROUND MINING; SEISMIC NOISE; MONITORING; SEISMIC DETECTORS; DISTRIBUTION; COAL MINERS; MINE RESCUE.

52507 Physiological Responses of Miners to Emergency. Stein, R. (Pennsylvania State University, University Park, PA, 16802). **Project number:** 03531. **Contract:** G0155006. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$81,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

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 on men, effect of inhalation of hot air, and effectiveness of cooling garments to relieve heat stress during rescue missions. A new series of 30 CFR 11H man tests will be developed and evaluated.
Keywords: COAL MINING; UNDERGROUND MINING; ACCIDENTS; MINERS; COAL MINERS; PHYSIOLOGY; EMERGENCY PLAN; BIOPHYSICS; MINE RESCUE; BIOLOGICAL FATIGUE; AMBIENT TEMPERATURE; COOLING; THERMAL STRESSES; HEALTH HAZARDS; SAFETY.

52508 Abatement of Noise of Continuous Miners. Bartholomae, R. (Bolt, Beranek and Newman, Inc., Arlington, VA, 22212). **Project number:** 03609. **Contract:** H0155113. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$268,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

A noise survey of a representative cross-section of continuous miners is to be performed with the goal of defining the major sources of noise associated with the continuous miner. In-mine retrofit abatement methods are to be developed and evaluated experimentally using a full scale test setup and on a modified continuous miner. The resulting modifications should reduce the noise level to 90 dbA or less. Recommended designs and modifications shall be compatible with all underground coal mine environments and shall satisfy all applicable requirements of MSHA's Schedule 2G and PL-173.
Keywords: COAL MINING; UNDERGROUND MINING; MINING EQUIPMENT; CONTINUOUS MINERS; NOISE; NOISE POLLUTION ABATEMENT; RETROFITTING; COMPARATIVE EVALUATIONS; HEALTH HAZARDS.

52509 Statistical Survey of Miners. Wiehagen, W. (John Short and Associates, Salt Lake City, UT). **Project number:** 03753. **Contract:** J0357109. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$83,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

The study of methodology proposed will provide a planning document for industry and government officials which will assist them to: (1) gain a 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--2000) extent, location, and workforce characteristics 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.
Keywords: MINING; COAL MINING; UNDERGROUND MINING; COAL MINERS; EDUCATION; SAFETY; INDUSTRIAL MEDICINE; FORECASTING; MINERS.

52510 Investigation of Direct Airborne Noise Generated During Coal Cutting. Burks, J.A. (Wyle Laboratories, Huntsville, AL, 35801). **Project number:** 03901. **Contract:** J0177060. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$76,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

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.
Keywords: COAL MINING; UNDERGROUND MINING; MINING EQUIPMENT; NOISE; CUTTING TOOLS; NOISE POLLUTION ABATEMENT; HEALTH HAZARDS.

52511 Recalculation of the Effect of Fires on the Ventilation System of Mines. Singer, J. (Michigan Technological University, Houghton, MI, 49931). **Project number:** 03981. **Contract:** J0285002. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$25,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

A report shall be prepared on the precalculation of the effect of fires on ventilation systems in mines. The report will contain practical applications of the computer program previously developed (Contract S0241032) to account for the influence of mine fires on ventilation networks. Approximately six coal and metal and nonmetal mines will be considered with at least one realistic fire scenario considered for each mine. The results of the calculation will be to predict air flow, temperature and gas concentration distributions from which danger zones and escape routes can be derived.
Keywords: COAL MINING; MINING; UNDERGROUND MINING; FIRES; VENTILATION SYSTEMS; COMPUTER CALCULATIONS; HEALTH HAZARDS; MINE RESCUE; SAFETY; GASES.

52512 Instruments and Techniques for Dynamic Particle Size Measurements of Coal Dust. Zeller, H.W. (University of Minnesota, Minneapolis, MN, 55455). **Project number:** 05304. **Contract:** H0177026. **Supported by:** Bureau of Mines, Washington, DC (USA). **Funding:** DOI-$100,000.
Related energy source: coal(100). **R and D categories:** Operational safety.

The contractor will develop and evaluate instruments and techniques for measuring airborne respirable dust. To date the con-

tractor 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. The current objectives are to continue evaluations of commercial dust monitors; develop a compact, permissible dust sizing instrument; develop a dust classifier; and build a submicron cascade impactor.
Keywords: COAL MINING; UNDERGROUND MINING; DUSTS; MEASURING METHODS; PARTICLE SIZE; MONITORING; CLASSIFICATION; CASCADE IMPACTORS; AIR POLLUTION MONITORS; EVALUATION.

53006 Effects of Petroleum Hydrocarbons on Marine Organisms of Northeast Pacific. Malins, D.C.; Rice, S. (Northwest and Alaska Fisheries Center, 2725 Montlake Blvd. East, Seattle, WA, 98112). **Project number:** 8-8C2U. **Supported by:** Northwest and Alaska Fisheries Center, Seattle, WA (USA). **Funding:** BLM-$450,000; EPA-$195,000; FWS-$169,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective is to determine impacts of crude oil, salt water soluble fraction of oil, refined products, aromatic hydrocarbons and their metabolites on behavior and viability of marine organisms indigenous to the Northeast Pacific (Northwest and Alaska). Interdisciplinary studies will utilize laboratory and field studies to relate exposure to amounts of oil fractions or multiple compounds over long periods on sensory systems, morphology, biochemical mechanisms, and physiology during different life stages of vertebrates and invertebrates. Port Valdez and Prince William Sound will be monitored for changes of petroleum hydrocarbons in sediment, water and biota and population changes in intertidal organisms after start of operations of the Trans-Alaska pipeline.
Keywords: PETROLEUM; PETROLEUM PRODUCTS; AROMATICS; BIOLOGICAL EFFECTS; PACIFIC OCEAN; TIME DEPENDENCE; MORPHOLOGY; BIOCHEMICAL REACTION KINETICS; PHYSIOLOGY; OIL SPILLS; ALASKA OIL PIPELINE; HYDROCARBONS; AQUATIC ORGANISMS; PATHOGENESIS; SEDIMENTS; VIABILITY; CONTAMINATION.

54001 U.S. Lineaments. Carter, W.D. (U.S. Geological Survey, 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: hydroelectric(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

Lineaments of the coterminous 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 is now underway to determine if strike-slip faults may be the cause of major offsets in the drainage pattern of the Penobscot and Kennebec Rivers.
Keywords: HYDROELECTRIC POWER PLANTS; GEOLOGY; TOPOGRAPHY; USA; MAINE; SITE SELECTION; RIVERS; MAPS; EARTH PLANET.

54002 Targeting Mineral Exploration. Taranik, J.V. (U.S. Geological Survey, EROS Data Center, Sioux Falls, SD, 57198). **Project number:** E-18. **Supported by:** Geological Survey, Sioux Falls, SD (USA). **Funding:** DOI-$79,000.
Related energy source: coal(10); oil and gas(60); oil shales and tar sands(10); nuclear fuels(general)(10); geothermal(10). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

A program is reported to demonstrate the usefulness of remote sensing and geophysical data and the effectiveness of data analysis techniques for: (1) targeting the areas for ground-based mineral exploration; (2) development of exploration strategies; and (3) rating and evaluating the development of successfully targeted mineral deposits in the light of environmental factors. Sites are being evaluated in different geologic settings where petroleum and ore deposits have already been defined by ground-based exploration effort. Existing multispectral remotely sensed data and geophysical data are being evaluated at different scales, accuracies and formats using different data analysis techniques. Conceptual exploration models are being developed that will enable exploration to be targeted for selected areas. Areas where mineral deposits are suspected will then be targeted using developed techniques. Success of the targeting procedures will be demonstrated through on the ground investigations conducted in the public domain.
Keywords: MINERAL RESOURCES; PETROLEUM DEPOSITS; GEOPHYSICAL SURVEYS; DATA ANALYSIS; REMOTE SENSING; TECHNOLOGY ASSESSMENT.

54005 Earth Sciences Applications. Nichols, D.R. (U.S. Geological Survey, 720 National Center, Reston, VA, 22092). **Project number:** S1-11. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$1,430,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

The objectives are to demonstrate for areas of diverse geologic and hydrologic conditions the application of earth-sciences data to the material benefit of urban land-use planning and decision making; and to provide land-resource and hazard data and relate to decisions on facility siting and other on-shore effects of oil and gas importation in a form directly usable by land-use planners and decisionmakers. The approaches are compilation and analysis of file data; field measurement of hydrologic properties and conditions of aquifers; analysis of streamflow and infiltration characteristics; geophysical and geologic mapping; direct and indirect field measurements of floods; engineering soils tests; horizontal level control surveys; various remote sensing techniques where appropriate; publication mainly as single purpose, individual maps or folio with text, designed for the land-use planner/decisionmaker.
Keywords: TECHNOLOGY TRANSFER; TECHNOLOGY UTILIZATION; LAND USE; DECISION MAKING; HAZARDS; SITE SELECTION; DATA COMPILATION; DATA ANALYSIS; FLOODS; REMOTE SENSING; MAPS; HYDROLOGY.

54012 Mined Area Reclamation and Related Land Use Planning. LaFevers, J.R. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** R2. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$100,000.
Related energy source: coal(67); oil shales and tar sands(33). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

Based on literature review and study of representative field conditions, a report will be prepared which summarizes, for the land and resource planner, the processes, methodologies, and alternative choices that arise as land is converted to surface mining and is later reconverted into an asset or is left as a liability. A methodology for integrating land use plans with mining and reclamation plans will be developed and compiled. Bibliographic reviews, case study analyses, field surveys and state-of-the-art surveys will be conducted, and an interpretation made for land use planners on how to accomplish integrated mining, reclamation, and end-state land planning. A series of workshops will be held to transfer knowledge gained to the state and regional planning community.
Keywords: COAL MINING; SURFACE MINING; LAND RECLAMATION; LAND USE; PLANNING; BIBLIOGRAPHIES.

54013 Development and Application of a Methodology for Siting Onshore Facilities Associated with OCS Development. Ciampa, V.; Mosena, D. (New England River Basins Commission, 53 State Street, Boston, MA, 02108). **Project number:** R-1 (R-10). **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$195,000; EPA-$100,000.
Related energy source: oil and gas(100).

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: PLANNING; CONTINENTAL SHELF; NATURAL GAS DEPOSITS; PETROLEUM DEPOSITS; EXPLOITATION; ENVIRONMENTAL IMPACTS; RECOMMENDATIONS; EXPLORATION.

54021 Arctic Engineering Geology (TAPS). Ferrains, O.J. Jr. (Geological Survey, 345 Middlefield Road, Menlo Park, CA, 94025). **Project number:** 9310-00002. **Supported by:** Geological Survey, Washington, DC (USA). **Funding:** DOI-$331,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

A program is reported that is designed to obtain geologic data needed for the planning, construction, and operation of the TransAlaska Pipeline (TAPS). An environmental impact statement is to be prepared along with technical stipulations on the alignment, construction, and operation of TAPS. A continued program is planned to obtain geologic and engineering-geologic data needed for the maintenance of TAPS. The program includes geologic and engineering-geologic mapping, modeling of heat flow from a pipeline in permafrost, measurements of seismicity, studies of the permafrost, and synthesis of borehole data from surficial deposits. New techniques, such as remote sensing, which will aid in the rapid determination and distribution and character of permafrost, are to be evalu-

ated along with other geologic-environmental features which consequently will facilitate solving engineering-geologic problems. Most of the objectives of the project have been accomplished.
Keywords: ALASKA OIL PIPELINE; GEOLOGICAL SURVEYS; PLANNING; CONSTRUCTION; OPERATION; MAPS; REMOTE SENSING.

54023 Arctic Environmental Studies Program. Ferrains, O.J. Jr. (Geological Survey, 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:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54028 Oil Shale Hydrology. Hudson, H.H. (U.S. Geological Survey, Denver Federal Center, Box 25046, MS 406, Lakewood, CO, 80225). **Project number:** CO-75-060. **Supported by:** Geological Survey, Lakewood, CO (USA). **Funding:** USGS-$2,311,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54030 Hydrology of the Madison Limestone in North Dakota, South Dakota and Wyoming. Cushing, E.M. (U.S. Geological Survey, 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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54031 Coal Hydrology. Kilpatrick, F.A. (U.S. Geological Survey, Reston, VA, 22092). **Project number:** WD-75-040. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** USGS-$1,318,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54039 Low Level Waste Hydrology. DeBuchananne, G. (U.S. Geological Survey, 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 fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54051 Impact of Outer Continental Shelf (OCS) Development on Coastal Land Use at Kenai, Alaska. (U.S. Geological Survey, Washington, DC). **Project number:** G-18. **Supported by:** Geological Survey, Washington, DC (USA). **Funding:** DOI-$4,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

A program is reported to assess the land use impact of continental shelf oil and gas development in the Kenai, Alaska, area. Included is an examination of OCS-related land use change through interpretation of air photos spanning 30 years.
Keywords: PETROLEUM DEPOSITS; NATURAL GAS DEPOSITS; ALASKA; CONTINENTAL SHELF; LAND USE; ENVIRONMENTAL IMPACTS.

54055 Heat Transfer Across an Air-Water Interface. Jobson, H.E. (U.S. Geological Survey, Gulf Coast Hydroscience Center, Bay St. Louis, MS, 39529). **Project number:** SR-73-033. **Supported by:** Geological Survey, Herndon, VA (USA). **Funding:** DOI-$180,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

54058 Energy Lands. Maberry, J.O. (U.S. Geological Survey, Denver Federal Ctr., Branch of Central Environmental Geology, Mail Stop 913, Box 25046, Denver, CO, 80225). **Project number:** 9530-01931. **Supported by:** Geological Survey, Denver, CO (USA). Geologic Div. **Funding:** DOI-$2,929,000.

Related energy source: coal(60); oil shales and tar sands(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54063 Council on Environmental Quality: Environmental Statistics and Indicators. Smith, E.T. (U.S. Geological Survey, MS 750, Reston, VA, 22092). **Project number:** R11. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$10,000.

Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

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. Statistics will be assembled largely from Federal sources, e.g., land use and minerals data from USGS, food/fiber data from USDA, and so forth 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. Two reports will be published. The Compendium of Environmental Statistics and Presentation of Environmental Indicators. Selected tables and graphs will appear in the CEQ annual report. Portions of the reports will become US contributions to the international State of the Environment report to be published by the Organization for Economic Cooperation and Development.

Keywords: USA; ENVIRONMENT; STATISTICS; AIR QUALITY; WATER QUALITY; INVENTORIES; MINERAL RESOURCES; ENERGY; FOOD; BIOMASS; LAND USE; MANUALS.

54064 Environmental Planning and Western Coal Development. Greenberg, A. (Missouri River Basin Commission, Western Coal Planning Assistance Project, 208 N. 29th St., Billings, MT, 59101). **Project number:** R3. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$358,000.

Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

Project objectives include: (1) provision of planning assistance to State and local planners in ND, MT, and WY coal areas to aid them in coping with coal resource development; and (2) compilation of available data, forecasts, methodologies, and bibliographic sources into a reference system which will be transferred to client group. These compilations will include documents describing geological data and coal resource development facts, comparative forecasts of coal resource development, a spectrum of methodologies available to analyze and evaluate probable impacts, and guides to sources of data and information concerning the coal resources of the study area.

Keywords: NORTH DAKOTA; MONTANA; WYOMING; ENERGY SOURCE DEVELOPMENT; COAL MINING; PLANNING; DATA COMPILATION; INFORMATION SYSTEMS; ECONOMICS; GEOLOGY; HYDROLOGY; MATHEMATICAL MODELS; ENVIRONMENTAL IMPACTS; ECONOMIC IMPACT; SOCIAL IMPACT.

54065 DEROCS Computer Program. Marcus, P.A. (U.S. Geological Survey, RALI Program, National Center, MS 750, Reston, VA, 22092). **Project number:** R1a. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$20,000.

Related energy source: oil and gas(100).

The objective is to develop a computer program which generates offshore energy development scenarios and onshore service base requirements based on work accomplished by the New England River Basins Commission on onshore facilities siting associated with OCS energy development.

Keywords: OFFSHORE OPERATIONS; ENVIRONMENTAL IMPACTS; SOCIAL IMPACT; ECONOMIC IMPACT; COMPUTER CODES; D CODES; NATURAL GAS DEPOSITS; PETROLEUM DEPOSITS; OIL SPILLS; HARBORS.

54066 Water Monitoring in Coal Lease Areas. Hudson, H.H. (U.S. Geological Survey, Denver Federal Center, MailStop 406, Box 25046, Lakewood, CO, 80225). **Project number:** CR-77-222. **Supported by:** Geological Survey, Herndon, VA (USA). **Funding:** DOI-$1,895,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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. Ninety-one 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.

54067 Remote Sensing of High Temperature Geothermal Areas of Iceland. Williams, R.S. Jr. (U.S. Geological Survey, 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:** USGS-$25,000.

Related energy source: geothermal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

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 17 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 the collation of aerial photography, aerial thermography, and satellite images and at the compilation of the bibliography and index of the 17 high-temperature geothermal areas of Iceland. Over 3,000 bibliographic citations on the geology and geophysics of Iceland have been typed, including references to most of the geothermal literature. 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.

54068 Digital Remote Sensing Techniques for Monitoring Surface Mine Growth and Reclamation with Landsat Imagery. Hoyt, C.D. (U.S. Bureau of Mines, State Liaison Program, 2401 E Street, NW, Room W-628, Washington, DC, 22024). **Project number:** 7030-

24205. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$30,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives of this project are to develop digital analysis methods for use on interactive computer systems to monitor strip mine growth and reclamations displayed on repetitive Landsat imagery and to transfer this technology to appropriate user groups through the Bureau of Mines State Liaison Program in collaboration with Stanford University's Remote Sensing Laboratory.
Keywords: COAL MINING; SURFACE MINING; LAND RECLAMATION; MONITORING; REMOTE SENSING; SATELLITES; TECHNOLOGY TRANSFER.

54069 National Environmental Overview Program. Epstein, J.B. (U.S. Geological Survey, National Center, Reston, VA, 22092). **Project number:** 9510-01593. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** DOI-$587,000.
Related energy source: fossil fuels(60); nuclear fuels(general)(40). **R and D categories:** Integrated assessment; Health effects.

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 SO_2 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.

54070 Energy-Related Environmental Studies. Masters, C.D. (Geological Survey, National Center, MS 915, Reston, VA, 22092). **Project number:** 9450-9460. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** USGS-$4,217,000; BLM-$3,285,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

54071 Marine Geology Investigations. Masters, C.D. (U.S. Geological Survey, National Center, MS 915, Reston, VA, 22092). **Project number:** 9460-9450. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** USGS-$1,246,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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 79, 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.

54072 Geothermal Investigations--Subsurface Environmental Impact. Christiansen, R.L. (U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA, 94025). **Project number:** 9700-01522. **Supported by:** Geological Survey, Reston, VA (USA). **Funding:** USGS-$552,000.
Related energy source: geothermal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

54073 Sulfur in Coal and Lignite. Bodenlos, A.J. (Geological Survey, National Center, MS 956, Reston, VA, 22092). **Project number:** 9420-01092. **Contract:** 9420-01092. **Supported by:** Geological Survey, Washington, DC (USA). **Funding:** DOI-$56,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

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.

54074 Reactor Hazard Research Program. Morris, R.H. (Geological Survey, 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 fuels(general)(90); conservation(10). **R and D categories:** Integrated assessment.

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.

54075 Fraunhofer Luminescence. Watson, R.D. (U.S. Geological Survey, EROS Program, 2255 North Gemini Drive, Flagstaff, AZ, 86001). **Project number:** 7030-24110. **Supported by:** National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center. **Funding:** DOI-$80,000.
Related energy source: oil and gas(60); oil shales and tar sands(40). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

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.
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.

54076 Attenuating Surface Waves in a Localized Region of the Open Ocean. Hires, R.I. (Stevens Institute of Technology, Davidson Laboratory, 711 Hudson Street, Castle Point Station, Hoboken, NJ, 07030). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI-$89,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

An experimental investigation will be conducted 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 on towed turbulence grids to determine parameters for grid size, draft, tow speed, wave attenuation and power. Dramatic wave attenuation can be obtained at very modest power requirements for wave periods up to six seconds.
Keywords: TRAVELLING WAVES; ATTENUATION; SURFACE WATERS; SEAS; OCEANOGRAPHY; UNDERWATER OPERATIONS; SAFETY; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; OFFSHORE OPERATIONS.

54077 Ultra Sonic Flowmeter Evaluation. Holmes, A. (Harry Diamond Laboratories, DELHD-RCD-Room 2D060, 2800 Powder Mill Road, Adelphi, MD, 20783). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

A program is reported to evaluate four designs of ultrasonic flowmeters by quantifying the ability to detect leaks in pipelines. The meters are to be calibrated at the Exxon clean crude facility at Baytown and then at the raw crude terminal at Grand Isle. Meters are being procured and piping modifications are being made at Baytown.
Keywords: PIPELINES; LEAK DETECTORS; FLOWMETERS; ULTRASONIC WAVES; CALIBRATION; MODIFICATIONS.

54078 Fluidic Pulser for Mud Pulse Telemetry. Holmes, A. (Harry Diamond Laboratories, DELHD-RCD-Room 2D060, 2800 Powder Mill Road, Adelphi, MD, 20783). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

A program is reported that is devoted to 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.
Keywords: WELL DRILLING; DRILLING FLUIDS; FLUIDIC CONTROL DEVICES; TELEMETRY; PULSE TECHNIQUES; DRILL BITS; MONITORING.

54079 Land Cover Mapping in the National Petroleum Reserve-Alaska (NPR-A). Gaydos, L. (U.S. Geological Survey, Geography Program, Moffett Field, CA, 94043). **Project number:** G-24. **Supported by:** Geological Survey, Washington, DC (USA). **Funding:** DOE-$93,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

A program is reported that is devoted to mapping of current land cover in the NPR-A on the north slope of Alaska to serve as a base reference for the environmental impact assessment for north slope oil and gas development. The mapping is achieved by computer processing for spectral analysis of digital data from the NASA Landsat satellite. Included are land cover maps and measurement of areas of various types of land cover, e.g., tundra, bare rock, or forest.
Keywords: ALASKA; TOPOLOGICAL MAPPING; SATELLITES; ENVIRONMENTAL IMPACTS; NATURAL GAS DEPOSITS; PETROLEUM DEPOSITS; EXPLOITATION; EXPLORATION.

54080 Analysis of SEASAT-ASAR Data for the Detection of Oil on the Ocean Surface. Estes, J.E. (University of California at Santa Barbara, Geography Remote Sensing Unit, Santa Barbara, CA, 93106). **Project number:** (RFP) 539W. **Contract:** 14-08-0001-G-506. **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI-$66,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

A project is reported the objective of which is to assess the utilization of SEASAT-A synthetic aperture radar (SAR) for detecting oil occurrences. The experiment will be accomplished using a multistage, multisensor sampling design. This will involve the use of surface oil sampling techniques combined with low and high altitude aerial photography and low altitude radar imagery. A secondary objective is to evaluate the potential transferability of the remote sensing methods, equipment and procedures developed to other OCS areas within the Western Region.
Keywords: OIL SPILLS; REMOTE SENSING; RADAR; SAMPLING; AERIAL SURVEYING; TECHNOLOGY ASSESSMENT.

54081 Technology Assessment for OCS Oil and Gas Operations in the Arctic Ocean. Brown, W. (Energy Interface Associates, P.O. Box 1173, Palos Verdes Estates, CA, 90274). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI-$67,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

An assessment is presented of the status of technology and identification of needed R and D for OCS operations in the ice covered Arctic Ocean.
Keywords: ARCTIC OCEAN; CONTINENTAL SHELF; OFFSHORE OPERATIONS; TECHNOLOGY ASSESSMENT; ICE; RESEARCH PROGRAMS.

54082 Underwater Inspection/Testing/Monitoring of Offshore Structures. Busby, R.F. (R. Frank Busby Associates, 576 23rd Street, Arlington, VA, 22202). **Contract:** 7-35336. **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI.

Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

A compilation is presented of European and American underwater structural inspection capabilities, practices and regulations. **Keywords:** OFFSHORE PLATFORMS; UNDERWATER FACILITIES; INSPECTION; REGULATIONS; TECHNOLOGY ASSESSMENT; EUROPE; USA.

54083 Dynamic Response of Offshore Structures. Vandiver, J.K. (Massachusetts Institute of Technology, Dept. of Ocean Engineering, Cambridge, MA, 02139). **Contract:** 14-08-0001-17202. **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI-$76,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

Research is summarized on 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 effort 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.
Keywords: OFFSHORE PLATFORMS; WATER WAVES; WAVE FORCES; RESPONSE FUNCTIONS; FORECASTING; DAMPING; FATIGUE; MATHEMATICAL MODELS.

54084 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). Conservation Div. **Funding:** DOI-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The devlopment of technology for sensing H2S and hydrocarbon gas on an offshore structure will be undertaken.
Keywords: OFFSHORE PLATFORMS; AIR POLLUTION CONTROL; HYDROCARBONS; HYDROGEN SULFIDES; MEASURING INSTRUMENTS; FLUIDIC DEVICES; SAFETY.

54085 Toxic Effects of Drill Mud on Coral. Shinn, G. (U.S. Geological Survey, Energy Resources Division, Fisher Island Station, Miami Beach, FL, 33139). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to study drill muds' toxicity and their additives' effects on various species of coral found in areas near USGS leased land. Tests to date indicate drill muds and their additives are no more toxic than standard mud (calcium carbonate).
Keywords: CORALS; TOXICITY; DRILLING FLUIDS; ADDITIVES; STANDARDS; ENVIRONMENTAL IMPACTS; OFFSHORE DRILLING; TOLERANCE; METABOLISM.

54086 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). Conservation Div. **Funding:** DOI-$209,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

Activities are reported of a program 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: NOSC has built a torpedo-shaped open frame vehicle and the University of New Hampshire has developed a highly maneuverable, though slower speed vehicle. Testing of the propulsion and control systems are scheduled for Summer 1978.
Keywords: OFFSHORE PLATFORMS; PIPELINES; UNDERWATER FACILITIES; INSPECTION; REMOTE SENSING; DATA ACQUISITION; TELEMETRY; REMOTE CONTROL; SUBMARINES.

54087 Hurricane-Driven Ocean Currents. Forristall, G. (Shell Development Co., Production Operations Research Dept., 3737 Bellaire Blvd., Houston, TX, 77025). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

USGS was one of several participants in a Shell Oil Company project to measure ocean currents which are generated by hurricanes. Shell has supplied most of the data from the experiment. Upon receipt of this final report, the information will be forwarded to the Office of Marine Geology, USGS, which will analyze the data for incorporation in a forthcoming data bank. Most of the data has been received by the USGS.
Keywords: HURRICANES; OCEANOGRAPHY; OFFSHORE OPERATIONS; SAFETY; DATA ACQUISITION; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY.

54088 Cavitating Water Jet Cleaning Nozzle. Thiruvengadam, A.P. (Daedalean Associates Inc., Springlake Research Center, 15110 Frederick Road, Woodbine, MD, 21797). **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI-$84,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety.

A program is reported to study the harnessing of the destructive forces of cavitation erosion in a water jet nozzle for cleaning underwater structural joints. Tests have been run on several nozzles and swirl plates. Data on erosion intensity, power, standoff distance, etc., have been obtained.
Keywords: OFFSHORE PLATFORMS; CLEANING; JETS; WATER; CAVITATION; NOZZLES; UNDERWATER FACILITIES; EROSION; JOINTS; PERFORMANCE TESTING.

54089 Overpressured Marine Sediments. Thompson, L.J.; Bryant, W.R. (Texas A and M University, Department of Civil Engineering, College Station, TX, 77843). **Contract:** 14-08-0001-G444. **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of the project 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. The final report is pending.
Keywords: OFFSHORE DRILLING; SITE SELECTION; SEDIMENTS; OCEANOGRAPHY; HYDROCARBONS; SEAS.

54090 Incipient Crack Detection in Offshore Structures. Hochrein, A.G. (Daedalean Associates, Inc., Springlake Research Center, 15110 Frederick Road, Woodbine, MD, 21797). **Contract:** 77-C-0567. **Supported by:** Geological Survey, Reston, VA (USA). Conservation Div. **Funding:** DOI-$95,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

A nondestructive evaluation (NDE) technique was developed for detecting incipient cracking by means of monitoring the internal damping characteristics of a metal. 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 has been processed through a computer which was rented.
Keywords: OFFSHORE PLATFORMS; CRACKS; FRACTURE PROPERTIES; JOINTS; FATIGUE; COMPUTER CALCULATIONS; NONDESTRUCTIVE TESTING; DAMPING.

54091 Chemical Analysis and Geologic Evaluation of Coal in Western U.S. Hatch, J.R. (U.S. Geological Survey, Denver Federal Center, P.O. Box 25046, Stop 972, Denver, CO, 80225). **Project number:** 9420-01980. **Supported by:** Geological Survey, Washington, DC (USA). **Funding:** DOI-$150,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

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.

55007 Process for Energy Routing to Minimize Impacts from Transmission Systems (PERMITS). Bisenius, D.J. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** w.o. 840-617. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOI-$30,000.

Related energy source: hydroelectric(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

The Bonneville Power Administration, in cooperation with the USFS-Region 1 Corridor Transmission Task Force, as well as the Kootenai, Lolo, and Panhandle National Forests are to undertake a Northwest Montana/North Idaho Transmission Corridor Study. USFS personnel will be engaged in many study phases, but BPA will maintain overall project coordination and responsibility. It will employ the analysis steps established in the PERMITS system, as they have been modified and adapted to meet BPA criteria and milestone scheduling. The study is to examine the complex set of planning and location choices related to: (1) integration of additional Libby generation; (2) reinforcement of service to North Idaho; and (3) the Hot Springs--Bell alternatives.

Keywords: MONTANA; IDAHO; POWER TRANSMISSION LINES; PLANNING; HVAC SYSTEMS; SITE SELECTION; SOCIO-ECONOMIC FACTORS; ENVIRONMENTAL EFFECTS.

55010 Transmission Line Effects on Raptors. Lee, J.M. Jr. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** 840-706. **Contract:** 14-03-7159N. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOI-$15,000.

Related energy source: hydroelectric(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of this effort are to determine the status of raptor (hawks, eagles, osprey) nesting on BPA transmission line towers, and to study birds living in high electric and magnetic field and corona noise environments. BPA heliocopter patrol observers have been given training in collecting information on nesting raptors. This information will be collected on all routine heliocopter patrol flights beginning in the spring of 1977. Measurements of electric fields in transmission towers where birds nest will be made. Estimates will be made as to the amount of raptor production occurring on BPA transmission structures. A small number of raptor nest platforms will be installed where maintenance problems exist. The results are expected to show that transmission lines can be positive factors for many kinds of birds because they provide nesting habitat in treeless areas.

Keywords: POWER TRANSMISSION LINES; BIRDS; POWER TRANSMISSION TOWERS; REPRODUCTION; MAGNETIC FIELDS; ELECTRIC FIELDS; NOISE; BEHAVIOR; BIOLOGICAL EFFECTS.

55011 HVDC Transmission Line Biological Study. Lee, J.M. Jr. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** 840-611. **Contract:** 14-03-6070N. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOI.

Related energy source: hydroelectric(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of this effort is to determine what, if any, effects the 800-kV Celilo-Sylmar dc transmission line has on crops, natural vegetation, wildlife, and domestic animals, which are detectable by field investigations. Two primary study areas have been established along the Oregon portion of the dc line. Within these areas, plants and animals are systematically sampled on the right-of-way and in nearby control areas off the right-of-way. Parameters studied include species diversity and relative abundance. Observations of animal behavior on and near the right-of-way are also included. The results of the study are expected to be the first reported biologic effect of a high voltage dc transmission line. The results will provide data for an environmental statement being prepared for a proposed second dc linc.

Keywords: HVDC SYSTEMS; POWER TRANSMISSION LINES; BIOLOGICAL EFFECTS; ANIMALS; PLANTS.

55012 UHV Transmission Biological Study. Lee, J.M. Jr. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** w.o. 842-502. **Contract:** 14-03-6033N. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOI-$10,000.

Related energy source: hydroelectric(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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 from the first growing season following energization of the 1200-kV line has been completed. Other than leaf damage to some trees purposely left near the line, no significant adverse effects have been identified.

Keywords: UHV AC SYSTEMS; OVERHEAD POWER TRANSMISSION; POWER TRANSMISSION LINES; ENVIRONMENTAL EFFECTS; ANIMALS; INSECTS; PLANTS; RESEARCH PROGRAMS; GROWTH; BEHAVIOR.

55013 Transmission Line Effects on Bird Flights. Lee, J.M. Jr. (Bonneville Power Administration, P.O. Box 3621, Portland, OR, 97208). **Project number:** w.o. 840-724. **Contract:** 14-03-7043A. **Supported by:** Bonneville Power Administration, Portland, OR (USA). **Funding:** DOI-$27,000.

Related energy source: hydroelectric(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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. Results of the 1-year long study are expected to provide the first comprehensive information on the effects of transmission lines on birds.

Keywords: HVAC SYSTEMS; EHV AC SYSTEMS; POWER TRANSMISSION LINES; ENVIRONMENTAL EFFECTS; RESEARCH PROGRAMS; BIRDS; SAFETY; OVERHEAD POWER TRANSMISSION.

DEPARTMENT OF TRANSPORTATION

62033 Energy Supply and Natural Resources Development Assessment. Woo, J. (Trans Systems Corporation, 118 Park Street, SE, Vienna, VA, 22180). **Project number:** DOT-FA-78WAI-904. **Contract:** DOT-FA-78WAI-904. **Supported by:** Federal Aviation Administration, Washington, DC (USA). **Funding:** DOT-$52,000.

Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective is to develop a guidance document for assessing energy impacts in terms of fuel usage, of major airport development and planning actions and air traffic operations. Concurrently, related training materials will be developed for agency use in disseminating the information, procedures and concepts of the document to appropriate agency personnel. The methods are to: develop a comprehensive listing of development and planning actions to be covered; construct alternative approaches to achieving these actions; and compare energy and other differences between alternatives. The end product shall include an energy assessment to be used by appropriate agency personnel in applying considerations of the National Environmental Policy Act when major Federal actions are contemplated. Additionally, the training materials will be used to develop a formal agency training course in this area.

Keywords: ENVIRONMENTAL IMPACTS; ENERGY CONSUMPTION; AIRPORTS; TRAFFIC CONTROL; PLANNING; EDUCATION; NOISE; NOISE POLLUTION ABATEMENT; ENERGY SUPPLIES; RESOURCE CONSERVATION.

62034 Transport Crashworthiness. Spicer, H.C. Jr. (Federal Aviation Administration, Aircraft and Noise Abatement Division, 2100 Second St., SW, Washington, DC, 20591). **Project number:** 182-520. **Supported by:** Federal Aviation Administration, Washington, DC (USA). Systems Research and Development Service. **Funding:** DOT-$975,000.

Related energy source: oil and gas(100). **R and D categories:** Operational safety; Health effects.

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.

62035 Development of Cost Methodology to Measure Benefits to Communities from Aircraft Noise Abatement. Project number: LGR-7-3805. **Contract:** LGR-7-3805 (RFP). **Supported by:** Federal Aviation Administration, Washington, DC (USA). Office of Environmental Quality. **Funding:** DOT-$200,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

62036 Helicopter Operations Development. Nelson, J.R. (Federal Aviation Administration, Approach Landing and Navigation Division, 2100 2nd Street SW, Washington, DC, 20591). **Project number:** 045-390. **Contract:** DOT-FA77WA-3966. **Supported by:** Federal Aviation Administration, Washington, DC (USA). Systems Research and Development Service. **Funding:** DOT-$965,000.
R and D categories: Operational safety.

The development of new regulations, standards, procedures and systems with specific intent on optimizing civil helicopter operations and improving safety while ensuring operational integration with the rest of the National Airspace System (NAS) is discussed. This work will be accomplished utilizing contractor efforts and in coordination with DOD and NASA. The development of new cerification criteria, air traffic control procedures, communication aides, navigational aides, approach and landing aides, heliport designs, and weather reporting aimed at improving the safety of helicopter operations will be studied.
Keywords: AIRCRAFT; OPERATION; SAFETY; STANDARDS; REGULATIONS; TRAFFIC CONTROL; NAVIGATIONAL INSTRUMENTS.

62037 Airport Air Quality Model Validation. Taubenkibel, L. (Federal Aviation Administration, Aircraft and Noise Abatement Division, 2100 Second Street, SW, Washington, DC, 20591). **Project number:** 201-521. **Supported by:** Federal Aviation Administration, Washington, DC (USA). Systems Research and Development Service. **Funding:** DOT-$25,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The project objective is to develop an analytical procedure for determination of air quality at airports. Experimental data will be collected at various airports for the purpose of improving the predicted capability of our analytical technique.
Keywords: AIRPORTS; AIR QUALITY; MATHEMATICAL MODELS; DATA ACQUISITION; ENVIRONMENTAL IMPACTS; AIRCRAFT; TRANSPORTATION SYSTEMS.

62038 Stratospheric Environmental Assessment Capability. Knox, J.B. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** 1-653. **Contract:** Conract No. DOT-FA7QEA1-653. **Supported by:** Federal Aviation Administration, Washington, DC (USA). **Funding:** DOT-$60,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

The objective is to develop and/or extend present transport and diffusion models to calculate in-cabin dose to passengers and crew flying on aircraft that could potentially intercept debris clouds resulting from foreign nuclear atmospheric tests. Presently two models, a trajectory puff and a particle-in-cell have been designed and are being implemented in the Atmospheric Release Advisory Capability (ARAC) center to respond to requests from the FAA for these dose calculations.
Keywords: STRATOSPHERE; DIFFUSION; ENVIRONMENTAL TRANSPORT; AIRCRAFT; AVIATION PERSONNEL; FALLOUT; HEALTH HAZARDS; DOSIMETRY; RADIATION DOSES; NUCLEAR EXPLOSIONS; RADIOACTIVITY; RADIONUCLIDE MIGRATION; EARTH ATMOSPHERE.

62039 Airport Noise Control. Ahlers, R.B. (Federal Aviation Administration, Airport Division, 2100 Second Street, SW, Washington, DC, 20591). **Project number:** 082-421. **Supported by:** Federal Aviation Administration, Washington, DC (USA). Systems Research and Development Service. **Funding:** DOT-$32,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objective is to develop standards for noise suppressing equipment at airports by researching all existing literature describing effectiveness of various kinds of barriers for reducing aircraft noise. Barriers will be developed which will reduce the noise impact on humans at large airports.
Keywords: AIRPORTS; NOISE POLLUTION CONTROL; POLLUTION; NOISE POLLUTION; BIOLOGICAL EFFECTS; AIRCRAFT.

62040 Jet Noise Source Location and Reduction. Zuckerman, R.S. (Federal Aviation Administration, Aircraft and Noise Abatement Division, 2100 Second St., SW, Washington, DC, 20591). **Project number:** 202-551. **Contract:** DOT OS-30034. **Supported by:** Federal Aviation Administration, Washington, DC (USA). Systems Research and Development Service. **Funding:** DOT-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The objectives are to develop an aircraft noise source data base and investigate suppression mechanisms for regulation related to high velocity jet noise. This effort will be accomplished utilizing contractor efforts. Full-scale ground tests as well as flight tests for the purpose of determining jet noise velocity will be evaluated. Technology application will be installed on wide-body and business jets in an effort to reduce noise at terminal areas.
Keywords: NOISE POLLUTION ABATEMENT; HEALTH HAZARDS; AIRCRAFT; TURBOJET ENGINES; NOISE; DATA ACQUISITION; SAFETY; ENVIRONMENTAL ENGINEERING.

63001 Feasibility Analysis and Design Concepts and Criteria for Community-Wide Separate Pedestrian Networks. Kagan, L.S. (RTKL Associates, Inc., The Village Square, Village of Cross Keys, Baltimore, MD, 21216). **Project number:** 31E1-042. **Contract:** DOT-FH-11-8816. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT.
Related energy source: conservation(100). **R and D categories:** Operational safety.

The purposes of this project are to determine feasibility, design concepts, and design criteria for separate pedestrian networks; determine compatibility of pedestrians and bicyclists on same facility; and develop pedestrian planning process for Central Business Districts and Multi-Lane Use Districts. It is planned to study the state-of-the-art of separate pedestrian networks and pedestrian planning processes for the Central Business Districts and other Multi-Land Use Districts.
Keywords: FEASIBILITY STUDIES; BICYCLES; TRAFFIC CONTROL; VEHICLES; URBAN AREAS; PLANNING; TRANSPORTATION SYSTEMS; USES.

63004 Effect of Truck Size and Weight on Accident Experience and Traffic Operations. McGee, H.T. (Biotechnology, Inc., 3027 Rosemary Lane, Falls Church, VA, 22044). **Project number:** 1U1-022. **Contract:** DOT-FH-11-8835. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$226,000.
Related energy source: conservation(100).

The purposes of this project are to determine the effect of truck size and weight on traffic operations and to determine whether or not truck size and weight influences accident incidence and severity. Field measures will be taken to determine traffic operational effects of truck size and weight. Test sites were selected to cover a wide range of operational conditions and truck sizes. Truck accidents at 80 preselected sites will be examined in detail to determine the effect of size and weight. A definitive conclusion will be drawn on the effect of truck size and weight on traffic operations and accident incidence and severity.
Keywords: TRUCKS; SIZE; WEIGHT; ACCIDENTS; TRANSPORTATION SECTOR; SAFETY ENGINEERING.

63010 Augmentation of Earth Heating for Purposes of Pavement Deicing. Pravda, M.F. (Dynatherm Corp., 1 Industry Lane, Cockeysville, MD, 21030). **Project number:** 31L7042. **Contract:** DOT-FH-11-9169. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT.
Related energy source: solar(50); wind(25); conservation(25).

The objective of this research is to determine the technical and economic feasibility of augmenting earth heat with nonfossil fuel energy sources for purposes of deicing roadways. Mathematical models were developed to determine the energy required to prevent

pavement icing for various regions. The basic system uses heat pipes to extract energy from the earth. This low grade solar energy can be augmented by other solar energy sources, wind energy, or ambient air energy and conserved by valves causing heat to be extracted only when there is a possibility of ice forming on the pavement.
Keywords: AMBIENT TEMPERATURE; HEAT PIPES; WIND; ROADS; ICE; MATHEMATICAL MODELS; FEASIBILITY STUDIES; SOLAR HEATING; SOLAR ENERGY; HEATING.

63011 Identification and Feasibility of Demand Incentives for Non-Motorized Travel. Robinson, F.O. (Barton-Aschman Associates, Inc., Ten Cedar Square West/Cedar Riverside, 1610 South Sixth Street, Minneapolis, MN, 55404). **Project number:** 331E-012. **Contract:** DOT-OS-60183. **Supported by:** Department of Transportation, Washington, DC (USA). Office of Environmental Affairs. **Funding:** DOT-$150,000.
Related energy source: conservation(100).

The purpose of this project is to identify or develop incentives for shifting from motorized to non-motorized travel, walking and bicycling for utilitarian trip purposes in urban areas. Potential bicyclists and pedestrians will be interviewed to ascertain what most induces non-motorized travel. These incentives will then be weighted with cost and demand information. Information will be compiled in a manual for local planners.
Keywords: TRANSPORTATION SYSTEMS; ENERGY CONSERVATION; AUTOMOBILES; BICYCLES; USES; PLANNING.

63013 Intersection Control to Improve Traffic Operations and Reduce Accidents. Benioff, B. (TJKM, 710 South Broadway, Walnut Creek, CA, 54596). **Project number:** 31A1-574. **Contract:** DOT-FH-11-8783. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT.
Related energy source: conservation(100). **R and D categories:** Operational safety.

The purpose of this project is to evaluate methods for improving traffic operations of signalized intersections and at the same time reduce accidents. This will be accomplished by: (1) reviewing past research and current practice; (2) surveying driver understanding; (3) collecting and analyzing field data on operations and safety; and (4) constructing analytical models. Guidelines will be developed for use in determining the conditions under which traffic signals should be placed on flashing operation and where flashing operation is used, when it should have a yellow/red pattern and when it should have a red/red pattern.
Keywords: SAFETY; TRANSPORTATION SECTOR; VEHICLES; TRAFFIC CONTROL; ROADS; ACCIDENTS; ENERGY CONSERVATION.

63014 Environmental and Safety Aspects of the Use of Sulfur in Highway Pavements. Saylak, D. (Texas A and M Research Foundation, College Station, TX, 77843). **Project number:** 34G1-103. **Contract:** DOT-FH-119457. **Supported by:** Federal Highway Administration, Washington, DC (USA). Materials Div. **Funding:** FHA-$108,000.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Integrated assessment.

This contract will evaluate the environmental and safety hazards of the use of sulfur in highway pavements. This investigation will collect and characterize emissions generated during the storage and handling, formulation, and construction of highway pavements containing sulfur. Leachates will also be collected and characterized that are generated during and after rains on pavements in service. Environmental and safety guidelines for the use of sulfur in highways will then be prepared.
Keywords: SULFUR; ROADS; ECOLOGICAL CONCENTRATION; HEALTH HAZARDS; ENVIRONMENTAL EFFECTS; USES; CONSTRUCTION; LEACHING.

63015 Effectiveness of Freeway Lighting. Hall, J. (Mark Battle Associates, Inc., 1019 19th Street, NW, Washington, DC, 20036). **Project number:** 31A1-684. **Contract:** DOT-FH-11-9140. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT.
Related energy source: conservation(100). **R and D categories:** Operational safety.

The purpose of this project is to determine the safety impact of reduced freeway lighting. Accident data will be analyzed where lighting has been reduced or installed. The effectiveness of freeway lighting will be reported. A method will be developed to determine best lighting level, optimizing the tradeoff between traffic safety and energy savings.
Keywords: LIGHTING SYSTEMS; ROADS; ENERGY CONSERVATION; SAFETY; TRANSPORTATION SECTOR; VEHICLES; ACCIDENTS; OPTIMIZATION.

63016 Speed Control on High Speed Roadways. Lee, R.B. (Urbitran Associates, Inc., 101 Park Avenue, New York, NY, 10017). **Project number:** 31A1-784. **Contract:** 5B2-40-8(a) 78C-151. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$96,000.
Related energy source: conservation(100). **R and D categories:** Operational safety.

The purpose of this project is to develop and evaluate pavement marking and delineation systems as potentially safe and effective means for controlling vehicle speeds on high speed highways. The end product will be the best marking system for use in field test.
Keywords: VEHICLES; TRAFFIC CONTROL; ROADS; SAFETY; TRANSPORTATION SECTOR; SPEED LIMIT; COMPLIANCE.

63017 Planning and Scheduling Work Zone Traffic Control. Haley, C.E. (JHK and Associates, Inc., Box 3727 Bay Bridge Office Plaza, San Francisco, CA, 94119). **Project number:** 31Y1-524. **Contract:** DOT-FH-11-9417. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT-$185,000.
Related energy source: conservation(100). **R and D categories:** Operational safety.

The purpose of this project is to develop a procedure for estimating the costs and consequences of alternative work zone strategies under varying traffic demands and environmental conditions. 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 roadway administrators and engineers.
Keywords: TRAFFIC CONTROL; PLANNING; SAFETY; TRANSPORTATION SECTOR; COST; ENVIRONMENTAL IMPACTS; CONSTRUCTION; ROADS; DECISION MAKING.

63018 I-35W Highway Advisory Radio System (Minnesota). Carlson, G.C. (Minnesota Department of Transportation, 1101 4th Avenue South, Minneapolis, MN, 55404). **Project number:** 32L2-072. **Contract:** DOT-FH-11-8565. **Supported by:** Federal Highway Administration, Washington, DC (USA). Office of Research and Development. **Funding:** DOT.
Related energy source: conservation(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objectives of this project are to evaluate the use of Highway Advisory Radio System in a surveillance and control network and provide an evaluation of motorist acceptance, operating agency experience and analysis of major system elements. The approach will be to install, operate and evaluate a Highway Advisory Radio System on I-35W. The study should determine: (1) motorist use and acceptance, (2) message characteristics, (3) operating agency experience and assessment, and (4) analysis of major system elements.
Keywords: SAFETY; ROADS; RADIO EQUIPMENT; TRANSPORTATION SECTOR; INFORMATION; VEHICLES.

64004 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: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

64005 Health and Safety Implications of Diesel Locomotive Emissions. Sanders, M.S. (Navy Personnel Research and Development Center, San Diego, CA, 92512). **Project number:** AR 74312.

Supported by: Federal Railroad Administration, Washington, DC (USA). Office of Safety. **Funding:** DOT-$53,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objective is to determine the long-term effects of exposure to low levels of diesel exhaust emissions in locomotive cabs (internal) by reviewing pertinent literature and interviewing affected parties. Recommendations and guidelines will be contained in the final report.
Keywords: DIESEL ENGINES; EXHAUST GASES; TRAINS; HEALTH HAZARDS; PERSONNEL; BIOLOGICAL EFFECTS.

64006 DODX Roll Stability Test. Kenworthy, M. (Ensco, Inc., 2560 Huntington Avenue, Alexandria, VA, 22303). **Project number:** DOT FR-64113. **Supported by:** Federal Railroad Administration, Washington, DC (USA). Analysis and Evaluation Div. **Funding:** DOT.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology.

The objective is to perform full-scale roll stability and wheel lift testing of a flat rat used to transport nuclear components over a perturbed track to measure the performance of the car to insure that the car does not exceed specifications. Car is tested in 3 configurations: empty, partially loaded, and fully loaded. Car is pulled over a specially perturbed track, designed to cause the maximum roll and wheel lift conditions. If car exceeds the maximum roll or wheel lift, the suspension of the car is modified until it is brought back to specifications. All cars to date have met the specifications.
Keywords: RADIOACTIVE MATERIALS; LAND TRANSPORT; PERFORMANCE TESTING; SAFETY; ROAD TESTS; WHEELS; VEHICLES.

67012 Power Consumption of Truck Tires. Gusakov, I. (Calspan Corporation, P.O. Box 235, Buffalo, NY, 14221). **Project number:** DOT-05-60156. **Contract:** DOT-05-60156. **Supported by:** National Highway Traffic Safety Administration, Washington, DC (USA). **Funding:** DOT-$26,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The unique Calspan flat surface tire test facility is being utilized to obtain accurate, laboratory quality rolling resistance values for tires to be mounted on the contributed test trucks in the DOT/SAE fuel economy verification program. 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 tires. Noise studies, treadwear studies and tire use practice studies conducted by DOT point to the use of radial-ply tires in lieu of bias-ply tires. The State of California has requested the DOT to provide them with the technical bases for the establishment of tire noise certification standards. The data from this project contributes to the overall data base necessary to satisfy California's request.
Keywords: TRUCKS; TIRES; ENERGY CONSUMPTION; TEST FACILITIES; ROLLING FRICTION; FUEL ECONOMY; NOISE.

67013 Assessment of Environmental Impacts of Light Duty Vehicle Dieselization. Forrest, L. (Aerospace Corp., 2350 East El Segundo Blvd., El Segundo, CA, 90245). **Project number:** DOT-TSC-1530. **Contract:** DOT-TSC-1530. **Supported by:** Department of Transportation, Cambridge, MA (USA). Transportation Systems Center. **Funding:** DOT-$73,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

It is the purpose of this work to identify and define potential environmental impacts associated with the operation of diesel-powered, light-duty vehicles in urban areas. The analytic effort will emphasize diesel exhaust emmission impacts upon air quality, especially particulates and odor. The impacts will be projected over a 20-year period from 1980 to 2000. Using a case study format, data from several major U.S. metropolitan areas will be used to assess the effects of different rates of introduction of diesel-powered light vehicles into the fleet. Any environmental impact that may constrain the introduction of light duty diesel vehicles will be clearly identified and the energy savings foregone will be estimated.
Keywords: DIESEL FUELS; VEHICLES; URBAN AREAS; EXHAUST GASES; ENVIRONMENTAL IMPACTS; AIR POLLUTION; ENERGY CONSERVATION; FORECASTING.

ENVIRONMENTAL PROTECTION AGENCY

70401 Evaluation of Emission Offset Policy Alternatives. Smith, A.E. (Argonne National Laboratory, Energy and Environmental Systems Div., 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** EPA-IAG-D7-0052. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Planning and Evaluation. **Funding:** EPA-$80,000.
R and D categories: Operational safety; Environmental control technology; Integrated assessment.

The objective is to evaluate alternatives for implementing the EPA's air pollution emission offset policy in nonattainment areas. Using the Chicago region as a test case, alternative air emission control levels are postulated for existing, modified, and new sources. Alternative policies for allowing growth in an area violating the National Ambient Air Quality Standards are formulated. Emissions and air quality are projected out to 1990 under each of the policy options and control levels. A report evaluating the effectiveness of each policy option in achieving the air quality standards will be compiled.
Keywords: AIR POLLUTION; GOVERNMENT POLICIES; IMPLEMENTATION; AIR POLLUTION CONTROL; STANDARDS; AIR QUALITY; POINT POLLUTANT SOURCES; POLLUTION REGULATIONS.

70402 Development of New Source Performance Standards. Cirillo, R.R. (Argonne National Laboratory, Energy and Environmental Systems Div., 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** EPA-IAG-D7-01075. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Emission Standards and Engineering Div. **Funding:** EPA-$40,000.
R and D categories: Operational safety; Environmental control technology; Integrated assessment.

Objectives are to provide technical assistance in the development of New Source Performance Standards for sources of air pollution and to provide technical support in the evaluation of policies for NSPS development. Data from field observations and other analyses are synthesized into a control level to be specified by promulgated regulations. An emission and air quality algorithm is used to establish priorities for the setting of NSPS. Results will include analyses to support the promulgation of specific NSPS and analyses of priorities for NSPS development.
Keywords: AIR QUALITY; STANDARDS; POINT POLLUTANT SOURCES; POLLUTION REGULATIONS; AIR POLLUTION; IMPLEMENTATION.

70403 Example Control Strategy for Lead. Smith, A.E. (Argonne National Laboratory, Energy and Environmental Systems Division, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** EPA-IAG-D7-01111. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. **Funding:** EPA-$38,000.
R and D categories: Operational safety; Environmental control technology; Integrated assessment.

The objective is to develop an example strategy to control emissions of lead into the atmosphere in accordance with the proposed National Ambient Air Quality Standard for Lead. The Chicago Air Quality Control Region is used as a test case. A lead emission inventory and lead air quality data are assembled. Emissions are projected to 1990 and their impact on ambient air quality are modeled. Alternative control strategies are identified and evaluated. A control program is developed. A document illustrating the procedures and methodologies to be used by the states in developing their own lead control programs will be compiled.
Keywords: LEAD; POLLUTION REGULATIONS; STANDARDS; AIR QUALITY; IMPLEMENTATION; AIR POLLUTION CONTROL.

70404 Effects of Energy-Related Pollutants on Carcinogenesis, Pulmonary Carcinogenesis: Test Systems. Reilly, C.A. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** EPA-IAG-D5-E681. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$94,000.
Related energy source: fossil fuels(80); coal(20). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

A number of biologically active pollutants, in particular polycyclic hydrocarbons, are present in the effluents of the various types of energy production facilities which are either now in use or are proposed. For many of these types of effluents, the lung is probably the chief organ at risk. Several polycyclic hydrocrbons are known pulmonary carcinogens but the magnitude of the risk associated with their presence in these effluents, as complex mixtures and in combination with other as yet untested constituents, is at present unknown. Therefore there is a need for appropriate, rapid and economic

methods of assay for the oncogenic potential of these compounds and for the study of their action in pulmonary tumorigenesis. Our objectives are to: (1) establish appropriate test systems for the assessment of the tumorigenic potential of energy-related environmental pollutants; (2) carry out the experiments in such a way that information about the mechanisms of susceptibility to tumorigenesis, including the role of intrinsic proliferative activity in pulmonary tissue, is obtained; and (3) determine whether pulmonary carcinogens act additively or synergistically.
Keywords: CARCINOGENESIS; LUNGS; NEOPLASMS; CHEMICAL EFFLUENTS; BIOLOGICAL MODELS; POLYCYCLIC AROMATIC HYDROCARBONS; HEALTH HAZARDS; MUTAGEN SCREENING; SYNERGISM; ADDITIVES.

70405 Development of Air Pollution Strategy Resource Estimator Model. Cirillo, R.R. (Argonne National Laboratory, Energy and Environmental Systems Division, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** EPA-IAG-D7-1026. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. **Funding:** EPA-$10,000.
R and D categories: Operational safety; Environmental control technology; Integrated assessment.

The objective is to develop an analytical tool to estimate the state and local control agency manpower and financial resources required to implement a federal air pollution control policy. A simulation model has been developed that uses historical agency data to determine resource requirements. The model is structured to permit the user to define the type of policy using an interactive computer terminal. The model can then compute requirements on a national or statewide basis. An operational computer code has been developed and installed on EPA equipment. User's manuals and reports defining the data base have been prepared. Updates of data and expansion of the strategy types that can be considered will be forthcoming.
Keywords: AIR QUALITY; POLLUTION REGULATIONS; AIR POLLUTION CONTROL; PLANNING; STANDARDS; MATHEMATICAL MODELS; FINANCING; MANPOWER.

70503 State-of-the-Art Report on Freshwater Mussel Taxonomy and Ecology. Isom, B. (TVA, Division of Environmental Planning, Muscle Shoals, AL, 35660). **Project number:** A612A-11. **Contract:** D7-F1060. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$4,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

70504 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:** all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

70505 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:** A612A-13. **Contract:** R805344-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA. **Related energy source:** all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

70508 Fundamental Studies for Development of Electrochemical COD and TOC Analyzers. Davenport, R.S. (Life Systems, Inc., 23715 Mercantile Road, Cleveland, OH, 44122). **Project number:** A612A-05. **Contract:** D7-F1015. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$40,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

To develop an automatic on-line total organic carbon (TOC)/chemical oxygen demand (COD) analyzer which is less costly to operate than conventional measurement systems and avoids use of environmental polluting reagents, a breadboard TOC/COD analyzer will be assembled to measure TOC and COD in samples after manual addition of reagents. The pCO2 sensor, developed for this project, ultraviolet reactor and coulometric persulfate sensor will be incorporated into this breadboard system. This development phase of the project will demonstrate the feasibility of providing a reliable on-line monitoring instrument.
Keywords: WATER POLLUTION MONITORS; DESIGN; ON-LINE SYSTEMS; CHEMICAL OXYGEN DEMAND; CARBON; CARBON DIOXIDE; VOLTAMETRY; PERSULFATES; ULTRAVIOLET RADIATION; MONITORING.

70513 Standardize Field and Laboratory Methods for Biomonitoring. Weber, C.I. (EPA, Office of Research and Development, Aquatic Biology Section, 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** A612A-10. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$240,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives of the project are to develop, evaluate, and standardize field and laboratory methods for biomonitoring programs to measure the biological properties and ecological effects of effluents, and to determine the biological integrity of surface waters. Projects include studies of methods for sample collection and preparation; organism counts and identification; measurements of biomass and metabolic rates; effluent bioassay; bioaccumulation of toxic substances; and data handling and interpretation. Methods are developed for all communities of aquatic organisms, including phytoplankton, zooplankton, periphyton, macrophyton and macroalgae, macroinvertebrates, and fish.
Keywords: CHEMICAL EFFLUENTS; WATER POLLUTION; SURFACE WATERS; ENVIRONMENTAL EFFECTS; MONITORING; TOXIC MATERIALS; BIOLOGICAL ACCUMULATION; AUFWUCHS; PLANKTON; ALGAE; INVERTEBRATES; PLANTS; FISHES; AQUATIC ORGANISMS; SAMPLING; SAMPLE PREPARATION; DATA PROCESSING; QUALITY ASSURANCE; BIOASSAY.

70517 Calibration of 90 degrees V-Notch Weirs Using Parameters Other than Weir Head. Eli, R.N. (West Virginia University, Department of Civil Engineering, Morgantown, WV, 26506). **Project number:** A621C-26. **Contract:** R805312-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$168,000.
Related energy source: solar(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of the proposed research is to develop, by means of a laboratory investigation, a less cumbersome and more accurate means of determining discharge over a 90 degrees V-notch Weir by taking direct measurements at the Weir plate. Compliance monitoring in connection with NPDES permits requires a procedure that can be easily applied in the field with a minimum of tools or instrumentation. Weir head, the level pool head above the Weir crest, is a difficult measurement to make since it must be made some distance upstream of the crest. Therefore, the main thrust of the investigation will be to select a new parameter that can be measured in the vicinity of the Weir plate. The new parameter is to be related to discharge by defining an empirical relationship by means of calibration tests to be conducted over the discharge range of approximately 0 to 5 cubic feet per second. Drawdown of the water surface in the vicinity of the Weir plate will require careful definition of the new measurement parameter.
Keywords: CONDENSER COOLING SYSTEMS; INTAKE STRUCTURES; PERFORMANCE TESTING; CALIBRATION; MEASURING METHODS.

70523 Development of Microbiological Quality Control Check Samples and Performance Evaluation Samples for Use in EPA Water Laboratories. Gherna, R.L. (American Type Culture Collection, Department of Bacteriology, 12301 Parklawn Drive, Rockville, MD, 20852). **Project number:** A621C-39. **Contract:** 68-03-2219. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$60,000. **Related energy source:** all(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The program is divided into two phases. The first phase is to develop and standardize a method (including cultural conditions, lyophilization, and rehydration) designed to yield stable qualitative and quantitative sets of known numbers of freeze-dried preparations of Escherchia coli, Klebsiella pneumoniae, Enterobacter aerogenes, Streptococcus faecalis, and Pseudomonas aeruginosa. After standardization of the counts, a shelf life study will be done for one year on the test units in order to determine the reduction in numbers, if any, over a given period of time. A small number of replicate quantitative test units will be provided to EPA for evaluation. Phase II is to prepare a pre-arranged number of quantitative and qualitative quality control samples to contain the above mentioned cultures. **Keywords:** BACTERIA; CULTIVATION TECHNIQUES; LYOPHILIZATION; CALIBRATION STANDARDS; SAMPLE PREPARATION; QUALITY CONTROL; WATER QUALITY; MEASURING METHODS.

70524 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:** A621A-41. **Contract:** 68-03-2470. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring; Health effects.

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.

70525 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.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Supersaturation of air in natural waters either by hydroelectric plants or thermal effluents is becoming an increasing environmental problem and has already accounted for large mortalities of anandromous fish in the northwestern United States. Increasing development of hydroelectric and/or nuclear plants as a result of increased energy needs can be expected to increase this problem, the definition of which requires less specialized, easily available analytical techniques. The methods currently available for measuring and/or monitoring total dissolved gas pressure in liquids, while accurate and reliable, are expensive, require specialists for operation, and are not suitable for continuous unattended monitoring. 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.
Keywords: MONITORING; WATER QUALITY; HYDROELECTRIC POWER PLANTS; FISHES; THERMAL EFFLUENTS; MORTALITY; NUCLEAR POWER PLANTS; ENVIRONMENTAL IMPACTS.

70527 Comparative Selectivity Study of the Nitrogen Oxide Electrode and the Solid State Nitrate Electrode for Determination of Nitrate. Wilson, R.F. (Texas Southern University, Department of Chemistry, 3201 Wheeler Avenue, Houston, TX, 77004). **Project number:** A625C-20. **Contract:** R805212-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.

This study will evaluate the sensitivity and selectivity of two commercial electrodes for measurement of nitrate ion concentrations directly. The applicability of the methods for various types of water wastewater samples will be determined. Orion's nitrate electrode and NOx electrode will be evaluated. The results obtained by the electrodes will be evaluated statistically to determine which will give the most accurate results. During the past budget period, Dr. Wilson evaluated the two electrodes for the determination of nitrate. He studied the working ranges and determined the relative standard deviation for both electrodes.**Keywords:** NITROGEN OXIDES; WASTE WATER; ELECTRODES; SENSITIVITY; NITRATES; QUANTITATIVE CHEMICAL ANALYSIS; WATER POLLUTION.

70542 Development and Implementation of Alternative Procedures in Water and Waste Monitoring. Huibregtse, K.R. (Envirex Inc., Environmental Sciences Div., 5103 West Beloit Road, Milwaukee, WI, 53214). **Project number:** A612A-01. **Contract:** 68-03-2595. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$87,000.
R and D categories: Integrated assessment.

The objective of this project is to develop an effective method to compare the equivalency of specific analytical techniques to already accepted NPDES procedures. Both specific variances and general method (laboratory wide) variances are to be considered. The method(s) will be chosen after a thorough state-of-the-art review involving an extensive literature search plus contacts to state and federal quality assurance personnel. The potential methods will be evaluated with consideration given to flexibility, general applicability, cost/effectiveness, simplicity of application, etc. The resultant recommended technique(s) will be submitted to EPA. If approved, the feasibility of a computerized system of calculation and storage will be evaluated and implemented. The final product will be the development of an information packet to be sent to those requesting a method variance.
Keywords: WATER POLLUTION; WASTE WATER; MONITORING; QUANTITATIVE CHEMICAL ANALYSIS; WASTE MANAGEMENT; COMPUTER CODES; AUTOMATION; QUALITY ASSURANCE.

70543 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:** A612A-31. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$275,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

Systems for measurement of a variety of parameters such as oil in water, total organic carbon, total hydrolyzable phosphorus, and turbidity have been acquired to determine utility for EPA programs and EPA-cooperators. A new concept in acquisition of data for selected parameters has been developed and is being further pursued permitting less field work and greater field data retrieval. Systems are thoroughly analyzed for design detail, investigated under a variety of field conditions, and reported upon. Factors affecting proper measurement are investigated and appropriate adjustments made, either in-house or otherwise. Total specifications will be developed once alternative approaches are investigated and design details will be related to coincide with unique requirements of EPA regional applications and EPA-cooperator applications.
Keywords: DRINKING WATER; AUTOMATION; SAMPLING; HYDROCARBONS; STANDARDS; CARBON; PHOSPHORUS; PETROLEUM; METALS; WATER QUALITY.

70544 Optimization of the LLE Method for Analysis of Volatile Halides in Drinking Water. Rawley, R. (North Texas State University, Institute of Applied Sciences, N. Texas Station, Box 13707, Denton, TX). **Project number:** A614D-01. **Contract:** R805472-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$53,000.
R and D categories: Integrated assessment.

The objective of the project is to develop and optimize a liquid/liquid extraction technique for the determination of trihalomethanes in drinking water at the microgram/l level. The optimized method will then be compared to the purge and trap technique to insure equivalency. The project is proceeding in four phases over a two-year time frame. The first two phases of the study will investigate the critical method parameters, the most noteworthy being: (1) chromatographic conditions, (2) solvent of choice, (3) solvent/sample ratio, (4) sample matrix effects, and (5) extraction efficiencies for the four trihalomethanes. At the same time similar data will be collected on five other organohalides which are commonly detected in finished waters. Once the critical method parameters are known, the study will proceed into Phases 3 and 4 where precision and accuracy data will be collected using dosed local finished waters. During Phase 4 the optimized method will be compared to the purge

and trap technique using EPA supplied diverse drinking water. Progress on Phases 1 and 2 is on schedule.
Keywords: DRINKING WATER; MONITORING; QUALITY ASSURANCE; ORGANIC HALOGEN COMPOUNDS; SOLVENT EXTRACTION; WASTE MANAGEMENT; HEALTH HAZARDS.

70545 Municipal Digested Sludge Quality Control Sample. Allen, C. (Texas Instruments, Inc., P.O. Box 5621, Dallas, TX, 75222). **Project number:** A621-08. **Contract:** 68-03-2336. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

The contractor is to design, develop, and produce 5,000 municipal digested sludge quality control samples which will be characterized for 26 parameters. These parameters will include the following groups: (1) demand, (2) nutrients, (3) trace metals, and (4) other organics such as O and C, phenols, etc.
Keywords: MUNICIPAL WASTES; SLUDGES; QUALITY CONTROL; WASTE MANAGEMENT; DIGESTION; METALS; ORGANIC COMPOUNDS; GROUND WATER; NUTRIENTS; OXYGEN; CARBON; WATER TREATMENT; REMOVAL.

70546 Techical Services to Support the Quality Assurance Program. Kowalski, V. (Bionetics, Inc., P.O. Box 19070, Cincinnati, OH, 45219). **Project number:** A621A-13. **Contract:** 68-03-2490. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$168,000. **Related energy source:** all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of the project is to provide the Quality Assurance Branch, EMSL-Cincinnati, with technical support services. A fully equipped chemistry laboratory and equipment to produce quality control samples was set up and staffed by contractor personnel. The Technical Service Laboratory has finalized the setting up of all instruments and associated equipment to make the laboratory functional. Technical Service personnel are currently developing oil and grease and suspended solid QC samples. Other activities include the distribution of quality control samples throughout the country and the development of an EPA manual on sampling and sample preservation of waters/wastewaters. Upon concluding the development of the QC samples, new directives will be given for the development of additional QC samples.
Keywords: WATER POLLUTION; MONITORING; SAMPLING; SAMPLE PREPARATION; QUALITY ASSURANCE; QUALITY CONTROL; CALIBRATION STANDARDS; LABORATORY EQUIPMENT; ENVIRONMENTAL MATERIALS.

70547 Arsenic and Selenium in Industrial and Domestic Effluents: Applicability of the Parr Acid Digestion Bomb Technique for Sample Pretreatment. Kinard, J.T. (Benedict College, Department of Chemistry, 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: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

This research comprises a comparative study of a number 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. At the conclusion of this investigation the most applicable hydride generation--flame atomic absorption spectrophotometric method for determining organic and inorganic arsenic and selenium in an industrial domestic-effluent matrix will have been identified. In addition, the advantages of this method and the graphite furnace method, when employed for routine determination of total arsenic and selenium in effluents, will have been determined and compared. Although this investigation is highly specific, it addresses the determination of two elements that have toxicological and perhaps carcinogenic characteristics, and exist in forms that have eluded total analytical characterization.
Keywords: ARSENIC; SELENIUM; ABSORPTION SPECTROSCOPY; SAMPLE PREPARATION; INDUSTRIAL WASTES; MUNICIPAL WASTES; CHEMICAL ANALYSIS; TRACE AMOUNTS; QUANTITATIVE CHEMICAL ANALYSIS; WASTES.

70548 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.
R and D categories: Physical and chemical processes and effects.

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.

70549 Ion Exchange Applied to New Methods of Sampling, Enrichment and Speciation in Water Analysis. Blaedel, W.J. (University of Wisconsin, Department of Chemistry, 500 Lincoln Drive, Madison, WI, 53706). **Project number:** A625C-10. **Contract:** R804179-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$34,000.
R and D categories: Integrated assessment.

The objective of this project is to apply ion exchange to the determination of trace metal ions at submicromolar concentration levels. Two methods are being investigated. Trace ions in a sample donor solution are concentrated by loading upon a pellicular ion exchanger, and these are eluted or stripped into an acceptor solution at an enhanced concentration level so that they can be more easily measured. In studies with Cu, enhancements over 100-fold have been obtained that are in accord with the theoretical Donnen enhancement. In another phase of this project, the kinetic and equilibrium properties of the copper ion-selective electrode are being investigated in the submicromolar concentration region. When they have become elucidated and measurable, these properties may serve to characterize the electrode, or they may have analytical usefulness.
Keywords: ION EXCHANGE; SAMPLING; WATER QUALITY; ECOLOGICAL CONCENTRATION; TRACE AMOUNTS; CHEMICAL REACTION KINETICS; COPPER; ELECTRODES; DISTRIBUTION FUNCTIONS; GROUND WATER; METALS; SURFACE WATERS; SEPARATION PROCESSES; WATER.

70550 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(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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 and using a suitable optical sensor, traces of oil in water will be monitored at 75 ppM level and greater. Current plans are to design, fabricate, and test a prototype instrument using the organophilically treated glass fiber for the determination of suspended hydrocarbons in water. The concept was demonstrated to be feasible, and its demonstration was reported at the Symposium on Energy Research and Development for Continental Margins, at the University of Southern California, Los Angeles, California, March 8, 1978.
Keywords: WASTE WATER; MONITORING; WATER POLLUTION MONITORS; HYDROCARBONS; COAL LIQUEFACTION; OIL SHALE PROCESSING PLANTS; PETROLEUM REFINERIES; DESIGN; FABRICATION; TESTING; CHROMATOGRAPHY; FIBER OPTICS.

70701 Microwave System to Prevent Hazardous Material Dike Failures. Koerner, R.M. (Drexel University, Department of Civil Engineering, 32nd and Chestnut Streets, Philadelphia, PA, 19104). **Project number:** B610A-192. **Contract:** R804763-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$51,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The detection and location of water levels, water pockets, voids and various other discontinuities between different layers of earth or rock are critical in insuring the performance and safety of earth dams. Such underground anomalies are particularly undesirable in the earth dams and dikes that contain hazardous materials since these relatively small embankments are generally not engineered or constructed in a rigorous and professional manner. One possible technique for detecting and monitoring such faults and weak

areas is the use of microwaves. By beaming continuous or pulsed microwaves at the dike and recording the return signal as it is reflected from the anomaly, the location, type and depth of faults can be determined. A literature search (technical, equipment, legal and safety) will be undertaken and a number of laboratory experiments will be performed to assess the practicality of using microwaves for the non-destructive assessment of dike stability. Basic soil properties such as dielectric constant, conductivity, attenuation, phase shift, and velocity will also be determined. The final result of this project will be the detailed specification for an inexpensive, mobile, microwave unit (with known limitations) to determine underground water, irregularities, and discontinuities in small earthen dikes.
Keywords: MICROWAVE RADIATION; DAMS; FAILURES; DETECTION; USES; GROUND WATER; MONITORING; SOILS.

70703 Document/Analyze Historical Data on Hazardous Spills. Buckley, J.L. (Factory Mutual Research Corp., 1151 Boston Providence, Norwood, MA, 02062). **Project number:** B610A-194. **Contract:** 68-03-0317. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$21,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives of this program are to collect and analyze documentation of spills of hazardous substances which present dangers to the nation's waterways. These incidents will be classified by frequency, quantity and type of material, hazard potential, and other significant parameters which will describe the impact of the incident. Each spill incident will be documented and the total number of incidents examined will be treated statistically in order to draw conclusions and make recommendations for subsequent work concerned with the prevention of such spills and the development of appropriate devices, techniques, methods, and procedures. An interim report, Hazardous Material Spills: A Documentation and Analysis of Historical Data, EPA-600/2-78-066, has been published. Recent spilis data are being combined with OHMTADS toxicological/chemical/physical data to improve data processing and spill frequency and other parametric data to increase reliability and facilitate spill frequency, size, material, site, etc., projections.
Keywords: HAZARDOUS MATERIALS; ACCIDENTS; AQUATIC ECOSYSTEMS; TOXICITY; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; WATER POLLUTION ABATEMENT; RISK ASSESSMENT; WATER POLLUTION CONTROL; PLANNING; ORGANIC COMPOUNDS; METALS; PESTICIDES.

70723 Audiovisual Program on Surface Mining and the Natural Environment. Beyer, L.E. (Interstate Mining Compact Commission, P.O. Box 11751, Lexington, KY, 40511). **Project number:** B623B-504. **Contract:** R804972-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$228,000.
Related energy source: coal(100).

The project objective is to prepare a comprehensive training package, consisting of a number of audiovisual presentations and an accompanying instructional manual, which can be used by government and industry to: (1) upgrade and improve the techniques and procedures for enforcing state and federal environmental regulations related to surface mining; (2) acquaint regulatory and production personnel with the environmental sciences, the nature, extent and relationship of surface mining environmental problems, and the basic environmental control principles and practices; and (3) explain and illustrate different uses and applications of best available and cost-effective environmental control techniques. A format which is generic in nature will be utilized in developing the course. The use of such a format is desirable in order to facilitate course utilization throughout the varied and extensive geographic area covered by the IMCC member states. In preparing those portions of the course dealing with the control basis, emphasis will be given to basic control philosophy, principles, and practices rather than a detailed coverage of specific laws and regulations within particular states.
Keywords: SURFACE MINING; EDUCATIONAL TOOLS; TERRESTRIAL ECOSYSTEMS; ENVIRONMENTAL IMPACTS; BIOLOGICAL MODELS; WASTE MANAGEMENT; COAL; CHEMICAL EFFLUENTS; WATER POLLUTION.

70736 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:** Integrated assessment.

The potential environmental impacts of advanced energy conversion technologies will be assessed in a three phase program over a 30 month period. Early identification of the need for pollution controls allows development of the controls along with development of the basic systems, and avoids the need for retrofitting and shutdowns later when plants are in commercial operation. The advanced cycles to be considered in this program include: open and closed cycle magnetohydrodynamics (MHD), open and closed cycle high-temperature gas turbines, liquid metal topping cycles, supercritical CO2 cycles (Feher), thermionics, fuel cells, advanced steam cycles (field) and bottoming cycles. The Phase I effort will consolidate the available information on the potential pollutants as well as the current state of development of advanced conversion technologies. The objective of Phase II will be to develop realistic and practical analytical models in order to estimate effluents, pollutants, and waste energy. These models will be employed to provide parametric analyses of emission levels related to cycle characteristics and efficiency. The cost/effectiveness of existing pollution control technologies for each cycle will then be determined. Phase III of the program will use all the information and data generated in the program to identify the critical R and D needed to make these technologies environmentally acceptable. The impact of pollution control on energy conversion efficiency will be stressed in the recommendation. This planning effort will include alternate R and D strategies and priorities based on anticipated ranges of available funding.
Keywords: POLLUTION CONTROL; MAGNETOHYDRODYNAMICS; GAS TURBINES; FUEL CELLS; ENERGY CONVERSION; ENVIRONMENTAL IMPACTS; ENERGY SOURCE DEVELOPMENT; POLLUTION ABATEMENT; PLANNING; ENERGY POLICY.

70737 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:** Integrated 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.
Keywords: MUNICIPAL WASTES; SOLID WASTES; COMBUSTION; ENVIRONMENTAL IMPACTS; TECHNOLOGY ASSESSMENT; ECONOMICS; REFUSE DERIVED FUELS; WASTE PROCESSING PLANTS; REFUSE-FUELED POWER PLANTS.

70738 Pilot Scale Pyrolytic Conversion of Mixed Waste to Fuel. Porter, J. (Energy Resources Co., Inc., 185 Alewife Brook Parkway, Cambridge, MA, 02138). **Project number:** B624B-399. **Contract:** 68-03-2340. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$250,000.
Related energy source: all(100).

The objective is to develop models relating fraction of fuel products (gas, liquid, solid) produced in pyrolysis of various types of solid wastes as a function of pyrolyzed conditions. Solid wastes include mixed municipal, agricultural, and industrial wastes. An investigation of chemical conversions, including steam gasification, partial oxidation, and catalytic effects of bed materials as well as detailed analysis and characterization of pyrolysis products including char and oil, will be conducted. An experimental study will be conducted using small batch pyrolyzer and pilot size (200 kg/hr) fluidized-bed pyrolyzer to produce data for model development and verification. Statistical and semi-empirical models will be examined for the normal fluidized-bed pyrolytic reaction as well as for steam gasification and partial oxidation. Several char and oil samples will be analyzed in detail to evaluate the acceptability of fuel products.
Keywords: SOLID WASTES; PYROLYSIS; CHEMICAL REACTION YIELD; GASES; PYROLYTIC OILS; CHARS; MUNICIPAL WASTES; AGRICULTURAL WASTES; INDUSTRIAL WASTES; GASIFICATION; PARTIAL OXIDATION PROCESSES; CATALYSIS; STEAM; FLUIDIZED BED; MATHEMATICAL MODELS; COMBUSTION PROPERTIES.

70745 Pyrolysis of Agricultural Residues and Feedlot Wastes in a Reactive Steam Atmosphere. Antal, M.J. (Princeton University, Department of Aerospace and Mechanical Sciences, Box 430, Princeton, NJ, 08540). **Project number:** B624B-538. **Contract:** R804836-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$90,000.
Related energy source: all(100).

A program to investigate the pyrolysis of agricultural residues and feedlot wastes in a steam atmosphere is to be done. The program

is motivated by the evident need to upgrade the energy value of organic wastes from them to become a nationally significant fuel resource. Hydrogen produced from solid wastes by steam pyrolysis could be used to meet a portion of the nation's natural gas demand. Experimental work on the kinetics of steam pyrolysis is needed to design a practical reactor system and to establish the regimes where minimum levels of environmental pollutants are produced. The research program outlined in this effort will investigate at the bench the effects of diverse parameters, e.g., heating rate and ultimate temperature, particle size, reactor residence time, and pressure on steam pyrolysis. In addition, catalysis of the pyrolysis reactions and effects of trace constituents of the waste on catalysis will also be studied. Mathematical models based on differential equations describing the rate processes will be developed when appropriate. The research program is aimed at determining the optimal conditions for the production of a synthesis gas (composed primarily of H2, CO, and CO2) from organic wastes by steam pyrolysis. In order to achieve this goal, yields of char and liquid products will be minimized. Ultimate pyrolysis temperatures will also be kept as low as possible, but other conditions will be treated as true variables in the optimization process. Results from this research will facilitate the design of a continuous, small-scale chemical reactor primarily for waste gasification, though some waste liquefaction information will also result.
Keywords: AGRICULTURAL WASTES; MANURES; PYROLYSIS; STEAM; HYDROGEN PRODUCTION; CHEMICAL REACTION KINETICS; CHEMICAL REACTORS; CHEMICAL EFFLUENTS; CATALYSIS; BENCH-SCALE EXPERIMENTS; TEMPERATURE EFFECTS; TIME DEPENDENCE; PRESSURE DEPENDENCE; MATHEMATICAL MODELS; SYNTHESIS GAS; SYNTHESIS; GASIFICATION; THERMOCHEMICAL PROCESSES.

70751 Environmental Guidelines for Onshore Impact of Offshore Petroleum Development. Doyel, W.W. (Geological Survey, Resources and Land Investigation 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).

The objective is to carry out a series of workshops for state and local planning officials to provide them with methodologies and information pertaining to the identification of the onshore impact of Outer Continental Shelf petroleum development and the siting of facilities associated with that development. The approach is to retain the American Society of Planning Officials (ASPO) to set up the meetings, arrange for curricula and facility, prepare preprints and proceedings, and present a final report both on the content and on the success of this means of rapid dissemination of information. The results of USGC-funded New England River Basins Commission (NERBC) methodology and development for the New England OCS frontier will be used as a basis for the first series of workshops (held in five locations around the coastal U.S.). State and local planners from the region where each workshop is held will be involved to the maximum extent possible in the preparation and execution to enrich the total content, to ensure useful feedback to NERBC, and to guarantee a nationally useful body of information and methods.
Keywords: CONTINENTAL SHELF; ENVIRONMENTAL IMPACTS; PETROLEUM DEPOSITS; EXPLOITATION; OFFSHORE OPERATIONS.

70752 Evaluation/Development of Foams for Mitigating Air Pollution from Hazardous Spills. Hiltz, R.H. (MSA Research Corp., Evans City, PA, 16033). **Project number:** B604A-234. **Contract:** 68-03-2478. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$91,000.
R and D categories: Physical and chemical processes and effects; Health effects.

Spilled volatile chemicals pose serious hazards to the environment, to personnel involved in control and cleanup operations, and to all people in the downwind zone. The hazards are twofold: the uncontrolled liquid surface, and vapors released into the atmosphere. Appraisal of possible procedures to mitigate the hazards have shown soft water based foams to have significant potential. These materials are widely available in the fire services. There is extensive experience in their use although primarily for firefighting. The objectives of this project are: (1) to undertake a state-of-the-art survey of the use of foams on hazardous spills and to present the results in the form of a preliminary matrix of spilled material vs suitable foam; (2) through laboratory and field testing, to fully define the capability of the foam systems commercially available in mitigating the hazards from spilled chemicals, revising the first-cut matrix to make it more complete and of wider use to spill response teams; and (3) to develop advanced foam technology directed to more effective and versatile foam systems specifically suited to the mitigation of the hazards from spilled volatile chemicals that are not readily controlled with existing foams and equipment.
Keywords: REMOVAL; HAZARDOUS MATERIALS; FOAMS; TESTING; SURFACE WATERS; AIR POLLUTION; LAND POLLUTION; WATER POLLUTION; SULFUR OXIDES; NITROGEN OXIDES; ORGANIC COMPOUNDS; ACCIDENTS; DECONTAMINATION; SPILLS; CLEANUP.

70755 Hazardous Material Spill Ultimate Disposal: Lab/Pilot Demonstration Sodium Fluxing and Glassification. Hiltz, R.H. (MSA Research Corp., Evans City, PA, 16033). **Project number:** B610A-579. **Contract:** 68-03-2492. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$40,000.
R and D categories: Physical and chemical processes and effects; Health effects.

The disposal of collected spilled hazardous materials can pose significant difficulty in assuring that such disposal is complete and that the material cannot enter the ecosystem in its hazardous form. This program will assess two techniques to provide ultimate disposal of those chemicals that are not generally amenable to existing disposal techniques such as incineration, landfill, etc. The first task will evaluate the ability of a liquid alkali metal to degrade organic compounds to elements or simple innocuous compounds (hydrogen, nitrogen, carbon, NaCl) or to compounds which can be treated by conventional techniques (Na2O, Na2S, C2H2). The liquid metal system will be designed along lines of current heat transfer equipment and will use technology derived from inert gas cleaning units. The second task will evaluate glass encapsulation of essentially nonvolatile materials. In this technique, the material to be disposed of will be blended with glass-forming materials. In-situ glass formation will be effected using either external heating or pyrochemical reaction within the mass. Accelerated leaching tests will be run to determine the stability of the resulting glasses. Careful attention will be paid to the control of reaction-generated vapors. Rather than restricting the project to work on only pure chemicals, both techniques will be developed for processing spilled hazardous materials contaminated with typical spilled debris (earth, sand, flora, water, etc.). A full analysis will be made of the fate of the reacted materials after disposal to the environment. Pilot scale units will be built and operated for those processes that are successful on a laboratory scale.
Keywords: HAZARDOUS MATERIALS; REMOVAL; BENCH-SCALE EXPERIMENTS; ACCIDENTS; ALKALI METALS; LIQUID METALS; HYDROGEN; NITROGEN; CARBON; SODIUM CHLORIDES; ORGANIC COMPOUNDS; DECOMPOSITION; HEAT TRANSFER; GLASS; VITRIFICATION; PILOT PLANTS; ENCAPSULATION; DECONTAMINATION; SPILLS.

70760 Full-Scale Demonstration of Hyperfiltration for Closed-Cycle Operation in Textile Plants. Brandon, C.A. (Riegel Textile Corp., La France Division, La France, SC, 29656). **Project number:** B624B-374. **Contract:** S805182-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$135,000.
Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

The objectives of this project are to demonstrate the economic and technical advantages to a full scale reverse osmosis (hyperfiltration) system for closed cycle operation of a textile dying and finishing plant. Involved is the design, installation, and twelve-month operation of a reverse osmosis treatment system for the hot wastewater from either a continuous dye range or a group of ten atmospheric dye becks. The two types of equipment are typical of the two broad categories of textile processing--continuous and batch. A conceptual design will be developed for each process and the one appearing to be the most economically viable will be demonstrated. Outputs from this program consist of: a detailed design for textile wastewater treatment by reverse osmosis, detailed operations and capital costs, documentation of energy savings of the reverse osmosis system compared to conventional waste treatment methods, and evaluation of chemical (dyes, salt) recycle in the dying process.
Keywords: FEASIBILITY STUDIES; ECONOMICS; FILTRATION; OSMOSIS; CLOSED-CYCLE SYSTEMS; TEXTILES; TEXTILE INDUSTRY; WASTE WATER; DYES; MANUFACTURING; ENERGY CONSERVATION.

70766 Waste Heat Inventory of Major Energy-Intensive Industries. Latour, S.R. (DSS Engineers, Inc., 2701 E. Sunrise Blvd., Fort Lauderdale, FL, 33304). **Project number:** B624B-530. **Contract:** 68-01-4454. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$1,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objective of this task is to identify the points, quantity, and quality of heat discharged from established industrial technologies now discharging substantial amounts of waste heat to the

environment, and emerging technologies for energy development, conversion and utilization.
Keywords: WASTE HEAT; INVENTORIES; THERMAL EFFLUENTS; WATER POLLUTION; AIR POLLUTION; THERMAL POLLUTION; ENERGY CONSUMPTION; CONSUMPTION RATES; WASTE HEAT UTILIZATION; INDUSTRY.

70767 Technology Assessment of Energy Development in Appalachia. Cobb, R.W. (Battelle Memorial Institute, Resource Management and Economic Analysis, 505 King Avenue, Columbus, OH, 43201). **Project number:** B624C-594. **Contract:** 68-03-2531. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$400,000.
Related energy source: coal(100).

The purpose of this program is to provide EPA and other decision makers with information necessary to: (1) foresee the effects of regulatory policies upon future energy development in Appalachia; and (2) determine areas requiring research emphasis in preparation for monitoring and controlling the impacts of new or expanded energy technologies. This regional study of energy development in Appalachia will focus on environmental, social, and economic impacts, both beneficial and adverse, associated with alternative energy policies and practices. Although the emphasis will be on the development of Appalachian coal resources, other energy resources will also be examined. The first year technology assessment will begin by reviewing existing literature on Appalachian energy development. Energy development scenarios will be formulated based on (1) national energy policy as it relates to Appalachia and (2) existing energy production technology that is expected to be used in 1985 (near-term development) as well as existing and new technology which can be expected to be available for use between 1985 and 2000 (mid-term development). Next the direct and higher-order impacts from the implementation of this technology will be examined. Concurrently, policy options available for controlling the impacts will be investigated along with issues that impacts raise. Emphasis will be placed on investigating the impacts from current plans for energy development under existing or proposed environmental protection policies. The second phase will expand upon and refine the work of the first year technology assessment. Emphasis will be placed upon identifying and analyzing alternative strategies for managing the rate and pattern of energy development in Appalachia.
Keywords: APPALACHIA; ENERGY POLICY; ENERGY SOURCE DEVELOPMENT; COAL; TECHNOLOGY ASSESSMENT; ENVIRONMENTAL IMPACTS; ECONOMIC IMPACT; SOCIAL IMPACT.

70799 Parametric Modifications of Spill Factors Affecting Air Pollution. Tuffly, B. (Rockwell International Corp., Rocketdyne Division, 8900 Desoto Avenue, Canoga Park, CA, 91304). **Project number:** B604A-494. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$108,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The objects of this project are: (1) to assess the effectiveness of applying heat absorbing materials to reduce the temperature and thus the vapor pressure of the spilled hazardous materials that create air pollution problems through vaporization; (2) to evaluate vapor dispersion retardants (chemicals, sorbents); (3) to explore other novel technologies that interfere significantly with the transfer of the volatilizing spilled hazardous material to the air column; and (4) to develop, demonstrate and evaluate the equipment and technology of those vapor retardation techniques that appear to be practical. This study will develop a tabulation of potential vaporization retardation techniques, including the application of coolants, chemicals, and sorbents, and will assess the various approaches for effectiveness and cost. The methods developed and demonstrated are intended to be suitable for use by those who normally arrive first at the scene of a spill, such as firefighters and emergency crews. The equipment and expendable items should have a long pre-use shelf life and should be suitable for application by those who are relatively unskilled. Attention will be paid to safety gear and protective clothing. The problem of generation of sparks by static electrification during dispersion of vapor suppressants will be considered along with other related safety aspects of response to spills of volatile hazardous substances.
Keywords: AIR POLLUTION CONTROL; HAZARDOUS MATERIALS; ACCIDENTS; TEMPERATURE EFFECTS; SURFACTANTS; VAPORS; INHIBITION; SORPTIVE PROPERTIES; EMERGENCY PLAN; SULFUR OXIDES; HYDROCARBONS; ODOR; PESTICIDES.

70800 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: coal(50); oil and gas(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of this project is to review and rewrite reports submitted by EPA in the established format of Office of Research and Development reports. A more complete and consistent report is desired than previously available. The reports will each be reviewed by a chemical specialist, technical editor, and format editor. Additional information, when available, will be added by engineers assigned to the project. It is planned tha the rough draft reports will be completed by the end of November. Subjects of the assessments are acrylonitrile, arsenic, benzene, benzidine, hexachlorbenzene, polybrominated biphenyls, polynuclear aromatics, trichloroethylene, tris, vinylidene chloride, cadmium, lead, phosphates, mercury, and asbestos.
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.

70801 Wet Scrubbing of Immersibles (Organic Products Processing). Cheremisinoff, P. (New Jersey Inst. of Technology, Department of Civil and Environmental Engineering, 323 High Street, Newark, NJ, 07102). **Project number:** B604B-136. **Contract:** R804455-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
R and D categories: Physical and chemical processes and effects.

The proposed investigation is to examine a series of organic compounds and their removal from gas streams by use of aqueous scrubbing solutions. Water scrubbing of air streams containing organic vapors in concentration ranges from 0.01 lb/m cubic ft to 1 lb/m cubic ft is at present impractical. Organic compounds with relatively high vapor pressures or pour solubility in water are not easily absorbed in conventional wet scrubbing processes. Solubility is a function of the physical properties of the solute-solvent interface. It is proposed to study changing solubility, wetting, surface tension and viscosity properties and effects on mass transfer between selected organic vapors and water. To change these properties, a study of the effects of various surface active agents will be undertaken. Laboratory simulation of mass transfer conditions is to be effected as a screening mechanism for those systems showing the greatest promise. A packed tower with suitable packing, piping, control devices will be used to determine operability of organic-vapor-aqueous system on a semi-commercial scale.
Keywords: SCRUBBING; ORGANIC COMPOUNDS; AIR; SOLUBILITY; AQUEOUS SOLUTIONS; AIR POLLUTION; REMOVAL; AIR CLEANING; ENVIRONMENTAL TRANSPORT.

70802 Microwave Regeneration for Carbon Regeneration. Bailin, L.J. (Lockheed Missiles and Space Co., Inc., Department of Chemistry, 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-$34,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects.

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. Recommendations based on the results will be detailed as warranted by the program data. 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 of recovery; and (3) preparation of a preliminary design for a potential full-scale system.
Keywords: MICROWAVE RADIATION; USES; MATERIALS RECOVERY; REGENERATION; RECYCLING; ACTIVATED CARBON; HEATING; WASTE DISPOSAL.

70803 ISAC: Paint, Ink, and Publishing. Scofield, F. (Wapora, Inc., 6900 Wisconsin Avenue NW, Washington, DC, 20015). **Project number:** B604B-801. **Contract:** 68-03-2580. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$25,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are to assist the National Flexible Packaging Association in the development of emission data from industries such

as paper converters, laminators and sealers, and flexible packagers; to prepare an assessment report on these emission sources and the control devices used; and to develop a suggested research plan which will evaluate the technologies applicable to these industries and the emission reduction possible through application of each type of level of control technology.
Keywords: PACKAGING; GASEOUS WASTES; RISK ASSESSMENT; POLLUTION CONTROL EQUIPMENT; POLLUTION ABATEMENT; PLANNING; WATER QUALITY; AIR QUALITY; ENVIRONMENTAL TRANSPORT; CHEMICAL EFFLUENTS; INDUSTRIAL WASTES; WASTE MANAGEMENT.

70804 Verification Testing for Polish PL-480 Project No. 5-533-5. Harris, D.L. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** B604C-T1004. **Contract:** 68-03-2550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$20,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

Monsanto Research Corporation will provide data that can establish a correlation between the Federal EPA stationary source testing methods and the methods currently in use by Polish scientists and engineers for measurement of particulate and possibly SO2. The program may include: (1) presurvey at the copper smelting facility at Gliwice, Poland; (2) preparation of sampling plan; (3) shipment of sampling equipment to and from Poland; (4) observation of tests conducted concurrently at the Polish facility using both EPA methods and Polish methods; and (5) establishment of correlation between EPA and Polish methods. A secondary objective of the project is to observe the operation of the Hoboken converters in use at the smelting facility to determine if a method can be employed to estimate the fugitive emissions of SO2.
Keywords: POLAND; AIR POLLUTION ABATEMENT; STATIONARY POLLUTANT SOURCES; MONITORING; AEROSOL MONITORING; SULFUR DIOXIDE; COPPER; SMELTING; SAMPLING; OPTIMIZATION; US EPA; FORECASTING; ATMOSPHERIC CHEMISTRY; METEOROLOGY.

70805 Feasibility of Smelter Weak SO2 Stream Control. Weisenburg, I.C. (Pacific Environmental Services, Inc., 1930 14th Street, Santa Monica, CA, 90404). **Project number:** B604C-759. **Contract:** 68-02-2606. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$65,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The report gives background design data for a specific copper smelter. The data is sufficiently detailed to allow air pollution control system engineering studies to be conducted. These studies will be concerned primarily with lead SO2 streams that currently are not being captured. Physical layout of the smelter and the surrounding area is presented, along with existing control equipment. Ductwork that would be considered for future system tie-in is defined. Emissions from operating equipment, gas flow rates, temperatures, sulfur balance, and a process flow sheet are included. Utilities, stack dimensions, footing requirements and solid waste handling are defined. Available areas for new control equipment, gas characteristic variation, and potential new control equipment installation problems are discussed.
Keywords: SULFUR DIOXIDE; SMELTING; STREAMS; WATER POLLUTION CONTROL; WASTE MANAGEMENT; POLLUTION CONTROL EQUIPMENT; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL IMPACTS.

70806 Hazardous Material Spill Ultimate Disposal: Lab/Pilot Plant Bromination Studies. Darnell, A.J. (Rockwell International Corp., Atomics International Div., 8900 DeSoto Avenue, Canoga Park, CA, 91304). **Project number:** B610A-580. **Contract:** 68-03-2493. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$40,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The program's objectives are to investigate and further develop the Atomics International bromination process in order to adapt and apply the method to the disposals of spilled hazardous materials. The process is a wet oxidation method that is effective in the destruction of organics. Spilled hazardous materials are reacted with bromine and water at 250 to 300 degrees C to form CO2 and aqueous HBr. The HBr solution is continually withdrawn and electrolyzed, thus regenerating the bromine and also yielding hydrogen. Any sulfur, phosphorus, or chlorine in organic compounds is converted into sulfate, phosphate, or chloride, respectively. These are treated with lime, then deposited in sanitary landfills. Any bromine residues are treated with acid to recover bromine. The process will be investigated first on a 10 to 100 gram scale and subsequently by making kilogram-size runs. The bromine electrochemical regeneration step will be investigated to determine the practical decomposition voltages of the concentrated HBr solution (47.5 w/o HBr) as a function of temperature, current density, electrode material, and electrolytic cell construction materials. Following the laboratory phase experiments, kilogram-scale experiments will be carried out in which a candidate material will be reacted with bromine and the HBr solution will be electrolyzed for the regeneration of the bromine. Factors which will be considered include the capital and operating costs, detoxification efficiency, and potentially hazardous wastes or by-products. Operator and environmental safety precautions will be strictly maintained.
Keywords: HAZARDOUS MATERIALS; ACCIDENTS; ORGANIC BROMINE COMPOUNDS; WASTE MANAGEMENT; INDUSTRIAL WASTES; SULFUR; PHOSPHORUS; CHLORINE; SANITARY LANDFILLS; BROMINE; MATERIALS RECOVERY; HEALTH HAZARDS; TOXICITY; ECONOMICS.

70807 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.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives of this program are: (1) to conduct a literature survey on the natural recovery and on the accelerated restoration of hazardous spill-damaged land areas, ponds, small streams, etc.; (2) to explore and develop useful, economic techniques of restoration; and (3) to develop a manual of operating procedures for restoration of hazardous spill-damaged areas. The quantity of hazardous materials transported over rails and highways has increased steadily. In spite of precautions taken, the number and volume of accidental discharges of hazardous materials has also increased. Land spills, even though controlled and cleaned up by responsible agencies or their representatives, can seriously scar the environment. In effect, spills destroy, severely damage or upset ecological chains and systems by wiping out and depopulating trophic levels and inhibiting growback. With time, natural processes such as evaporation, dispersion/diffusion, washout, weathering, bioconversion to harmless end products, etc., will reduce residual soil concentration of hazardous materials (which affect biological activity) to subtoxic levels and effect at least a partial restoration of fertility. The purpose of this project is the evaluation and application of restorative methods for the enhancement of the rehabilitation rate of hazardous spill-damaged terrain, etc.
Keywords: HAZARDOUS MATERIALS; SPILLS; REVEGETATION; BIOLOGICAL RECOVERY; LAND RECLAMATION; CLEANUP; ECONOMICS; MANUALS.

70808 Evaluation of PVC Wastes Reclaimed by the Hafner Process. Hafner, E.A. (Hafner Industries Inc., Amity Station, P.O. Box 3923, New Haven, CT). **Project number:** B610B-141. **Contract:** S804693. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$65,000.

The objective of this research project is to demonstrate the technical feasibility of recovering PVC resin, plasticizer and other materials from PVC manufacturing waste compositions using the Hafner Recovery Process. Five PVC waste feedstocks used in this study will be furnished by major U.S. producers who will cooperate in this study by supplying drumming samples of PVC flooring, wall covering, upholstery, sound records and insulated wire wastes. The recovered materials will be recompounded and evaluated for physical properties.**Keywords:** MATERIALS RECOVERY; FEASIBILITY STUDIES; RESINS; PLASTICS; RECYCLING; PHYSICAL PROPERTIES; WATER POLLUTION ABATEMENT; HYDROCARBONS.

70809 Development and Demonstration of a Hydroperm Microfiltration System for the Treatment of Battery Manufacture Wastewater Effluents. Bitler, J.A. (General Battery Corp., P.O. Box 1262, Reading, PA, 19603). **Project number:** B610B-466. **Contract:** R805748-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$96,000.

The objective is to demonstrate the applicability of hydroperm microfiltration for the virtually complete removal of suspended solids, and for the removal of toxic heavy metals, specifically lead, to levels below 0.05 ppM from battery manufacture wastewater effluents. Hydroperm is a microfiltration system, the principal element of which is a hollow tubular filter of discrete wall thickness (approximately 6 to 9 mm id) made of thermoplastic material and containing micron-size pores. At relatively low pressures (approximately 5 psi), these tubes are capable of virtually total removal of suspended solids as well as significant amounts of high molecular weight dissolved solids from a variety of industrial and domestic wastewaters, while maintaining reasonably high permeation rates.

The filtrate permeates through the porous walls of the tube in a direction perpendicular to the direction of flow of the feed. The tubes themselves can be optimized in terms of their performance by proper choice of operating pressure and feed circulation velocity. Moreover, the tubes can be made with controlled microporosity and pore-size distribution so as to optimize their application to a particular type of wastewater. This will be the subject of Phase I of the program. Phase II will be a comprehensive, 8-month program involving the design, construction, installation and demonstration of a 24,000 gpd hydroperm system, interfacing with the existing wstewater treatment plant at the General Battery Plant in Hamburg, Pennsylvania. Four compact hydroperm modules will be used, each containing 100 square feet of filtration surface area.**Keywords:** LEAD-ACID BATTERIES; WASTE WATER; WASTE MANAGEMENT; FILTRATION; TOXIC MATERIALS; LEAD; MUNICIPAL WASTES; INDUSTRIAL WASTES; WATER POLLUTION CONTROL; WATER TREATMENT PLANTS; DESIGN; CONSTRUCTION; DEMONSTRATION PLANTS; PENNSYLVANIA; METALS; REMOVAL; ENVIRONMENTAL IMPACTS.

70810 Task 005: Effluent Guidelines Development Sampling, Part I. Rawlings, G.D. (Monsanto Research Corp., Environmental Engineering Analysis Section, 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** B610C-T1005. **Contract:** 68-03-2550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The objective of this work directive is to provide accurate data on the concentrations of the 129 consent decree priority pollutants in selected wastewater streams at two nonferrous metal smelters. Two plants preselected by the Metals and Inorganic Chemicals Branch (MICB), will be firest presurveyed to establish site specific information and to identify sampling locations. Sampling teams will then proceed to each plant and collect samples for subsequent priority pollutant analyses. The technical approach for this work directive is divided into two states--an engineering presurvey, followed by field sampling and sample analysis.
Keywords: WATER POLLUTION; WASTE WATER; METAL INDUSTRY; INORGANIC COMPOUNDS; METALS; SAMPLING; OPTIMIZATION; WASTE MANAGEMENT.

70811 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 shales and tar sands(100). **R and D categories:** Integrated assessment.

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.

70812 Proposal to Assess Metal Ion Pollution of Groundwater as a Consequence of Underground Coal Gasification in the San Juan Basin. Walters, E.A. (University of New Mexico, Department of Chemistry, University Hill Northeast, Albuquerque, NM, 87106). **Project number:** B623A-850. **Contract:** R806303-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$25,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Underground coal gasification (UCG) has received considerable attention in recent years as a possible means of harvesting the deep seam coal resources because of anticipated economic, health, and environmental advantages when compared to conventional mining techniques. One attractive site for such an operation is the San Juan Basin of New Mexico. It has been shown elsewhere that UCG is technologically feasible, but one of the prime uncertainties is what adverse effects to the environment may arise. One potential impact is contamination of groundwater by metal ions leached from the ash that remains underground after a UCG burn. This proposal addresses the question of how serious a problem this might be. We propose here to study the possibility of groundwater contamination by selected metal ions following UCG. Subsidence is likely to enhance permeability of the overburden and permit migration of groundwater into the UCG site where it can dissolve metal ions in the ash. This investigation consists of a baseline study of water, coal, and soil from a UCG test site for metal ion levels and leachability. This will be followed by an extensive laboratory program to determine rates of solution, distribution coefficients, and extent of ion exchange and adsorption of a number of metal ions. These results will permit eventual development of a model for ion migration from a UCG site.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; NEW MEXICO; GROUND WATER; CONTAMINATION; METALS; LEACHING; DIFFUSION; ENVIRONMENTAL EFFECTS.

70813 Analysis of Selected Samples for Metal Uptake. Becker, B.C. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** B623B-S3002. **Contract:** 68-03-2664. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$17,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The possible uptake of metals by plants and animals in the mining environment is a source of major concern. This project will sample vegetation at a sulfur mine reclamation project and an oil shale reclamation project, and will sample fish and vegetation at a coal mine drainage (acid) neutralization settling lagoon.
Keywords: PLANTS; UPTAKE; ANIMALS; METALS; MINING; BIOLOGICAL EFFECTS; SULFUR; OIL SHALE INDUSTRY; COAL MINING; ACID MINE DRAINAGE; PONDS; FISHES; TOXICITY; ENVIRONMENTAL IMPACTS; WATER POLLUTION.

70814 Alternatives for Sodium Cyanide for Flotation Control. Smithson, G.R. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** B623B-T2008. **Contract:** 68-03-2552. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$25,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Cyanide has been designated by the EPA as a toxic substance. Cyanide has been detected in many discharges from the mining industry, particularly the beneficiating processes. Sodium cyanide is currently being used to depress pyrites in the flotation processes in the milling operations. Therefore it is essential for environmental protection that methodology for removal of cyanide under large volume, low concentration conditions be developed. Conversely, if a suitable alternative could be developed to suppress the pyrite in the flotation process, the use of sodium cyanide could be discontinued and the problem eliminated. This study is concerned with finding a less toxic or non-toxic replacement for cyanide in its function as pyrite (or other sulfide mineral) depressant in mineral flotation rather than to find a cyanide removal treatment process effective at the concentration encountered. The primary objectives of this study are the following: provide a review of alternatives to sodium cyanide as a pyrite depressant in flotation; assess and evaluate the applicability and feasibility (including preliminary comparative cost estimates) of replacements for sodium cyanide as a depressant, including an assessment of environmental hazards associated with such alternatives; determine data requirements and research essential to substantiate and verify possible cyanide alternatives; and perform flotation studies to determine the relative performance of selective alternative depressants with respect to sodium cyanide.
Keywords: SODIUM COMPOUNDS; TOXICITY; CYANIDES; FLOTATION; CONTROL; SEPARATION PROCESSES; COAL MINING; HEALTH HAZARDS; ENVIRONMENTAL IMPACTS; PYRITE; INHIBITION.

70815 Treatment Categories for Coal Mine Drainage. Uhrmacher, C.C. (Hittman Associates, Inc., 9190 Red Branch Road, Columbia, MD, 21045). **Project number:** B623B-T3001. **Contract:** 68-03-2566. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$65,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

An investigation was made through literature and records review concerning whether a separate subcategory for the coal mining point-source best available treatment guidelines should be established to differentiate between mine drainage treatment technology in the East as opposed to that in the West.
Keywords: WASTE PROCESSING; MINE DRAINING; COAL MINES.

70816 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-$25,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

Antimony and its various compounds have been designated by EPA as toxic substances. Significant concentrations of antimony have been observed in many discharges from the mining industry, particularly the beneficiating processes. Current technology involves antimony removal by lime neutralization; however, this technique has not been successful in reducing the antimony concentration to minimum desirable levels. Other or additional treatment is therefore needed. One such alternative is sulfide precipitation, which is currently in use on other types of wastes. An assessment of the antimony removal technology evaluation of treatment alternatives is in order to place the situation in proper perspective and to provide a suitable basis for further action. This contract will entail literature reviews and data assimilation via personal communication. No bench-scale research is anticipated.
Keywords: ANTIMONY; REMOVAL; TECHNOLOGY ASSESSMENT; SEPARATION PROCESSES; TOXICITY; REVIEWS; DATA COMPILATION; DATA ACQUISITION; CHEMICAL EFFLUENTS; WATER POLLUTION; WASTE MANAGEMENT; MINING.

70817 Priority Pollutant Removal from Mine Drainage. Going, J.E. (Midwest Research Institute, 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** B623B-T6003. **Contract:** 68-03-2563. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$350,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective of this program is to collect and analyze mine drainage water samples for selected priority pollutants. The drainage water will be subjected to various treatment processes. Samples will be collected before and after treatment to determine the efficiency of removal of priority pollutants. Treatment studies are being conducted in EPA laboratories, and samples are being analyzed in Midwest Research Institute laboratories.
Keywords: SAMPLING; REMOVAL; CHEMICAL ANALYSIS; MINE DRAINING; WATER; WATER QUALITY.

70818 Pollution Control Guidance for Oil Shale Development. Krishnan, R. (Jacobs Engineering Group, Inc., Environmental Services Group, 251 S. Lake Avenue, Pasadena, CA, 91101). **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 shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The Office of Research and Development is preparing a pollution control guidance document for oil shale. The purpose of this document is to serve as a reference and guide to EPA offices, federal agencies, and private developers which are or will be involved with the oil shale industry by providing information on anticipated environmental requirements for the emerging oil shale industry and to serve as the basis for preliminary regulatory guidance. To prepare this document, inputs are being prepared by many individuals in various EPA laboratories. Additional information must be collected by Jacobs Engineering, especially regarding ongoing activities on the CA and CB federal oil shale lease tracts, DOE's program Opportunity Notice (PON) program, and present federal, state and local permit requirements. The contractor must assemble information from all these inputs into draft and camera-ready copies of the final documents.
Keywords: OIL SHALE INDUSTRY; POLLUTION CONTROL; MANUALS.

70819 MOP: Premining Planning Eastern Surface Coal. Ramanl, R.V. (Pennsylvania State University at University Park, Graduate School, 205 Kern Graduate Building, University Park, PA, 16802). **Project number:** B623B-323. **Contract:** R803882. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$10,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The purpose of this research effort is to study the surface mining of coal in the eastern United States and to establish guidelines for developing, evaluating, and selecting the least environmentally detrimental mining and reclamation practices. The study is to consider the geological and hydrological settings before mining as the basic inputs to premining planning, and guidelines are to be developed for assessing alternatives in the areas of surface mine engineering, water management, and land use planning. The recommended methods, techniques, and alternatives for selecting and designing mining systems will be based on a review and critical evaluation of the methods reported in the literature and applied in the field. They will be presented in a series of six reports, which together make up a user's manual for premining planning of surface coal mining operations in the eastern United States.
Keywords: COAL MINING; SURFACE MINING; LAND RECLAMATION; ENVIRONMENTAL EFFECTS; USA; PLANNING.

70820 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 shales and tar sands(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

Oil shale deposits in the upper Colorado River Basin are located in the states of Colorado, Wyoming, and Utah. The large fraction of potential commercial deposits are contained in the Green River Formation in the Piceance Basin of Colorado. The Green River Formation is an early tertiary geologic unit, formed in a depositional basin during Eocene time. Topographic and structural highs surround the Piceance Basin on the south, east, and west sides. Both surface and subsurface drainage are toward the north to the White River. The White River is tributary to the Colorado. The specific objectives of the proposed project are: (1) to gather all available data pertinent to the present and future assessment of the water quality hydrology in the oil shale regions of the upper basin (these data will be sought from universities, federal and state agencies, and private companies); (2) to summarize and analyze these data toward the identification of data deficiencies, needs for additional data, and procedures for the assessment of the impact on water quality hydrology; and (3) to develop procedures for the quantitative assessment of the quantity and quality of surface and subsurface runoff from processed shale residue and mine spoils, and to verify these procedures using large volumetric lysimeters at the Anvil Points, Colorado, field site and by means of a mathematical model.
Keywords: HYDROLOGY; GREEN RIVER FORMATION; OIL SHALE DEPOSITS; WATER QUALITY; COLORADO; WYOMING; UTAH.

70821 Planning and Instrumentation Development for Studying Subsidence Due to a Large Scale Underground Coal Gasification Experiment. Mead, S.W. (Department of Energy, Division of Conservation, 20 Massachusetts Avenue North, 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective is to develop a comprehensive plan for the investigation of subsidence associated with the first large (or multiple adjacent cavity) in-situ coal gasification experiment. The kinds of activities to be integrated into the final plan include the following: (1) overburden materials studies; (2) surface and subsurface geotechnical measurements before, during, and after gasification; and (3) finite element modeling. The proposed planning effort is expected to include the following activities: (1) identify subsidence and ground deformation questions of particular concern for a large, multiple-cavity in-situ coal gasification experiment; (2) determine the number and placement of the geotechnical instrument installation; and (3) determine an appropriate sequence of modeling studes for before and after the anticipated gasification operation. Manpower, facility, and equipment requirements for the planned subsidence investigation will be identified.
Keywords: IN-SITU GASIFICATION; COAL GASIFICATION; GROUND SUBSIDENCE; EQUIPMENT; MEASURING METHODS; PLANNING.

70822 Shakedown of R and D Prototype Systems and Pilot Plant Construction. Sproul, M.L. (Mason and Hanger-Silas Mason Co., Inc., 200 W. Vine Street, Lexington, KY, 40507). **Project number:** B623C-228. **Contract:** 68-03-2647. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$135,000.

The objectives are to establish and operate an environmental emergency response unit (EERU) to be located at the EPA facilities in Edison, New Jersey. The function of the unit will be for the operation of oil and hazardous material spill control prototype devices during actual spill situations; the shakedown, repair, modification and demonstration of the devices during periods when the equipment is not on spill call; and the establishment and operation of a set of pilot plants to be used for the determination of the best practicable application of the prototype equipment and other equipment and techniques for oil and hazardous materials under widely varying circumstances. The principal function of the pilot plants will be to identify, under controlled circumstances, which devices or techniques are applicable to a given spill situation, and to establish

the most practicable values of the operating parameters associated with complex spill control equipment.**Keywords:** OIL SPILLS; HAZARDOUS MATERIALS; SPILLS; PILOT PLANTS; POLLUTION CONTROL.

70823 Ohmsett Support: Naval Weapons Station Earle. Brundage, D. (Department of Defense, Naval Weapons Station, Colts Neck, NJ, 07722). **Project number:** B623C-236. **Contract:** D4-F491. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$25,000.
R and D categories: Physical and chemical processes and effects.

The objective of this interagency agreement is to provide Ohmsett with certain specific support services which are required for Ohmsett operations, and which either cannot be obtained elsewhere or can be obtained through the Navy at the least cost. The support services are obtained through an interagency agreement with Naval Weapons Station Earle from whom EPA has leased the property on which Ohmsett is sited. This agreement provides security services, fire protection, tank filling and emptying services (operation of Navy pumps to provide water), rubbish removal, rental of a forklift and cranes as needed, and other similar services.
Keywords: MILITARY FACILITIES; SECURITY; FIRE PREVENTION; OPERATION; WASTE DISPOSAL; WATER REQUIREMENTS.

70824 Evaluation of Spill Prevention Practices. Tuffly, B. (Rockwell International Corp., Rocketdyne Division, 8900 Desoto Avenue, Canoga Park, CA, 91304). **Project number:** B623C-499. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$75,000.
Related energy source: oil and gas(100).

The purpose of this project is to evaluate the effectiveness in reducing the number of reportable oil spill incidents of the suggested spill prevention systems identified in the regulation. This information will be generated by reviewing the spill incident history of predesignated facilities before and after the effective date of the SPCC plan. The study will consider only spill prevention systems installed and operating in existing facilities. A geographic distribution of selected facilities will be made in order to obtain a representative sampling. Upon completion of the evaluation study, improved spill prevention systems will be designed, fabricated and demonstrated as appropriate. Based on the evaluation study and the demonstrations, selected spill prevention systems will be recommended to the EPA Operating Divisions for inclusion in guidelines containing the spill prevention regulations.
Keywords: OIL SPILLS; EVALUATION; REGULATIONS; CONTROL.

70825 Field Verification of Pollution Control Rationale for Offshore Platforms. Tuffly, B. (Rockwell International Corp., Rocketdyne Division, 8900 Desoto Avenue, Canoga Park, CA, 91304). **Project number:** B623C-500. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$534,000.
Related energy source: oil and gas(100).

The purpose of this project is to conduct a field study for offshore oil and gas producing facilities including sampling, analysis and characterization of all appropriate unit processes. The results of this sampling program will be evaluated and compared to the pollution control recommendations developed by Exxon Research and Engineering Company. Based on this comparison, these recommendations will be modified, deleted or added to as necessary in order that they may become reliable information which has been verified through careful field sampling and analysis. In addition, this project will develop information relating to proper maintenance and operating procedures of each unit process which should be practiced or avoided in order to minimize the discharge of pollutants from offshore facilities. Finally, this project will identify operational and pollution control equipment which should be installed, removed, and/or modified on existing facilities in order to minimize the discharge of pollutants. These recommendations will be based on the costs associated with purchasing and installing this equipment and benefits to be derived from these recommendations.
Keywords: OFFSHORE PLATFORMS; POLLUTION CONTROL; NATURAL GAS; PETROLEUM; PRODUCTION.

70826 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:** Characterization, measurement, and monitoring.

The Oily Waste Treatment Facility in Port Valdez, Alaska, consists of gravity separation, chemically assisted air flotation, and final gravity separation. This facility is considered by many to represent the latest in the state of the art for oil treatment; therefore, it is most important that information on the compositional changes of the oily waste as it progresses through the various treatment stages of this facility be obtained. This project will characterize the influent and effluent of each unit process in order to obtain a quantitative evaluation of the performance and effectiveness of the Oily Treatment Facility to remove dissolved and suspended oil. This project will also identify those petroleum components which are not amenable to removal by gravity/dissolved air flotation treatment.
Keywords: EMULSIONS; STABILITY; LIQUID WASTES; WASTE PROCESSING; PETROLEUM; WATER; SEPARATION PROCESSES.

70827 Pollution Assessment of Advanced Oil and Gas Recovery Programs. Tuffly, B. (Rockwell International Corp., Rocketdyne Division, 8900 DeSoto Avenue, Canoga Park, CA, 91304). **Project number:** B623C-502. **Contract:** 68-03-2648. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$125,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The purpose of this research project is to obtain environmental data in sufficient detail from ongoing DOE studies so that variations of the compositions of discharges from tertiary oil recovery can be correlated over time with formation characteristics and process variables. The types of data which need to be collected include cost-benefit analyses of air quality control strategies for thermal recovery projects, identification of point and area sources of hydrocarbon emissions in thermal oil recovery, measurement of chemical concentrations in produced water from each of the processes identified, especially micellar-polymer flooding and in-situ combustion, and characterization of organic and inorganic pollutants from each process.
Keywords: ENHANCED RECOVERY; PETROLEUM; AIR QUALITY; AIR POLLUTION; WATER POLLUTION; MICROEMULSION FLOODING; IN-SITU COMBUSTION.

70828 Multiagency Project for Oil Spill Equipment Evaluation, Phase II. Ackerman, R. (Mason and Hanger-Silas Mason Co., Inc., P.O. Box 156, Leonardo, NJ, 07737). **Project number:** B623C-587. **Contract:** 68-03-2642. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.

A performance evaluation of commercially available spill cleanup equipment and performance testing of actual equipment at OHMSETT will be conducted. Equipment will be selected and its throughput efficiency, oil recovery efficiency and oil recovery rate will be determined for two oil types under a variety of current and wave conditions. A final report will be prepared.
Keywords: SKIMMERS; PERFORMANCE TESTING; OIL SPILLS; REMOVAL; WATER POLLUTION.

70829 Performance Testing of Air Jet Boom. Akerman, R. (Mason and Hanger-Silas Mason Co., Inc., P.O. Box 156, Leonardo, NJ, 07737). **Project number:** B623C-588. **Contract:** 68-03-2642. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$59,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.

A performance evaluation of full-size air-jet boom will be conducted. Phase I will include tests of the original model at EPA's OHMSETT facility. Phase II will include tests of Model I and Model II at OHMSETT. Performance with two test oils under various current and wave conditions will be evaluated.
Keywords: SKIMMERS; PERFORMANCE TESTING; WATER POLLUTION; OIL SPILLS; REMOVAL.

70830 Performance Testing: Inland/Harbor Equipment Phase II. Ackerman, R. (Mason and Hanger, Silas Mason Co., Inc., P.O. Box 156, Leonardo, NJ, 07737). **Project number:** B623C-589. **Contract:** 68-03-2642. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$40,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.

The objectives are to evaluate performance of selected sorbent booms and a spill gellation process; and conduct controlled, reproducible tests in EPA's OHMSETT test facility. Three sorbent booms and an oil gellation process will be selected and evaluated with different test oils under various wave and current conditions.
Keywords: SORBENT RECOVERY SYSTEMS; PERFORMANCE TESTING; OIL SPILLS; EQUIPMENT; REMOVAL; WATER POLLUTION.

70831 Hydrodynamic Characteristics of Booms, Phase II. Ackerman, R. (Mason and Hanger-Silas Mason Co., Inc., P.O. Box 156, Leonardo, NJ, 07737). **Project number:** B623C-590. **Contract:** 68-03-2642. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$23,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.

The purpose of this project is to determine the effects of boom angle, length and rigging configuration upon successful diversion of oil on inland waterways. The B.F. Goodrich seaboom was chosen to be used in this project because of its durability, stability and availability. It will be rigged in various diversionary modes and towed into an oil slick at OHMSETT (Oil and Hazardous Materials Simulated Environmental Test Tank) at various speeds until a critical stability speed is reached. Photographic and video documentation, along with observer notes, will record boom performance. Results will be evaluated in terms of the percentage of oil lost beneath the boom and away from the rear of the boom. Tests will be conducted in accordance with a test matrix developed by the U.S. Environmental Protection Agency.
Keywords: SKIMMERS; PERFORMANCE TESTING; WATER POLLUTION; OIL SPILLS; REMOVAL.

70832 OCS Pipeline Construction and Operation: Potential Environmental Problems and Recommendations for Mitigation of Impacts. Gowan, A.W. (New England River Basins Commission, 53 State Street, 1st Floor, Boston, MA). **Project number:** B623C-685. **Contract:** D5-X0063. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$42,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

The purpose of this research is to pull together the available information on the potential environmental effects of submarine pipelines utilized to transport oil and/or natural gas from the outer continental shelf to shore. Preliminary recommendations of practices to minimize environmental problems will also be included. The study will cover three phases extending over three years, depending on the availability of funds and the conclusions of Phase I efforts. Work to be accomplished during Phase I will include reporting on the information available in the literature and interviews with knowledgeable persons. Phases II and III could include gathering additional information and possibly overseeing limited field studies. Topics discussed in Phase I reports will include: a history of past pipeline failures; the most advanced techniques utilized in pipeline construction; natural and man-made hazards to pipeline construction and integrity; potential environmental effects resulting from the construction and operation of pipelines in frontier analysis; and preliminary recommendations of practices to minimize environmental problems. It is anticipated that the results of this effort will be of use to any group or agency involved in the planning, construction, operation or regulation of pipelines, pipeline corridors and pipeline landfalls.
Keywords: PIPELINES; ENVIRONMENTAL IMPACTS; NATURAL GAS; PETROLEUM; CONTINENTAL SHELF; UNDERWATER OPERATIONS; CONSTRUCTION; OPERATION.

70833 Field Test Kit for Characterizing Oil-Brine Effluents. Smith, J.H. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** B623C-686. **Contract:** R806091-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$66,000.
Related energy source: oil and gas(100).

The objective of this project is to evaluate in the laboratory, and subsequently in field stations, test methods for characterizing oil-brine effluents from offshore exploration and production platforms. A field test kit including all equipment, materials, supplies and detailed operating instructions will be prepared and delivered to EPA.
Keywords: OFFSHORE PLATFORMS; BRINES; PETROLEUM; CHEMICAL EFFLUENTS; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES.

70834 Process Evaluation--Multiwaste Gasification. Ctvrtnicek, T.E. (Monsanto Research Corp., Dayton Laboratory, 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** B624B-T1001. **Contract:** 68-03-2550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$6,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objective of this project is to perform a complete environmental, economic, and technical feasibility study of converting solid waste into low- or medium-Btu gas for combustion with other fuels in existing combustion systems. The study will develop and focus on a scenario in which a specific conversion process is situated in an area of established economic parameters and known current waste disposal practices and waste characteristics. Sensitivity analysis evaluating the interplay of important economic parameters is then to be performed and supplemented with an assessment of environmental factors in order to establish potential environmental benefits of the waste conversion scheme in reference to current disposal practices.
Keywords: SOLID WASTES; GASIFICATION; TECHNOLOGY ASSESSMENT; ENVIRONMENTAL IMPACTS; ECONOMIC ANALYSIS; LOW BTU GAS; INTERMEDIATE BTU GAS; SYNTHESIS; MUNICIPAL WASTES; WASTE MANAGEMENT; COMPARATIVE EVALUATIONS.

70835 *Quick-Response Management Support for Power Technology and Conservation Program.* Hedley, W.H. (Monsanto Research Corp., Process Evaluation Section, 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** B624B-T1003. **Contract:** 68-03-2550. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$46,000.
R and D categories: Physical and chemical processes and effects.

The objective of this work dirctive is to provide management support services to the Power Technology and Conservation Branch (PTCB) of the Environmental Protection Agency on a quick-reaction basis. A review of the methodology used and the conclusions and recommendations made by Mitre Corporation and SRI International in a previous energy conservation assessment will be conducted. An advanced project priority rating system to evaluate energy conservation programs is to be developed. This system, to be made available to PTCB in the form of a computer program and an explanatory report, will include consideration of energy, environmental, socioeconomic, and regulatory aspects. Specific factors relevant to the above evaluation criteria will be defined and their relative importance determined. The proposed methodology will be tested by ranking several sample energy conservation projects and by performing a factor sensitivity analysis. Other work will involve evaluation of the utility of public opinion polls on energy and the environment to the PTCB program, review of position papers by the Branch, and assistance in conference planning.
Keywords: ENERGY CONSERVATION; PUBLIC OPINION; RESEARCH PROGRAMS; EVALUATION; ENVIRONMENTAL EFFECTS; SOCIO-ECONOMIC FACTORS; REGULATIONS; MANAGEMENT; AIR POLLUTION; LAND POLLUTION; WATER POLLUTION; MATHEMATICAL MODELS; INFORMATION SYSTEMS; ENERGY POLICY.

70836 Evaluation of Sealants for Spray-On Asbestos-Containing Material in Buildings. Smithson, G.R. (Battelle Memorial Inst., 505 King Avenue, Columbus, OH, 43201). **Project number:** B624B-T2005. **Contract:** 68-03-2552. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects.

A preliminary study indicates that asbestos from a sprayed-on asbestos-containing material can enter the ambient atmosphere when the sprayed-on material begins to deteriorate by vibration and air movement, by accidental impact by various objects against the material, and by removal or replacement of the material. The objective of this study is to evaluate commercially available sealants which can be used to cover sprayed-on asbestos-containing materials in buildings, and which will inhibit the release of asbestos fibers into the ambient atmosphere.
Keywords: SEALING MATERIALS; SEALS; SPRAYED COATINGS; ASBESTOS; AIR POLLUTION CONTROL; TESTING.

70837 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).

Acurex will supply the EPA with technical and engineering services to assist the programs of the Industrial Environmental Research Laboratory, Cincinnati, Ohio. The task objective is to review, identify, evaluate, and prioritize research needed to define environmental consequences of widespread solar energy utilization. The work will consist of four phases: (1) a survey of available literature including DOE solar environmental development and plans to identify and define potential environmental consequences of solar energy utilization; (2) a quantification of environmental effects in terms of their probable severity and ease of mitigation, as an indication of research needs; (3) a definition and prioritization of research needs; and (4) a preparation of research package descriptions for high priority research items dealing with environmental effects of solar energy technology utilization.
Keywords: SOLAR ENERGY; ENVIRONMENTAL IMPACTS; TECHNOLOGY UTILIZATION; SOLAR INDUSTRY.

70838 Incineration of Chlorinated Hydrocarbon Hazardous Wastes. Schalit, L. (Acurex Corp., Aerotherm Group, 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-T4007. **Contract:** 68-02-2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: all(100).

Acurex will provide management, technical, and administrative assistance in selecting and establishing a test site, test procedures, test permits, and permit approval to demonstratc the feasibility of disposal of chlorinated hydrocarbon wastes by: (1) burning them in a coal-fired cement kiln; (2) conducting a study of the disposal of liquid chlorinated hydrocarbon wastes in a wet-process cement kiln; and (3) performing sampling, monitoring, and analysis of feed, process and effluent streams and of the work environment.
Keywords: WASTE MANAGEMENT; ORGANIC CHLORINE COMPOUNDS; HYDROCARBONS; INCINERATORS; PYROLYSIS; HEALTH HAZARDS; COAL; KILNS; FEASIBILITY STUDIES; CHEMICAL EFFLUENTS; ENVIRONMENTAL IMPACTS.

70839 Comparison of Energy Use and Cost of Alternative Pollution Control Techniques. Cooper, L. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-T4008. **Contract:** 68-03-2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$19,000..

The objectives of this project are to identify research needs and to prepare a preliminary work description for a future program to be entitled Comparison of Energy Use and Cost of Alternative Multimedia Pollution Control Technologies. The approaches include: (1) determination of the availability of published data on this energy use and other costs of various multimedia control technology alternatives; (2) determination of need for a desirability of additional data from equipment suppliers and users; (3) identification of the impact of emerging EPA regulatory requirements on the energy use and other costs of pollution control; (4) identification of the names of key intra- and inter-agency individuals who are sources for obtaining and reporting data on the above topics; and (5) evaluation of the desirability of various levels of depth of the energy conservation potential analysis and the suitability and feasibility of various types of presentation of results.**Keywords:** POLLUTION CONTROL; COST; ENERGY CONSERVATION; FEASIBILITY STUDIES; MATHEMATICAL MODELS; DATA ACQUISITION; REGULATIONS; RESEARCH PROGRAMS; RECOMMENDATIONS; ENERGY CONSUMPTION; ENVIRONMENTAL EFFECTS.

70840 Preparation of Sixteen-Page Brochure for PTCB Describing Branch's Program. Farley, B. (Acurex Corp., Aerotherm Group, 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** B624B-T4011. **Contract:** 68-03-2567. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$27,000.
R and D categories: Physical and chemical processes and effects.

The objective of this task is to research, write, design and produce a 12- to 16-page brochure that describes the on-going and future studies of the Power Technology and Conservation Branch of IERL at Cincinnati. The brochure will be designed and written so that the intelligent, non-technical layperson can understand and appreciate the goals and accomplishments of PTCB. During the initial phase of this project, Acurex will collect information on the overall objective of the PTCB, as well as the goals and accomplishments of individual PTCB projects. As part of the information collection phase, the key writer on this project will interview personnel at the PTCB to ensure that the tone and emphasis of the brochure accurately reflect the goals and accomplishments of the PTCB.
Keywords: INFORMATION; PUBLIC RELATIONS; RESEARCH PROGRAMS; ENERGY CONSERVATION.

70841 Containment of Geothermal Brines. Sung, R.D. (TRW, Inc., Environmental Engineering Div., 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).

The work objective is to determine the containment measures necessary to prevent environmental damage from unplanned or accidental surface losses of geothermal fluids in liquid-dominated geothermal energy conversion systems. Program planning wil include: (1) identification of the prominent liquid dominant energy conversion processes (i.e., the binary, flash, total flow and hybrid binary/flash system); (2) description of system components in the conversion processes from production wells through injection wells; (3) analysis of the causes of potential geothermal fluid release including corrosion, plugging, inadequate casing cementation and injection pressure excursions; and (4) definition of containment measures for reducing probability of unplanned fluid release, for minimizing fluid release rates and volume, and for mitigating environmental impact of fluid release. Containment measures will be evaluated in terms of economic feasibility, probability of fluid release, volume of release, technical feasibility and procurement lead time.
Keywords: GEOTHERMAL FLUIDS; HOT-WATER SYSTEMS; BRINES; TOTAL FLOW SYSTEMS; FLASHED STEAM SYSTEMS; BINARY-FLUID SYSTEMS; CORROSION; FAILURES; CONTAINMENT; LEAKS; ENVIRONMENTAL IMPACTS.

70842 Costs of Geothermal Pollution Control. Sung, R.D. (TRW Inc., Environmental Engineering Division, 1 Space Park, Redondo Beach, CA, 90278). **Project number:** B624B-T5004. **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).

The principal objectivc of the project is to provide preliminary cost estimates (construction and O/M costs) of each of the several pollution control technologies that may be applied to waste fluid from various geothermal energy conversion systems. The technical approach will include 6 subtasks: (1) identification of waste streams from major geothermal conversion technologies; (2) evaluation of air and water control technologies; (3) estimation and quantification of treatment residuals; (4) cost estimates for air pollution control; (5) cost estimates for water pollution control; and (6) cost estimates for residual disposal. All cost estimates will be determined for various effluent qualities and flow ranges as stipulated in the work directive. It is expected the major sources of information for this project will be from actual site visits, EPA, IERL and MERL reports, existing contractor files, and manufacturers and/or vendors of equipment.
Keywords: POLLUTION CONTROL; WASTE DISPOSAL; GEOTHERMAL ENERGY CONVERSION; AIR POLLUTION CONTROL; WATER POLLUTION CONTROL; COST; TECHNOLOGY UTILIZATION.

70843 Sampling and Analysis at 130 Geothermal Sites. Sung, R.D. (TRW, Inc., Environmental Engineering Div., 1 Space Park, Redondo Beach, CA, 90278). **Project number:** B624B-T5007. **Contract:** 68-03-2560. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$203,000.
Related energy source: geothermal(100). **R and D categories:** Characterization, measurement, and monitoring.

The work objective is to acquire data on the physical, chemical and radiological characteristics of geothermal fluids at manifestations with the most probable potential for geothermal development. Program planning will include: (1) data assessment which involves the compilation, analysis and evaluation of all available physical, chemical and radiological data relevant to the 130 geothermal sites stipulated in the work directive; (2) program coordination in which TRW will coordinate with the Bureau of Land Management (BLM), regional offices of USGS, and various state mineral and geologic offices to obtain information regarding the legality, accessibility and ownership of the 130 geothermal sites for sampling and analysis; (3) sampling/analysis plan preparation in which TRW will prepare for EPA a detailed sampling and analysis plan consisting of a summary of the sampling and analysis plan, rationale for sites selected, factors affecting reliability and integrity, sampling approach locations and procedures to be followed at each site, data handling procedures, quality assurance/quality control plan, and proposed sampling schedule and level of effort and cost; (4) field sampling in which TRW will sample all sites delineated in the sampling plan and will perform on-site analysis of gaseous parameters such as H2S, CO2, CO, NH3, and CH4 by gas chromatography; (5) laboratory analysis which will include analyses of 38 parameters from each of the samples collected under the field sampling efforts; and (6) sampling manual preparation in which TRW will prepare a sampling manual for all the above sites including step-by-step procedures involved in the actual sampling and analysis program.
Keywords: GEOTHERMAL FLUIDS; SAMPLING; CHEMICAL ANALYSIS; QUALITY CONTROL; PLANNING; LAND USE; GAS CHROMATOGRAPHY; LEGAL ASPECTS; COST; GEOTHERMAL RESOURCES; SITE SELECTION; MANUALS.

70844 Process Evaluation: China Lake Pyrolysis System. Gladney, F.L. (Dow Chemical Co., Department of Resources Research, Freeport, TX, 77541). **Project number:** B624B-T7003. **Contract:** 68-03-2568. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$8,000.
Related energy source: all(100).

This project is to evaluate the technical, economic, and environmental feasibility of the concept of pyrolysis of solids toward the production of gasoline on a commercial basis, as demonstrated by the China Lake Pyrolysis System. The work will be done by a

team of professional-technical people at the Texas Division of Dow Chemical USA, at Freeport, Texas.
Keywords: SOLID WASTES; PYROLYSIS; GASOLINE; SYNTHESIS; TECHNOLOGY ASSESSMENT; ECONOMIC ANALYSIS; ENVIRONMENTAL IMPACTS.

70845 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); all(50).

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 shall be in the form of providing an independent analysis of the most efficient, most cost-effective method(s) of protecting wastes-as-fuel for energy generation. This contract shall produce an assessment of techniques and devices to be utilized in controlling water pollution resulting from the utilization of wastes-as-fuel in the generation of energy. The assessment shall include an analysis of all available data on pollutants produced by wastes-as-fuel processes. Equipment design shall be prepared for each of several mobile pilot-plant-scale water pollution control processes selected for detailed field investigations. Several of these designs shall 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 for several months and then moved to another site.
Keywords: SOLID WASTES; ENERGY CONVERSION; WATER POLLUTION; WATER POLLUTION CONTROL; PILOT PLANTS; FIELD TESTS; POLLUTION CONTROL EQUIPMENT.

70846 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).

A methodology will be developed to evaluate the effects of operational and accidental releases of geothermal fluids on groundwater at specific sites. The constituents of geothermal fluids will be characterized, and a sequential screening procedure will be formulated to assess the potential environmental effects of accidental or intentional fluid releases. Using this informaion, the potential of contaminating the groundwater will be evaluated. Should a detailed elucidation of impacts be needed, the unsaturated zone water quality model GEOHY-GEOQAL will be used as part of the methodology.
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.

70847 Indoor Air Quality. Swift, J.L. (Geomet, Inc., 15 Firstfield Road, Gaithersburg, MD, 20760). **Project number:** B624B-666. **Contract:** 68-02-2294. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$108,000.
R and D categories: Physical and chemical processes and effects; Health effects.

The objectives of this 24-month research project are to identify the pollution sources which affect indoor air quality; determine their concentrations in the indoor environment; assess potential health and welfare effects of the pollution concentrations measured; assess impact of energy conservation measured (as applied to existing and new structures) upon the generation, build-up, and elimination of indoor air pollution; identify control techniques to reduce concentrations and effects of indoor air contaminants; and suggest alternative energy conservation measures compatible with acceptable indoor air quality. A 14-month program of field monitoring for indoor and outdoor pollutants, meteorology, energy factors, building occupancy and building characteristics was accomplished from July, 1976, through January, 1978. Measurements were made in seven houses, two mobile homes, six apartments, and a school. A general mathematical model capable of predicting indoor pollution concentrations as a function of independent variables such as outdoor air quality, meteorology, building design, occupancy, usage, and energy conservation measures will be developed.
Keywords: RESIDENTIAL BUILDINGS; SCHOOL BUILDINGS; AIR QUALITY; ENERGY CONSERVATION; MONITORING; RECOMMENDATIONS; MATHEMATICAL MODELS; AIR POLLUTION.

70848 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: all(100).

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.

70849 Geopressured Geothermal Development Workshops. Coffer, H.F. (Department of Energy, Division of Conservation, 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The intent of EPA's support of this program is to assure that adequate emphasis is maintained on environmental issues in geothermal development, that industry and DOE are kept aprised of environmental developments and potential constraints, and that EPA is guided properly in solving any regulation development problems that may ensue. The work to be accomplished is the dissemination of information on the DOE program for the development of the geopressured geothermal resource. It will integrate the expertise of the oil field industry, DOE, EPA, other federal agencies, and state and local governments through meetings of an overview group, a site selection working subgroup, a drilling and testing working subgroup, an environmental and laboratory research working subgroup, and a legal and institutional working subgroup. Minutes of the meetings will be made available to all attendees and other interested parties. Information and contacts provided by this work will materially assist in facilitating, accelerating, and prioritizing all phases of the DOE Geopressured Geothermal Development Program.
Keywords: MEETINGS; GEOTHERMAL ENERGY; GEOTHERMAL RESOURCES; ENVIRONMENTAL IMPACTS; GEOTHERMAL INDUSTRY; US ORGANIZATIONS; GOVERNMENT POLICIES; GEOPRESSURED SYSTEMS; SITE SELECTION; WELL DRILLING; LEGAL ASPECTS.

70850 Co-Firing of Refuse-Derived Fuel and Dross with Coal in a Stoker Boiler. Rehm, F.R. (Milwaukee County Environmental Services Division, 901 North 9th Street, Milwaukee, WI, 53233). **Project number:** B624B-844. **Contract:** R806338. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$159,000.
Related energy source: all(100).

This research and development project is to determine the suitability of a traveling grate stoker furnace for combustion of coal and dross from a resource recovery plant. Dross, or the heavies fraction, is the material left after municipal solid waste is processed to produce a refined refuse-derived fuel (RDF) suitable for suspension firing, a ferrous fraction, aluminum fraction, and a glass fraction. The remaining material is expected to have a high combustible content; but because of its unsuitability for firing in a suspension-fired utility boiler, it is normally destined for landfill. In the project, the dross material will be fired with coal and the emissions from the combustion process will be characterized.
Keywords: SOLID WASTES; COMBUSTION; FOSSIL-FUEL POWER PLANTS; COAL; BOILERS; BOILER FUEL; COMBUSTION PRODUCTS; WASTE PROCESSING PLANTS.

70851 Air Quality in Energy Conserving Residence. Moschandreas, D. (Geomet Inc., 15 Firstfield Road, Gaithersburg, MD, 20760). **Project number:** B624B-846. **Contract:** 68-02-2936. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab. **Funding:** EPA-$99,000.
R and D categories: Characterization, measurement, and monitoring.

The objective of this project is to monitor and analyze the indoor air quality in four energy conserving residences. The project is being conducted in cooperation with the Lawrence Berkeley Laboratory. EPA will monitor benzo(a)pyrene and aldehydes, and LBL will monitor the complete list of pollutants which EPA previously identified. EPA will modify the mathematical model developed on the previous project to include predictions of BaP levels. (Aldehydes are already included.) The approach to be used will be to instrument the test houses for sampling, place a trailer containing

the recording instruments nearby, and record air quality continuously for a two-week period at each house. A log of the occupants activities will be kept for comparison with air sample measurements. Mathematical model results will be compared also. The project is underway with equipment and methods preparation for performing monitoring when the test houses are complete.
Keywords: RESIDENTIAL BUILDINGS; AIR QUALITY; ENERGY CONSERVATION; MONITORING; MATHEMATICAL MODELS; FORECASTING.

70918 Thermoradiation Treatment of Sewage Sludge Using Reactor Waste Fission Products. Sivinski, H.D. (Department of Energy, Albuquerque Operations Office, Albuqerque, NM). **Project number:** C611B-7081. **Contract:** D5-0675. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects; Health effects.

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 digested municipal sewage sludge, sludge cake, and sludge compost. Experimental studies are being conducted on a 160 ml batch basis with Co-60 and Cs-137 and also on a 1 to 2 liter dynamic system (heat and radiation pulse in a single flow-thru system) on thermoradiation and irradiation disinfection of liquid digested sludge. The end result of this phase of study will be the design of a 40,000 gpd pilot unit. Preliminary cost studies show that the cost of gamma irradiation significantly decreases as the solid content of the sludge increases. Thus, batch type studies are being conducted on gamma irradiation of sludge cake and sludge compost. A pilot unit for gamma irradiation of sludge cake, sludge compost and dried sludge is currently being constructed.
Keywords: SEWAGE SLUDGE; MUNICIPAL WASTES; DISINFECTANTS; RADIOSTERILIZATION; WASTE PRODUCT UTILIZATION; RADIOACTIVE WASTES; GAMMA RADIATION; COBALT 60; CESIUM 137; LIQUID WASTES; PILOT PLANTS.

70925 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:** C618A-7029. **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:** Characterization, measurement, and 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 studied. Gas and leachate composition and volumes, and refuse temperature 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.

70933 General Methodology for Evaluating Urban Stormwater Quality Management Alternatives. Heaney, J.P. (University of Florida, Department of Environmental Engineering, 220 Black Hall, Gainesville, FL, 32611). **Project number:** C611A-0007. **Contract:** R805664. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$50,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The objective of this project is to present a general methodology for evaluating the cost-effectiveness of a wide range of urban stormwater quality management alternatives. Work to date shows how to evaluate and compare some of the available control options, i.e., storage, treatment, street sweeping and sewer flushing. This work will be updated and extended to include analysis of varying levels of sophistication. Results will be presented as a user's manual.
Keywords: URBAN AREAS; RUNOFF; STORMS; WATER QUALITY; MANAGEMENT; WATER POLLUTION CONTROL; MANUALS.

70934 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:** C611B-0014. **Contract:** S805823-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$332,000.

The City of Hagerstown Wastewater Pollution Control Plant proposes to make available its anaerobic digesters, sludge handling facilities, and manpower in a research study to improve sludge digestion and increase gas production. The unique feature of the research study will combine operation of an experimental aerobic digester with an existing conventional anaerobic digester. The proposed program is designed to determine the operational characteristics and advantages of the combined system. The objectives of the study include an assessment or determination of the following: (1) comparison of methane gas production over that produced from conventional anaerobic treatment; (2) measuring the efficiency of the process in killing pathogenic organisms and virus; (3) determining the maximum temperature rise in the aerobic digester to control the temperature of the anaerobic digester; (4) determining the dewatering characteristics of the final digested sludge; and (5) comparing digester efficiency of the combined process with conventional anaerobic processes.**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.

70935 Co-Disposal of Sewage Sludge and Municipal Refuse. Rogers, C.E. (South Charleston City Sanitation Board, South Charleston, WV, 25303). **Project number:** C611B-0016. **Contract:** S803769-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$10,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this project are to confirm and demonstrate the technical and economic feasibility of disposing of sewage sludge in combination with municipal refuse in the Union Carbide Purox System, and to establish the environmental effects of this means of disposal. The project will be carried out at Union Carbide Corporation's full scale test facility in South Charleston, West Virginia.
Keywords: SEWAGE SLUDGE; MUNICIPAL WASTES; WASTE DISPOSAL; FEASIBILITY STUDIES; PUROX PYROLYSIS PROCESS; ENVIRONMENTAL EFFECTS; TEST FACILITIES.

70936 Evaluate Selected European Processes for Composting Sewage Sludge. Baytos, W.C. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** C611B-0017. **Contract:** 68-03-2662. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The overall objectives of this program are to evaluate the most advanced European sewage sludge composting process (KNEER) and project its use to the United States commercial practice. This will be accomplished by performing an on-site evaluation at an operating facility in Germany. Detailed study of plant operations, product analysis, cost and environmental data are the basis of the evaluation. A secondary objective is to evaluate other, recently-developed composting systems which might be economic alternatives and compare them to the KNEER and the USDA-developed process.
Keywords: SEWAGE SLUDGE; COMPOSTING; COMPARATIVE EVALUATIONS; ECONOMICS; FEASIBILITY STUDIES; WATER POLLUTION ABATEMENT; SEDIMENTS; WASTE WATER; WASTE PRODUCT UTILIZATION; AGRICULTURE; GROUND DISPOSAL.

70937 Measurement of Air Pollution Discharges from Municipal Wastewater Sludge Incinerators. Wall, H. (EPA, Office of Research and Development, Municipal Environmental Research Lab., 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-

0018. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$144,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

Air pollution studies will be conducted on six municipal wastewater incinerators. Four incinerators will be multiple hearth incinerators, two incinerators will be fluidized bed incinerators. Data from four multiple hearth incinerators already tested will be combined with these data. The tests by a contractor will consist of Source Assessment Sampling System (SASS) train testing of both the incinerator exhaust (incinerator to scrubber) and the scrubber exhaust to the atmosphere. Tests for SO2, NOx and total organic vapors will also be taken. Samples of sludge in ash, scrubber water in, and scrubber water out will also be taken. Samples will be analyzed for 17 heavy metals and carbon. Atmospheric dispersion calculations will be made of the total particulate, materials in size ranges greater than 10 microns, 3 to 10 microns, 0 to 1 micron, and greater than 0.1 micron. Material balances will be made around the system. This work will be done in-house.
Keywords: AIR POLLUTION; MUNICIPAL WASTES; WASTE WATER; SLUDGES; INCINERATORS; GASEOUS WASTES; AEROSOL MONITORING; ENVIRONMENTAL IMPACTS; FLUE GAS; SULFUR DIOXIDE; NITROGEN OXIDES; ORGANIC COMPOUNDS; HYDROCARBONS; METALS; CARBON; QUANTITATIVE CHEMICAL ANALYSIS; ECOLOGICAL CONCENTRATION; MONITORING.

70938 Pilot Scale Evaluation of a Gas Producer for Thermal Conversion of Sludge. Schroeder, E.D. (University of California at Davis, Department of Civil Engineering, Davis, CA, 95616). **Project number:** C611B-0019. **Contract:** R805703-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$53,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of the program is to make a pilot scale evaluation of a process to evalute the application of packed bed gas producers to the production of combustible gases from municipal wastewater sludges. The project will consist of the following: (1) development of a method of making a briquette from municipal wastewater sludge and refuse-derived fuel suitable for use in a packed-bed gas producer; (2) a pilot scale operation of a packed bed using the sludge RDF briquettes to demonstrate the unit; and (3) the engineering and economic evaluation of the unit and data obtained to determine the suitability of the processes for use as a municipal wastewater sludge disposal method.
Keywords: SEWAGE SLUDGE; GASIFICATION; GAS GENERATORS; TECHNOLOGY ASSESSMENT; PILOT PLANTS; GASES; BRIQUETTING; REFUSE DERIVED FUELS; PACKED BED; ECONOMIC ANALYSIS; SYNTHESIS.

70939 Development of Standards and Guidelines for the Application of On-Line Instrumentation for Wastewater Treatment. Mattingly, G.E. (Department of Commerce, Fluid Engineering Div., 14th St. Bet. Const. Avenue, Washington, DC, 20234). **Project number:** C611B-0027. **Contract:** D8-X0024. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$50,000.
R and D categories: Characterization, measurement, and monitoring.

The objective is to develop equipment standards and guidelines for the installation, application, and maintenance of on-line instrumentation for wastewater treatment plants. NBS will systematically test, both in the laboratory and in the field, selected measuring devices for precision of analysis under varying conditions. Phase I of the work plan (the gathering and analysis of currently available information) is nearing completion. Phase II will include the review of Phase I reports and actual testing.
Keywords: WASTE WATER; WASTE PROCESSING PLANTS; WASTE MANAGEMENT; DATA ACQUISITION; ON-LINE MEASUREMENT SYSTEMS; STANDARDS; RECOMMENDATIONS.

70940 Application of Adsorption Theory Towards Virus Decontamination. Parks, G.A. (Stanford University, Department of Applied Earth Science, Stanford, CA, 94305). **Project number:** C611B-0035. **Contract:** R805016-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$4,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.
Keywords: VIRUSES; ABSORPTION; COLLOIDS; DECONTAMINATION; INFECTIVITY; ECONOMICS; WASTE WATER; HEALTH HAZARDS; RECYCLING; REMOVAL.

70941 Evaluate Selected European Processes for Composting Sewage Sludge. Baytos, W.C. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** C611B-0139. **Contract:** 68-03-2662. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The overall objectives of this program are to evaluate the most advanced European sewage sludge composting process (KNEER) and project its use to the United States commercial practice. This will be accomplished by performing an on-site evaluation at an operating facility in Germany. Detailed study of plant operations, product analysis, cost and environmental data are the basis of the evaluation. A secondary objective is to evaluate other, recently-developed composting systems which might be economic alternatives and compare them to the KNEER and the USDA-developed process.
Keywords: SEWAGE SLUDGE; COMPOSTING; COMPARATIVE EVALUATIONS; ECONOMICS; FEASIBILITY STUDIES; WATER POLLUTION ABATEMENT; SEDIMENTS; WASTE WATER; WASTE PRODUCT UTILIZATION; AGRICULTURE; GROUND DISPOSAL.

70942 Conduct Investigations of the Feasibility of Extracting Metals from Sludge. Salotto, B.V. (EPA, Office of Research and Development, Ultimate Disposal Section, 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-0144. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$24,000.

Heavy metals such as cadmium, lead, zinc, nickel, and copper are retained and concentrated in the sludge produced in wastewater treatment. Sludge is recognized as being a valuable resource for soil conditioning; however, heavy metal contamination of sludge limits its use. The purpose of this in-house research is to find cost effective methods to move metals, especially cadmium, from sludge so as to make it more amenable for land use. Several bench scale experiments have been carried out to determine the feasibility of using metal solvents such as organic complexing agents found to be too costly or ineffective.**Keywords:** FEASIBILITY STUDIES; SLUDGES; METALS; RESOURCE RECOVERY ACTS; REMOVAL; CADMIUM; LEAD; ZINC; NICKEL; COPPER.

70943 Effect of Temperature, Oxidation Conditions: Distribution of Metals in Various Particle Fractions of Sludge and Char. Wall, H. (EPA, Office of Research and Development, Ultimate Disposal Section, 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-0148. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects.

Sludge will be incinerated at various temperatures ranging from 650 degrees C to 980 degrees C in a laboratory scale furnace. The metal particulates in the air/gas leaving the furnace and in the ash left behind will be determined. The temperature tests will be repeated passing nitrogen instead of air to remove the particulates and gas leaving the furnace.
Keywords: INCINERATORS; METALS; SLUDGES; WASTE MANAGEMENT; PYROLYSIS; AIR POLLUTION; ENVIRONMENTAL IMPACTS; AEROSOLS; ASHES; RESIDUES; QUANTITATIVE CHEMICAL ANALYSIS; CHEMICAL COMPOSITION; FLUE GAS; TEMPERATURE EFFECTS; OXIDATION.

70944 Technical Assistance. Kreissl, J.F. (EPA, Office of Research and Development, Municipal Environmental Research Lab., 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-0149. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$18,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

This project involves a continuing effort to provide EPA headquarters and field personnel, other federal agency staffs, state and local officials, and private individuals and entities assistance in determining solutions to problems relating to rural wastewater generation, treatment, disposal, and management. This task is accomplished through correspondence, telephone contacts, and informal and formal meetings. Technology transferral generally takes one or more of the following forms: (1) document distribution, (2) oral presentation, and/or (3) written presentation.
Keywords: RURAL AREAS; WASTE WATER; WATER TREATMENT; WASTE DISPOSAL; WASTE MANAGEMENT; TECHNOLOGY TRANSFER; WATER POLLUTION CONTROL.

70945 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:** C611B-070. **Contract:** R806144-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$200,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

This project consists of the technical, economic and environmental evaluation of co-disposal plant subsystems. Systems proposed for research evaluation include: (1) solid waste fuel preparation; (2) sludge/fuel preparation; (3) combustion system; and (4) energy using system.
Keywords: ECONOMICS; ENVIRONMENTAL EFFECTS; SEWAGE SLUDGE; SOLID WASTES; COMBUSTION; WASTE DISPOSAL; ENERGY CONSUMPTION; FEASIBILITY STUDIES; COMBUSTORS; EVALUATION.

70946 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:** C611B-7053. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$180,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.
Keywords: OZONE; DISINFECTANTS; WATER QUALITY; INFECTIVITY; BACTERIA; PILOT PLANTS; WASTE WATER; CHLORINATION; CHEMICAL PROPERTIES; SEWAGE; PARASITES.

70947 Research Study for Continuing Documentation of Purifying Domestic Sewage by Use of Aquatic Plants: Known as the MPI System. O'Connor, J.E. (Moulton Niguel Water District, 27500 S. La Paz Road, Laguna Beach, CA, 92677). **Project number:** C611B-7056. **Contract:** R805279-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$36,000.
R and D categories: Physical and chemical processes and effects.

The objectives of the project are to: (1) obtain and monitor performance data for a 12-month period of a properly designed and well operated biological water purification process known as the Max Planck Institute System (MPI System) for treatment of domestic waste sewage; (2) attempt to satisfy highest levels for the quality for wastewater that are now established by the federal government and the California Water Quality Control Board; and (3) obtain and collect data for the evaluation of the reliability and effectiveness of the MPI system in purification of raw domestic sewage, transformation of sludge, and removal of nutrients from secondary treatment effluent. Data will be collected and documented on the operation and performance of a multi-trench facility, using the aquatic plants known as Phragmites (Reed) and Scirpus (Bulrush) as follows: (1) record sewage influent and effluent daily showing variations in flow, air temperature, sunlight, and precipitation; and (2) record water quality with composite sampling equipment at 3 locations designated (influent from domestic sewage lines, effluent from filter trenches, and effluent from elimination trenches). Certified laboratory tests will determine the ability of the MPI system to remove organic, inorganic, and pathogenic pollutants, including BOD and TSS. Results will be evaluated to determine reliability of this system in this transformation of sludge and reclamation of domestic wastewater for future installations by small municipalities and outlying areas of large communities.
Keywords: AQUATIC ORGANISMS; WATER POLLUTION; SEWAGE; PURIFICATION; BIOADSORBENTS; PLANTS; LIQUID WASTES; MUNICIPAL WASTES; SORPTIVE PROPERTIES; PARASITES; RECYCLING.

70948 Feasibility of Using Chlorine Dioxide in the Disinfection of Municipal Wastewater Effluents. Roberts, P.V. (Stanford University, Department of Civil Engineering, Stanford, CA, 94305). **Project number:** C611B-7057. **Contract:** R805426-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$68,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

Chlorine dioxide will be evaluated as an alternative to chlorine for the disinfection of wastewater. Principal criteria are: (1) effectiveness in killing fecal coliform bacteria, and (2) cost of generation and application. The dose-kill relationship will be investigated in laboratory-scale disinfection experiments in which the effects of dose time, pH and temperature kill will be studied. Based on these experiments and a survey of the scientific literature, users' experience, and commercially available generation technology, a concept for disinfection facilities will be developed and tested at pilot scale. Preliminary design and cost estimation of facilities in the range of 1 mgd to 100 mgd will provide the basis of an evaluation of economic feasibility. The comparative effectiveness of chlorine and chlorine dioxide in killing coliforms and virus will be determined in a limited number of parallel experiments, as will the formation of volatile, chlorinated organic substances.
Keywords: FEASIBILITY STUDIES; MUNICIPAL WASTES; DISINFECTANTS; CHLORINE OXIDES; CHEMICAL PROPERTIES; INFECTIVITY; WASTE WATER.

70949 Sludge Dewatering Trailer. Villiers, R.V. (EPA, Office of Research and Development, Municipal Environmental Research Lab., 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-7062. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

This is a two-phase project. The first phase consists of equipping a 40-foot Fruehauf van with the necessary equipment to conduct pilot studies on the thickening and dewatering of municipal wastewater sludges. The second phase will consist of conducting field studies at various municipal wastewater treatment plants in order to gather engineering design data from which methodologies can be developed for handling, processing and disposing of sludges at the least cost and in compliance with all environmental regulation criteria. Initial outfitting of the trailer was completed in the latter part of 1977. The trailer was then moved to Portland, Maine, for use in septic tank sludge dewatering studies. The trailer returned to Cincinnati in June 1978, and was moved to a field site at Loveland, Ohio. The trailer is undergoing additional outfitting and equipment debugging. Plans are to move it to the new T and E pilot facility at Mill Creek as soon as space is available.
Keywords: SEWAGE SLUDGE; WATER REMOVAL; MUNICIPAL WASTES; WATER POLLUTION ABATEMENT; GROUND DISPOSAL; PILOT PLANTS; ENVIRONMENTAL IMPACTS.

70950 Conduct Investigation of Sludge Quantities Produced by Upgrading Treatment Plants by Chemical Addition. Salotto, B.V. (EPA, Office of Research and Development, Wastewater Research Division, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** C611B-7063. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$24,000.

A bench scale investigation of a procedure for quickly determining the amount of sludge produced by chemical addition has been completed. A draft board report has been prepared and is under review. Aluminum sulfate produced more chemical sludge per unit dose than ferric chloride. Factors affecting sludge production were chemical coagulant type, influent characteristics, and phosphorus concentration.**Keywords:** WASTE WATER; SLUDGES; ALUMINIUM SULFATES; IRON COMPOUNDS; CHLORIDES; COMPARATIVE EVALUATIONS; PRODUCTION; FLOCCULATION; BENCH-SCALE EXPERIMENTS; WATER TREATMENT; PURIFICATION; WASTE MANAGEMENT; PHOSPHORUS; QUANTITY RATIO.

70951 Pilot Scale Anaerobic Treatment of High-Strength Heat Treatment Liquors. Donovan, E. (Hydroscience, Inc., 363 Old Hook Road, Westwood, NJ, 07675). **Project number:** C611B-7064. **Contract:** 68-03-2484. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects.

The purpose of this contract is to determine and evaluate the anaerobic filter process in the treatment of heat treatment liquor. The use of his process may reduce the pollutional load of the liquor sufficiently to allow it to be returned back to the wastewater treatment plant. The contract has been extended six months to complete the work. Results so far indicate about 50% removal of cod from the feed liquor with good gas production.
Keywords: ANAEROBIC DIGESTION; WASTE WATER; PURIFICATION; WATER TREATMENT PLANTS; SLUDGES; FEASIBILITY STUDIES; WATER POLLUTION CONTROL; CHEMICAL EFFLUENTS; CHEMICAL OXYGEN DEMAND; LIQUID WASTES; OXYGEN; PROCESS CONTROL.

70952 Autoheated Aerobic Thermophilic Digestion with Air Aeration. Jewell, W.J. (State University of New York at Binghamton, Graduate School, Vestal Parkway, Binghamton, NY, 13901). **Project number:** C611B-7065. **Contract:** R804636-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$114,000.
R and D categories: Integrated assessment.

The Federal water pollution control laws encourage the application of sewage sludge to agricultural land and for other beneficial uses as the preferred solution to this ultimate disposal problem. Because of the high capital and energy costs of reliable sludge treatment and disinfection, less costly and simpler treatment alternatives are being sought. Thermophilic aerobic digestion of sewage sludge offers promise of improving sludge management at a low cost. The possibilities of using the heat released during microbial oxidation of the sewage sludge to autoheat the waste liquid sludge has been considered by a number of investigators. The heat of oxidation of organics appears to be capable of autoheating sewage sludge at 95% to 97% water content to the thermophilic range only if the aeration system can achieve an oxygen transfer efficiency greater than 15%. Since most conventional aerators achieve transfer efficiencies less than 5%, it has been suggested that aeration with oxygen enriched air or pure oxygen would be necessary to support the concept of autoheating. Presently, a full scale commercially available unit being operated by Cornell University has been shown to be able to achieve thermophilic temperatures with a single air aeration system using autoheating with a mixture of a primary and secondary sewage sludge. Continuation of this study will document the limitations of the process and effectiveness of pathogen kill obtained with the autoheated temperatures.
Keywords: SEWAGE SLUDGE; GROUND DISPOSAL; ENVIRONMENTAL IMPACTS; WASTE PRODUCT UTILIZATION; INFECTIVITY; AEROBIC DIGESTION; PARASITES; AGRICULTURE.

70953 Evaluation of Control Strategies by Computer Simulation. Smith, R. (EPA, Office of Research and Development, Municipal Environmental Research Lab., 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-7070. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$32,000.
Related energy source: biomass(100).

A time dependent digital computer model for the anaerobic digester has been developed which is capable of simulating the performance of the digester. The modified Euler system of numerical integration was used and this method appears to be adequate because of the long time constant of the system. Plans are underway to test the model against pilot plant studies. As yet, no experimental results have become available. The model will not be published until it can be validated with experimental data.
Keywords: ANAEROBIC DIGESTION; COMPUTER CODES; MATHEMATICAL MODELS; PERFORMANCE TESTING; EQUIPMENT; WASTE MANAGEMENT; WATER POLLUTION CONTROL; PROCESS CONTROL; BIOMASS; ENVIRONMENTAL EFFECTS.

70954 Evaluation of Control Strategies from Field Data. Roesler, J.F. (EPA, Office of Research and Development, Municipal Environmental Research Lab., 26 West St. Clair Street, Cincinnati, OH, 45268). **Project number:** C611B-7111. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$32,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

During FY 77 and FY 78 the anaerobic digestor will be operated in the Lebanon Pilot Plant on a pilot scale. The digestor will be driven to failure in order to evaluate to coefficients for a mathematical model which will then be used to develop control strategies for the automation of the digestor. These control strategies will then be evaluated at the pilot plant.
Keywords: ANAEROBIC DIGESTION; PILOT PLANTS; PROCESS CONTROL; AUTOMATION; WASTE WATER; SLUDGES; WATER TREATMENT.

70955 Economic and Cost Evaluation for Water Supply Technology Management and Systems. Clark, R.M. (EPA, Office of Research and Development, 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C614-7145. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$4,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The objective is to evaluate data collected extramurally and by in-house staff. These data will be used by EPA in developing new research areas or for evaluating on-going projects, or for reevaluating completed research. Results are presented in publications, oral presentation, and information research reports. Examples of the output from this project include support provided to the Office of Water Supply in establishing organic standards for the Safe Drinking Water Act. Work has been undertaken to explore the impacts of the Safe Drinking Water Act on available financing for water utilities. Research has been initiated to explore difficult to quantify benefits (such as reduction in disease) from installation of water treatment technology. Other areas of socio-economic and water supply technology research are being pursued.
Keywords: ECONOMICS; COST; WATER TREATMENT; RECYCLING; RESOURCE CONSERVATION; DRINKING WATER; STANDARDS; WATER RESOURCES; DATA ANALYSIS; RESEARCH PROGRAMS; PUBLIC UTILITIES; COST BENEFIT ANALYSIS; SOCIO-ECONOMIC FACTORS; ORGANIC COMPOUNDS; HYDROCARBONS; REMOVAL.

70956 Water Sample Preservation. Nash, H.D. (EPA, Drinking Water Research Division, 26 W. St. Clair Street, Cincinnati, OH, 45268). **Project number:** C614A-0051. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$40,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objective is to determine recommendations for storage limits to minimize bacteriological changes in treated potable water samples prior to analysis. Distribution water from a dead end will be analyzed. Samples have a low density of coliform. The coliform density after initial analysis (with 3 hours of collection) and again after 24, 30, and 48 hours storage at 20 degrees C will be determined. Parameters being measured are: (1) total coliform, (2) standard plate count, (3) turbidity, and (4) temperature. Both the membrane filter and multiple tube procedures are being used.
Keywords: WATER; SAMPLE PREPARATION; DRINKING WATER; BACTERIA; SAMPLING; INFECTIVITY; QUALITY ASSURANCE.

70957 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:** C614A-062. **Contract:** R805900-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$188,000.
R and D categories: Integrated assessment.

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. The experimental program will investigate the three processes and obtain data on the following parameters required for design of larger scale plants and realistic cost estimates for the processes. Water quality, rate of long-term water production, quantity and kinds of products, labor requirements and interference by common ions. Equipment of two different sizes will be constructed and operated. Laboratory size reverse osmosis and ion exchange will be used initially to select membranes, module configuration, and resins suitably adapted for the McFarland well water. Reverse osmosis and ion exchange field test equipment will then be designed and operated.
Keywords: NITRATES; REMOVAL; DRINKING WATER; CONTAMINATION.

70958 Study of Erosion of Asbestos from Asbestos-Cement Pipe. Buelow, R.W. (EPA, Office of Research and Development, Water Supply Research Division, 26 West St. Clair Street, Cincinnati, OH 45268). **Project number:** C614A-7166. **Supported by:** Environmenta Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$16,000.

A number of field installations (municipal water supplies) having waters of various agressiveness to a/c pipe have been studied, and water was circulated through a 90-ft a/c pipe loop that has been constructed at our facilities in Cincinnati. The object in both cases was to determine whether asbestos fibers were being released

from the pipe under certain conditions, but not others. The field studies are complete and a report has been prepared. The ninety foot a/c pipe loop has been abandoned since it was concluded that we were unable to control the water quality in the loop, and as a result the data collected was meaningless. In its place we have constructed 8 mini-loops in which the system is closed to the atmosphere and water is circulated from a 100 gallon tank past small sections of pipe suspended in the middle of a 1-1/2 inch PVC pipe. Various water qualitites are being studied as well as various treatments to prevent corrosion. Corrosion or lack thereof is determined by physical inspection (softness) and by scanning electron microscopy of the pipe surface.**Keywords:** ASBESTOS; EROSION; CEMENTS; PIPES; WATER POLLUTION; HEALTH HAZARDS; DRINKING WATER; WATER QUALITY.

70959 Environmental Research Information Center Support Services for Economics of Solid Waste Management. Anderson, R.J. (Mathtech, Inc., Department of Economics, P.O. Box 2392, Princeton, NJ, 08540). **Project number:** C618A-0157. **Contract:** 68-03-2634. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$20,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective is to provide opportunity for discussion and exchange of ideas by persons knowledgeable in the economics of solid waste management. A workshop for selected participants will address current issues, including pricing solid waste management and product disposal charges. Proceedings of the workshop will be published as an EPA document.
Keywords: WASTE MANAGEMENT; ECONOMICS; WASTE DISPOSAL; MEETINGS; ENVIRONMENTAL EFFECTS.

70960 Production of 2000 Tons of Densified Refuse-Derived Fuel. Herrman, R. (Teledyne National, 117 Church Lane, Cockeysville, MD, 21031). **Project number:** C618A-0161. **Contract:** 68-03-2760. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$127,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

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.
Keywords: REFUSE DERIVED FUELS; FABRICATION; DENSITY; COMBUSTION; WASTE MANAGEMENT.

70961 Solid Waste Testing Procedures: Newsletter. Lowenbach, W. (Mitre Corp., Metrek Division, 1820 Dolley Madison Blvd., McLean, VA, 22101). **Project number:** C618A-098. **Contract:** CA-83145J. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$10,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The Mitre Corporation will prepare for publication a newsletter which will identify and report, in synopsis form, on those environmental research efforts which are utilizing leaching tests.
Keywords: SOLID WASTES; LEACHING; WASTE DISPOSAL; ENVIRONMENTAL IMPACTS; SANITARY LANDFILLS; ENVIRONMENTAL TRANSPORT.

70962 Parametric Evaluations of a Field Scale Hazardous Waste Incinerator. Whitmore, F.C. (Versar, Inc., 6621 Electronics Drive, Springfield, VA, 22151). **Project number:** C618A-104. **Contract:** 68-03-2679. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$75,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

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 shall 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 shall 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, online 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.
Keywords: INCINERATORS; HAZARDOUS MATERIALS; WASTES; PYROLYSIS; AROMATICS; ORGANIC CHLORINE COMPOUNDS; WATER POLLUTION; ENVIRONMENTAL IMPACTS; TOXICITY; AIR POLLUTION.

70963 Annotated Bibliography of Air Pollution from Stationary Source Wastes. Frederick, E.R. (Air Pollution Control Assn., 4400 5th Avenue, Pittsburgh, PA, 15213). **Project number:** C618A-111. **Contract:** CA-8-2351J. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$2,000.
Related energy source: all(100).

The contractor will produce an annotated bibliography of reference materials pertaining to air pollution involving wastes generated from stationary sources. The annotation will not exceed two or three sentences but will be sufficient to enable the user of the bibliography to determine the approximate content of the reference and its scope. Subject areas include, but are not limited to: municipal, incineration of chemical wastes, flue-gas desulfurization sludges, and flyash. Bibliographic entries will utilize a style consistent with that of any reputable scientific or technical journal or society, and preference will be given to citations published within the last five years.
Keywords: AIR POLLUTION; BIBLIOGRAPHIES; STATIONARY POLLUTANT SOURCES; FLUE GAS; MUNICIPAL WASTES; INCINERATORS; CHEMICAL EFFLUENTS; DESULFURIZATION; SOLID WASTES; FLY ASH; SULFUR DIOXIDE; NITROGEN OXIDES; HYDROCARBONS; PARTICLES; AEROSOLS.

70964 Comparative Study of Air Classifiers. (Midwest Research Institute, 425 Volker Blvd., Kansas City, MO, 64110). **Project number:** C618A-116. **Contract:** 68-03-2730. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$194,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The purpose of this effort is to provide EPA with information on the performance of full-scale operational air classifiers at several resource recovery facilities. The end product of this program will be a comprehensive report describing the individual site evaluations. These evaluations should include, but not be limited to, the following aspects: a/c design, designed a/c performance, modifications, measured a/c performance, operational problems, and testing procedures.
Keywords: AIR QUALITY; MONITORING; SITE SELECTION; MEASURING METHODS; MEASURING INSTRUMENTS; AIR POLLUTION MONITORS; COMPARATIVE EVALUATIONS.

70965 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:** C618A-118. **Contract:** R805613-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$135,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The objectives of this project are to: (1) demonstrate the ability to burn refuse-derived fuel (RDF) in a cement kiln and determine the effect on cement quality, economics, kiln operations and maintenance, and emissions; and (2) establish broad RDF specifications, burn rates, and quality-control procedures for burning in cement kilns. The approach will be a six-month test burn of RDF firing rates equivalent to 10 percent, 20 percent and 30 percent of the heating value of coal. A total of 3000 tons of RDF will be combusted over the span of testing. Physical and chemical analysis will be conducted on the RDF, RDF ash, coal, clinker, cement product, and fly ash. An economic analysis of the cost benefit of the RDF combustion will be performed. In addition, as of June 1978, tasks were added to the grant by EPA-MERL/SHWRD to study the solid waste processing aspects of RDF for cement kilns in greater detail. This area includes determining methods for increasing material throughput from available processing lines by optimal sequencing and/or additions of shredders, trommels, conveyors and other unit operations. Reliable production of suitable RDF at particle sizes of 1/2 inch or less at rates of up to 10 tons/hr from the existing equipment will require additional research studies which should yield new processing information applicable in many other fields.
Keywords: CEMENT INDUSTRY; ENERGY SOURCES; REFUSE DERIVED FUELS; COMBUSTION PROPERTIES; ECONOMICS; QUALITY CONTROL; KILNS; FUEL SUBSTITUTION; SPECIFICATIONS; ASHES; FLY ASH; WASTE PROCESSING PLANTS; OPTIMIZATION; EQUIPMENT.

70966 Resource Recovery from Glass and Plastic Wastes. Powell, D. (Pacific Environment Services, Inc., 1930 14th Street, Santa Monica, CA, 90404). **Project number:** C618A-123. **Contract:** 68-03-2708. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$61,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This effort will document the present state of the art on glass plastic waste recovery and will assess potential solutions to the recovery of glass and plastic from municipal, industrial, and commercial wastes. This project will address the scientific, technological, economic, environmental, and social aspects.
Keywords: MATERIALS RECOVERY; GLASS; PLASTICS; RECYCLING; SOLID WASTES; INDUSTRIAL WASTES; MUNICIPAL WASTES; SOCIO-ECONOMIC FACTORS; ENVIRONMENTAL EFFECTS; FEASIBILITY STUDIES.

70967 Evaluation of Sanitary Landfill Gas and Leachate Production. Eifert, M.C. (Systems Technology Corp., 245 N. Valley Road, Xenia, OH, 45385). **Project number:** C618A-7003. **Contract:** 68-03-2120. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$41,000.
Related energy source: biomass(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives are to determine the effect of: (1) varying moisture regimen on production of gas and leachate; (2) temperature on gas and leachate production; (3) wastewater treatment plant sludges on solid waste decomposition; (4) pH control on solid waste decomposition; (5) premature wetting; (6) hazardous liquid and sludge and their fate; (7) the survival of polio virus; and (8) the settlement rate in the lysimeters. The approach consists of 17 lysimeters, each containing 3 tons of raw compacted waste. These lysimeters are located at the EPA Center Hill facility in Cincinnati, Ohio. Fifteen of these cells are outside of the building while two are inside the building at room temperature. There are two stages to the program. The first stage is preparation of the cells, characterization of the waste, and placement of the waste into the cells along with the instrumentation. The second phase is monitoring the cells for gas composition and volume, leachate composition and volume temperature, pressure, settlement, water applications and the application of polio viruses into one of the cells. Water application rate is according to average U.S. rainfall pattern. The study is to last for approximately 3 years. Annual reports summarizing work accomplishments and a final report describing and evaluating the results obtained from this study will be prepared. The final report will be useful in assessing the potential environmental impacts of landfilled municipal refuse and admixtures of refuse and industrial and municipal sludges.
Keywords: SANITARY LANDFILLS; ENVIRONMENTAL IMPACTS; GASEOUS WASTES; LEACHING; MOISTURE; TEMPERATURE EFFECTS; SOLID WASTES; BIODEGRADATION; PH VALUE; HAZARDOUS MATERIALS; TOXICITY; POLIO VIRUS; RAIN; WASTE MANAGEMENT; OPTIMIZATION; CHEMICAL EFFLUENTS.

70968 Evaluation of Liner Materials Exposed to Hazardous and Toxic Sludges. Haxo, H.E. (Matrecon, Inc., 2811 Adeline Street, Oakland, CA, 94608). **Project number:** C618A-7005. **Contract:** 68-03-2173. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$75,000.
R and D categories: Physical and chemical processes and effects.

The objective is to determine the effective lives of twelve pond liner materials exposed to a variety of nonradioactive industrial hazardous wastes. The approahces utilized will be to expose specimens of liners sealed at the bottom on individual test cells to six different hazardous wastes to determine seepage through liners and changes in physical properties over twenty-four months; and to seal six polymeric liners and six admix and soil liners in cells for exposure to six different sludges containing hazardous waste streams. The six polymeric liners will include polyvinyl chloride, butyl rubber, chlorosulfonated polyethylene, chlorinated polyethylene, ethylene propylene rubber and neoprene. The soil and admix liner materials will include a bentonite clay seal, an emulsified asphalt seal, a soil cement, a hydraulic asphalt concrete, a compacted fine grain soil, and a sixth liner to be selected. The hazardous wastes will include a strong acid, a strong base, a pesticide, an oil refinery tank bottom waste containing scale, lead wastes from gasoline tanks and a cyclic hydrocarbon sludge. Seepage through the liners will be assessed over twenty-four months, and exposed liner specimens will be demounted at intervals. Physical properties will be determined for comparison with original properties.
Keywords: SLUDGES; TOXIC MATERIALS; HAZARDOUS MATERIALS; LINERS; INDUSTRIAL WASTES; WASTE DISPOSAL; PHYSICAL PROPERTIES; LEACHING; SOILS; WATER POLLUTION ABATEMENT; ORGANIC CHLORINE COMPOUNDS; CLAYS; ASPHALTS; CEMENTS; PH VALUE; PESTICIDES; PETROLEUM REFINERIES; LEAD; GASOLINE; POLYCYCLIC AROMATIC HYDROCARBONS; SANITARY LANDFILLS; PLASTICS; COMPARATIVE EVALUATIONS; ENVIRONMENTAL IMPACTS.

70969 Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Bailin, L.J. (Lockheed Aircraft Corp., Research Laboratory, 3251 Hanover Street, Palo Alto, CA, 94304). **Project number:** C618A-7006. **Contract:** 68-03-2190. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$285,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The primary objective is to evaluate the effectiveness of a large, continuous cold plasma system for the decomposition of herbicide and pesticide wastes and related materials in gaseous, liquid and solid forms. The approach is to utilize a generic extrapolation of the laboratory-size resonant cavity cold plasma which has been in use at the corporation since 1968. The new volume will be 2 to 3 liters larger. Thus, material throughout, based on laboratory discharge data, can be estimated from several hundred to several thousand liters per hour. Current plans call for commercially available microwave hardware to be used for construction of the system. Gas chromatographic analysis will be used to determine plasma reaction products and the degree of detoxification achieved. Various other analytical supportive equipment will also be utilized, including infrared spectroscopy. Included are the fabrication and test-evaluation of various sizes of units in terms of capacity, such as a grams/hr unit, a 1 to 7 pounds per hour unit, and a 10 to 30 pounds per hour unit. The 10 to 30 lb/hr unit is planned to be a prototype design suitable for conversion in the future to a truck-mounted portable unit available for field evaluations if desired.
Keywords: MICROWAVE RADIATION; HAZARDOUS MATERIALS; SULFUR OXIDES; CARBON OXIDES; PARTICLES; AEROSOLS; PESTICIDES; HERBICIDES; ENVIRONMENTAL EFFECTS; WASTE MANAGEMENT; DECOMPOSITION; ENVIRONMENTAL TRANSPORT.

70970 Field Verification of Land Cultivation/Refuse Farming. Johnson, S. (Arthur D. Little, Inc., 15 Acorn Park, Cambridge, MA, 02140). **Project number:** C618A-7023. **Contract:** 68-03-2602. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$84,000.
R and D categories: Physical and chemical processes and effects.

The objective is to develop a matrix of industrial organic and municipal solid waste streams versus operational parameters by conducting detailed field surveys and limited laboratory/field experimentation. The final marix of information will be sufficiently complete to develop design and guideline criteria. An informational matrix will be developed which will include inorganic industrial wastes and municipal refuse. Parameters to be determined include waste characterization and selection, disposal methodology, environmental impact, monitoring and economics. This research will be performed by a detailed field survey of ongoing land cultivation sites.
Keywords: CULTIVATION TECHNIQUES; SOLID WASTES; ORGANIC COMPOUNDS; HYDROCARBONS; STREAMS; INDUSTRIAL WASTES; MUNICIPAL WASTES; WASTE MANAGEMENT; WASTE DISPOSAL; ENVIRONMENTAL IMPACTS; MONITORING; ECONOMICS; GROUND DISPOSAL; AGRICULTURE; SOIL CONSERVATION.

70971 Priorities Assessment of Energy and Materials Recovery Technique. (National Academy of Sciences, 2101 Constitution Avenue, Washington, DC, 20037). **Project number:** C618A-7026. **Contract:** 68-03-2629. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$75,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

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.
Keywords: ENERGY CONSERVATION; MATERIALS RECOVERY; TECHNOLOGY ASSESSMENT; SEDIMENTS; POLLUTION; ENVIRONMENTAL IMPACTS; SLUDGES.

70972 Priorities Assessment of Energy and Materials Recovery Technique. Townsley, E.S. (National Academy of Sciences, 2101 Constitution Avenue, Washington, DC, 20037). **Project number:** C618A-7026. **Contract:** 68-03-2629. **Supported by:** Environmental

Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$74,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

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 screened for development of papers to be presented at symposiums.
Keywords: ENERGY CONSERVATION; MATERIALS RECOVERY; TECHNOLOGY ASSESSMENT; SLUDGES; SEDIMENTS; POLLUTION; ENVIRONMENTAL IMPACTS.

70973 Small Scale and Low Technology Study. Mitchell, G. (Stearns, Conrad and Schmidt Engineers, Inc., 11800 Sunrise Valley Drive, Herndon, VA, 22091). **Project number:** C618A-7027. **Contract:** 68-03-2653. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$6,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The primary purpose of this study is to document the extent to which small-scale, low-technology approaches are available, have been applied, or are being developed. The study should focus on source separation, energy and materials recovery technologies. The study should analyze small-scale and low-technology systems as applied to resource recovery from individual residences, multiple unit dwellings, office complexes and high people density institutions. Also included is a cursory investigation of any foreign technology which may have application in the United States. The study should relate these systems to technical feasibility, environmental impacts, and energy balance.
Keywords: MATERIALS RECOVERY; TECHNOLOGY ASSESSMENT; FEASIBILITY STUDIES; ENVIRONMENTAL IMPACTS; RESIDENTIAL BUILDINGS; OFFICE BUILDINGS; ENERGY BALANCE; RECYCLING; SOLID WASTES.

70974 Controlled Landfill Stabilization by Leachate Recycle. Pohland, F. (Georgia Inst. of Technology, School of Civil Engineering, 225 North Avenue NW, Atlanta, GA, 30332). **Project number:** C618A-7032. **Contract:** R803953-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$25,000.

The objectives of the proposed work are to confirm laboratory studies of the leachate recycle concept with larger, prototype test cells and to elucidate information on mass flux of gas and leachate components, with particular attention to the effect of evapotranspiration on the rates and quantities of leachate. Two doubly-lined test cells, 12 x 12 x 10 feet high, one completely closed for quantitative gas measurement and the other covered with soil as is the usual practice at landfills, will receive identical volumes of water and weight of shredded solid waste. The moisture content will be brought to 60% (wet weight) by adding digested sewage sludge during construction. Gas will be monitored for CO2, CH4, and other constituents and total volume; leachate will be monitored for BOD, COD, TOC, total and individual volatile acids, alkalinity, acidity, pH, nitrogen and phosphorus, chlorides, sulfides or sulfates, and pertinent heavy and alkaline earth metals. The solid waste of each cell will be sampled at the start and completion of the tests for visual and quantitative characterization. Mass flux will be determined for the contaminant monitored and analyses made to interpret and control the stabilization process. Modifications to the basic systems operation will be made as required. The energy generation potential, methane production, will be assessed. Recommended design and control procedures for leachate containment and recycle will be developed. A rigorous assessment of the cost/benefits of the recycle concept, in context of daily operation/implementation, including economic and technical feasibility and the extent of potential application, will be prepared.**Keywords:** SANITARY LANDFILLS; STABILIZATION; LEACHING; GASEOUS WASTES; EVAPORATION; WASTE MANAGEMENT; OPTIMIZATION; NITROGEN; PHOSPHORUS; CHLORIDES; SULFIDES; SULFATES; METALS; SOLID WASTES; SOLUBILITY; METHANE; PRODUCTION; DESIGN; RECYCLING; FEASIBILITY STUDIES; ECONOMICS.

70975 Predicting Organic Contaminant Removal by Clay Minerals and Waste Materials. Griffin, R.A. (State Geological Survey, Natural Resources Building, Urbana, IL, 61801). **Project number:** C618A-7036. **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:** Integrated assessment.

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 familics 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.
Keywords: ORGANIC COMPOUNDS; CLAYS; REMOVAL; SORPTIVE PROPERTIES; MINERALS; WASTE PRODUCT UTILIZATION; CHARS; COAL; SANITARY LANDFILLS; WATER POLLUTION CONTROL.

70976 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:** C624-7211. **Contract:** R804150-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$36,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

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.
Keywords: REFUSE DERIVED FUELS; DENSITY; COMBUSTION PROPERTIES; FABRICATION; COST; BOILER FUEL; ECONOMICS; MUNICIPAL WASTES; SOLID WASTES; SPECIFICATIONS; PELLETS; BRIQUETS.

70977 Economic Analysis of Scrap Futures Markets for Stimulating Resource Recovery. Anderson, R.C. (Environmental Law Institute, 1346 Connecticut Avenue North, Suite 620, Washington, DC). **Project number:** C624-7214. **Contract:** R804309-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$29,000.
R and D categories: Integrated assessment.

The principal objectives are to determine the technical and economic feasibility of commodity futures markets for secondary materials. Basic questions to which answers will be sought include: (1) are secondary materials amenable to commodity futures markets; (2) would futures markets increase capital flow to the salvage market industry and improve supply-demand elasticities; (3) what would be the nature of the benefits to market participants and society; and (4) what would be the cost to society. Research will include interviews with officials of commodity futures trading commissions and mercantile exchanges to obtain their views as to impediments and the potential role of futures markets for secondary materials. Existing cash markets for scrap will be studied for price determinants and appropriate grades and product qualities. A statistical determination of the determinants of volume trading based on existing markets is proposed.
Keywords: ECONOMICS; FEASIBILITY STUDIES; SOLID WASTES; RECYCLING; MARKET; TECHNOLOGY TRANSFER; LAND POLLUTION ABATEMENT; GOVERNMENT POLICIES.

70978 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:** C624A-7010. **Contract:** R805414-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$122,000.
Related energy source: all(100).

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.
Keywords: REFUSE DERIVED FUELS; FABRICATION; MUNICIPAL WASTES; SOLID WASTES; WASTE PROCESSING; DENSITY.

70979 Municipal Solid Waste Survey Protocol. Stearns, R.P. (Stearns, Conrad and Schmidt Engineers, Inc., 4014 Long Beach Blvd., Suite 211, Long Beach, CA). **Project number:** C624B-0153. **Contract:** 68-03-2486. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$19,000.
Related energy source: all(100).

The objective of this study is to provide a detailed evaluation of the various techniques available for solid waste quantity and composition estimation. Equal emphasis will be placed upon both the comparative methodology evaluation itself and assessing the accuracy and precision requirements which are placed upon those methodologies by resource recovery designers. The study will begin with a detailed analysis of past and present practices for estimating the quantity and composition of the solid wastes comprising a municipal waste stream. An analysis will also be made to determine the accuracy and precision requirements for designing solid waste storage and processing equipment, with the primary source of information being the designers themselves. A comparative evaluation of the resulting methodologies will then be performed, with the principal criteria being accuracy, precision, ease of implementation, and equipment and manpower requirements. Input/output models will also be discussed for use as possible cross checks for sampling results. Based on the results of the evaluation procedure, several survey protocols will be selected as most effective. These protocols will then be implemented in the field and the results again compared. The final product of this study will be a detailed procedural outline for each selected methodology, along with guidance for that proper application.
Keywords: MUNICIPAL WASTES; FORECASTING; SOLID WASTES; CLASSIFICATION; WASTE PROCESSING; WASTE STORAGE; INPUT-OUTPUT ANALYSIS.

70980 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:** C624B-124. **Contract:** 68-03-2589. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab. **Funding:** EPA-$79,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives of this research project are: (1) to test and evaluate the performance of large-scale shredders for solid waste/refuse waste-to-energy processing systems; and (2) to assimilate the data with previous tests on small-scale shredders. Field tests will be conducted on primary and secondary shredders at three solid waste processing plants. Test data will include shred size distribution, moisture content, energy consumption and wear measurements. The final report to EPA will be part of a series of waste processing reports providing state-of-the-art information on technology in the field of shredders, magnetic separators, air classifiers, and related equipment considerations.
Keywords: SOLID WASTES; WASTE PRODUCT UTILIZATION; MATERIALS RECOVERY; ENERGY CONSUMPTION; SEPARATION PROCESSES.

71015 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:** D625F-112. **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:** Health effects.

The objectives are to investigate: (1) development of lesions induced by inhalation of Ni-enriched fly ash (NEFA) as a function of exposure time and aerosol concentration; (2) mortality as a function of exposure; and (3) reversibility of NEFA-induced lesions as a function of exposure and age by periodically withdrawing hamsters from exposure and maintaining them for life-span observations. In Phase I, NEFA and fly ash (FA) will be prepared and characterized. Exposure facilities and equipment will be prepared and tested. Hamsters will be ordered and quarantined. Acute and subacute toxicity tests with NEFA and FA will be conducted. In Phase II, four groups of male Syrian gold hamsters will receive high-level exposures to NEFA, low-level exposures to NEFA, high-level exposures to FA, and sham exposures, respectively. Each group will consist of a subgroup of 50 animals to receive life-span (15 months) exposures, a subgroup of 20 animals to be sacrificed quarterly in lots of 5, and another subgroup of 20 animals to be withdrawn from exposure quarterly in lots of 5 for further observation. Dead animals will be necropsied. Lungs and grossly observed lesions will be histopathologically examined.
Keywords: FLY ASH; BIOLOGICAL EFFECTS; NICKEL; INHALATION; TOXICITY; CHEMICAL COMPOSITION; QUANTITY RATIO; HAMSTERS; MORTALITY; EPIDEMIOLOGY; MALES; PATHOLOGICAL CHANGES; BIOLOGICAL MODELS.

71019 Subcommittee on the Geochemical Environment in Relation to Health and Disease (GERHD). Petrie, W.L. (National Academy of Sciences, National Research Council, 2101 Constitution Avenue, Washington, DC, 20037). **Project number:** D625F-116. **Contract:** 68-03-2554. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

GERHD has broad interdisciplinary interests encompassing both earth scientists and biomedical specialists and is concerned with the concentrations of certain minerals in localized areas and with abnormally high and low concentrations of certain elements that may cause specific biologic effects. For example, problms may be related to excesses of iron, selenium, fluorine, copper, zinc, and manganese; on the other hand, problems have been correlated with deficiencies of iodine, zinc, and cobalt. Interactions of certain elements such as copper, molybdenum, zinc, iron, and sulfate associated with mining and industrial activities may have potential biological effects. GERHD identifies the association of abnormal levels of trace elements as a guide to research into understanding and protection of plant, animal, and human health. It also evaluates important research opportunities concerned with industrial production, health and environmental interest, and government regulatory agencies. Ad hoc panels are preparing reports on their studies. A draft report from the panels on the geochemistry of water in relation to cardiovascular disease and trace element geochemistry of coal resource development related to health has been assembled and is undergoing in-house NAS review.
Keywords: ECOLOGICAL CONCENTRATION; MINERALS; IRON; SELENIUM; FLUORINE; COPPER; ZINC; MANGANESE; IODINE; COBALT; MOLYBDENUM; SULFATES; MINING; PLANTS; ANIMALS; HUMAN POPULATIONS; HEALTH HAZARDS; BIOLOGICAL EFFECTS; METABOLISM; ENVIRONMENTAL EFFECTS; AGE DEPENDENCE; INDUSTRY; CHEMICAL EFFLUENTS.

71020 Effect of Mobile Emissions or Single Pollutants on Susceptibility to Respiratory Infection. Campbell, K.I. (EPA, Office of Research and Development, Toxicological Assessment Branch, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D601B-004. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$55,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.

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 engines 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 August 1978. Tests of manganese oxide and ultrafine sulfuric acid aerosols were proposed but have been tabled in favor of higher priority demands.
Keywords: AIR POLLUTION; MOBILITY; ENVIRONMENTAL TRANSPORT; RESPIRATORY SYSTEM DISEASES; AEROSOLS; PATHOGENESIS; GASOLINE; EXHAUST GASES; SULFURIC ACID; DIESEL FUELS; FUEL ADDITIVES; MICE; PLATINUM COMPOUNDS; CATALYTIC CONVERTERS.

71021 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:** D601B-006. **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** Physical and chemical processes and effects; Health effects.

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.

71022 Health Effects of Non-Pesticides Reaching Man by Multiple Routes of Exposure. Clarke, N.A. (EPA, Office of Research and Development, Laboratory Studies Division, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D601E-002. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$295,000.

Related energy source: coal(50); oil and gas(50). **R and D categories:** Integrated assessment; Health effects.

The objective is directed toward discerning exposure--effects relationships between health and certain non-pesticide environmental contaminants which typically reach man by multiple routes of exposure. Laboratory animals will be exposed by different routes to pollutants. Biological endpoints include neurophysiological and behavioral parameters such as spontaneous electroencephalograms and evoked potentials, assay of enzyme systems and other biochemical parameters, pulmonary functions measurements, pathological assessment of tissues and deterioration of tissue concentrations of metals under study. No changes in the visual evoked potentials were detected in female rats exposed to 200 ppM lead chloride in drinking water two weeks prior to mating. Lung permeability using 131-I labelled albumin was unchanged after 45 days exposure to 2 mg/cubic meter manganese sulfate aerosol. Fourteen days exposure to an ammonium sulfate aerosol at a concentration of 300 mg/cubic meter had no effect upon body weight, pulmonary function, arterial blood gases, or lung pathology in rats.

Keywords: HEALTH HAZARDS; ANIMALS; NEUROLOGY; PHYSIOLOGY; BEHAVIOR; HUMAN POPULATIONS; ENZYMES; BIOCHEMISTRY; LUNGS; PATHOLOGICAL CHANGES; TISSUES; METALS; BIOLOGICAL EFFECTS; IODINE 131; LABELLED COMPOUNDS; ALBUMINS; SULFATES; AMMONIUM SULFATES; MAGNESIUM SULFATES.

71023 Mutagenic Potential of Urban Water and Air Samples. Witmer, C. (Thomas Jefferson University, School of Medicine, 1025 Walnut Street, Philadelphia, PA, 19107). **Project number:** D601F-002. **Contract:** R806279-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$81,000.

Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

The relative capacities of normal and induced tissues (rat liver, lung, kidney cortex, placenta and embryo, and human placenta) to biotransform secondary mutagens to active mutagens (carcinogens) will be compared using mutagen sensitive bacterial strains developed by Ames, Garro and others. Use of three representative carcinogens in the bacterial tester system will aid in the choice of tissue for testing the mutagenic (carcinogenic) capacity of environmental compounds found in the air and water of the City of Philadelphia which are suspected carcinogens. These compounds will also be tested as primary mutagens without addition of tissue enzymes. Compounds biotransformed to mutagens by placenta or embryo will be tested as teratogens in rats. The actual involvement of cytochrome P-450 in the biotransformations will be studied by the addition to the tester system of compounds which inhibit P-450 mediated reactions in vitro. Relative mutagenic effects of the compounds will be assessed by dose-response studies.

Keywords: AIR POLLUTION; WATER POLLUTION; HEALTH HAZARDS; WATER QUALITY; AIR QUALITY; MUTAGENESIS; BIOLOGICAL MODELS; HAMSTERS; RATS; CARCINOGENS; METABOLISM.

71024 Health Risks of Human Exposure to Wastewaters. Clark, C.S. (University of Cincinnati, Department of Environmental Health, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** D607A-003. **Contract:** R803643-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$331,000.

The proposed work involves the fourth and final year of an on-going prospective serologic-epidemiologic study of persons occupationally exposed to municipal wastewater. The initial objective of this study was to determine the sensitivity of the methodology for appraising the health effects of human exposure to wastewater. Volunteers for the study were municipal employees in Cincinnati, OH, engaged in sewer maintenance and highway maintenance work. During the second year of the study the project was expanded with the added objective of determining the health effects associated with occupational exposure to viable aerosols generated by activated sludge wastewater treatment plants. Volunteers for this aspect of the study have been recruited from Cincinnati, OH, Chicago, IL, and Memphis, TN. The control groups are water treatment plant employees in Chicago, electrical distribution systems workers in Memphis, and the previously recruited highway maintenance workers in Cincinnati. A total of over 400 volunteers are currently active in the study, over 100 of whom were recruited at the time of initial employment at activated sludge wastewater treatment plants.**Keywords:** HUMAN POPULATIONS; HEALTH HAZARDS; WASTE WATER; EPIDEMIOLOGY; OCCUPATIONAL DISEASES; MUNICIPAL WASTES; SEWAGE; ROADS; PERSONNEL; ACTIVATED SLUDGE PROCESS; WATER TREATMENT PLANTS; MAINTENANCE; CHEMICAL EFFLUENTS; WATER POLLUTION; CHRONIC EXPOSURE; AEROSOLS; OHIO; TENNESSEE; ILLINOIS; PUBLIC UTILITIES; EXHAUST GASES; TRANSPORTATION SYSTEMS; VEHICLES.

71025 Monitoring for Pathogenic Naegleria. Wellings, F.M. (State Epidemiology Research Center, 4000 West Buffalo Avenue, Tampa, FL, 33614). **Project number:** D607C-024A. **Contract:** R804375-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$151,000.

R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objective of this continuation grant is to define the distribution of pathogenic Naegleria in the State of Florida. Multiple isolates have been made from freshwater lakes as well as thermally polluted ones. Overwintering appears to be confined to lake bottom sands and/or sediments. Over the next year this aspect should be confirmed. A rapid method for identification has been developed but requires additional testing of specimens from various areas. Immunological and physiochemical aspects of pathogenic Naegleria and seropositive nonpathogenic Naegleria will be investigated to determine their relationship. A one-time survey of water and sediments from approximately 20 Georgia lakes will be conducted in August 1978.

Keywords: WATER POLLUTION; PARASITES; POPULATION DYNAMICS; THERMAL POLLUTION; GEORGIA; WATER QUALITY; BIOLOGICAL EFFECTS; EPIDEMIOLOGY.

71026 Particulate Analysis of Drinking Water Supplies. Millette, J.R. (EPA, Office of Research and Development, Exposure Evaluation Branch, 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D614B-007C. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.

R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The purpose of this task is to accumulate data on the particulates found in drinking water and develop systems for classification of these particulates. The outputs of this research will include in-house reports on particulates found in various water samples and the preparation of an ORD research report on particulates in drinking water. Results to date include analysis of over 60 samples of drinking water and classification of particulates into fibous, non-fibrous, crystalline, organic and asbestos categories. A report differentiating between chrysotile asbestos and two clays, attapulgite and halloysite, is being prepared.

Keywords: PARTICLES; DRINKING WATER; WATER QUALITY; CHEMICAL ANALYSIS; STANDARDS; ASBESTOS; CLAYS; CARCINOGENESIS; EPIDEMIOLOGY.

71027 Electron Microscope Analysis of Fibers in Tissue: Support to Migration Studies. Millette, J.R. (EPA, Office of Research and Development, Health Effects Research Lab., 5555 Ridge Avenue,

Cincinnati, OH, 45268). **Project number:** D614B-010D. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$7,000.
R and D categories: Integrated assessment; Health effects.

The purpose of this task is to provide support for synthetic tritiated asbestos studies of migration of asbestos fibers in the tissues of mammals. The outputs of the task will be in-house reports which will eventually be data listed in EPA publications of the research on asbestos migration in the body. No results are available to date because the synthetic asbestos to be used in the studies has not been produced.
Keywords: ELECTRON MICROSCOPY; BIOLOGICAL PATHWAYS; ASBESTOS; TISSUES; METABOLISM; TRACER TECHNIQUES; TRITIUM COMPOUNDS.

71028 Availability of Cadmium to Rats from Crops Grown on Cadmium Enriched Soils. Buhler, D.R. (Oregon State University, Department of Agricultural Chemistry, 35th and Jefferson Streets, Corvallis, OR, 97331). **Project number:** D614B-011E. **Contract:** R805774-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$96,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

We plan to determine the availability of cadmium by rats from edible plants grown on cadmium enriched soils. Specifically we will measure the absorption and tissue distribution of 109-Cd in weanling rats fed semisynthetic diets containing spinach, carrots, lettuce, soybeans, tomatoes, and wheat grown on soil treated with 109-CdCl2 and compare the relative uptake of metal with that found from similar nonradioactive diets spiked with identical concentrations of 109-CdCl2. We will also determine the influence of cooking on the uptake of 109-Cd by rats fed a vegetable diet and investigate the distribution and nature of 109-Cd binding in the various crops.
Keywords: CADMIUM; RATS; UPTAKE; CROPS; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL EXPOSURE PATHWAY; FOOD CHAINS; SOILS; CONTAMINATION; METABOLISM.

71029 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:** D614B-018D. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

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.
Keywords: ASBESTOS; DRINKING WATER; QUALITATIVE CHEMICAL ANALYSIS; QUANTITATIVE CHEMICAL ANALYSIS; WATER QUALITY; USA; HUMAN POPULATIONS; HEALTH HAZARDS; DATA COMPILATION.

71030 Study of Cancer and the Public Drinking Water Supplies in Missouri. Marienfeld, C.J. (University of Missouri at Columbia, Department of Community Health, M228 Medical Sciences, Columbia, MO, 65201). **Project number:** D614B-067. **Contract:** R805297-02. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$203,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This project deals with the establishment and maintenance of a statewide surveillance system for human cancer incidence in relationship to the multiple sources of community public water supplies in Missouri and the methods of treatment of such local water supplies. Using the available mortality and morbidity data, a computerized rural route geocoding system will be used to locate the residence of the affected individuals identified as a part of the population at risk within the geographic water supplied area.
Keywords: CARCINOGENESIS; HUMAN POPULATIONS; NEOPLASMS; DRINKING WATER; EPIDEMIOLOGY; HEALTH HAZARDS; WATER QUALITY; STANDARDS; MISSOURI.

71031 Identification of Non-Asbestos Fibers Occurring in Drinking Water. Millette, J.R. (EPA, OFfice of Research and Development, Health Effects Research Lab., 5555 Ridge Avenue, Cincinnati, OH, 45268). **Project number:** D614B-101. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The purpose of this task is to provide data on non-asbestos fibers in drinking water through electron microscopy analyses. The output of this task will be a report on the particulates in drinking water. Results to date include analyses of over 100 samples for particulates. The only non-asbestos fibers found in significant concentrations have been biological in origin and clays.
Keywords: DRINKING WATER; QUALITATIVE CHEMICAL ANALYSIS; FIBERS; QUANTITY RATIO; ELECTRON MICROSCOPY; PARTICLES; ECOLOGICAL CONCENTRATION; CLAYS.

71032 Intoxication/Carcinogenesis, Mutagenesis, Teratogenesis, and Reproductive Potential of Five Compounds Generated by Coal Conversion. Hart, E.R. (Litton Bionetics, Inc., Department of Pharmacology and Toxicology, 5516 Nicholson Lane, Kensington, MD, 20795). **Project number:** D625F-002. **Contract:** 68-03-2472. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$116,000.
Related energy source: coal(100). **R and D categories:** Health effects.

Five compounds will be investigated for determination of their potential for chronic intoxication/carcinogenesis, mutagenesis, teratogenesis, and alteration of reproductive function. The first four compounds will be methylbenzimidazole, dibenzofuran, 1,2,4-trimethylbenzene and thallium sulfate. The fifth compound will be selected from a longer list of compounds of environmental concern. The protocol to be followed is an integrated one similar to that published by the Minister of Health and Welfare, Canada, in the book entitled The Testing of Chemicals for Carcinogenesis, Mutagenesis and Teratogenicity, September 1973. It differs primarily in that it uses the heritable translocation test, rather than the dominant lethal test.
Keywords: TOXICITY; CARCINOGENESIS; MUTAGENESIS; TERATOGENESIS; REPRODUCTION; ENERGY CONVERSION; SULFATES; HYDROCARBONS; THALLIUM COMPOUNDS.

71033 Effect of Environmental Pollutants in Relation to Age and Dietary Influence: Toxic Trace Elements. Kostial, K. (Institute for Medical Research and Occupational Health, Mineral Metabolism, 158 M. Pijade, Zagreb, Yugoslavia, 41000 ZA). **Project number:** D625F-006. **Contract:** R804641-01. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$141,000.
Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

This work is intended to evaluate various factors influencing the effect of environmental pollutants on rats with particular emphasis on trace elements. Special attention will be paid to differences in absorption, distribution, and retention in relation to age, to the estimation of critical organs in the immature, to differences in toxicity due to age, to late effects caused by infant exposure, and to nutritional factors and deficiencies as they influence trace element metabolism and effects. Most of the experimental work will be performed on rats using radioactive isotopes of trace elements for studying various metabolic parameters. Stable trace elements will be added to different diets to evaluate the effects of chronic exposures of one month or longer and the interaction of toxic and essential trace elements. Experiments on humans are envisaged for a later stage. These investigations are expected to provide a better basis for evaluating the effects of environmental pollutants in the young.
Keywords: AGE DEPENDENCE; DIET; NUTRITION; BIOLOGICAL EFFECTS; RATS; METABOLISM; CADMIUM 115; MERCURY 203; LEAD 203; MANGANESE 59; INFANTS; TRACER TECHNIQUES; TOXICITY; DYNAMIC FUNCTION STUDIES; TRACE AMOUNTS; CHRONIC EXPOSURE; MERCURY; LEAD; CADMIUM; MANGANESE.

71034 Environmental Health Study of Lead in Teeth. Wilkinson, D.R. (Delaware State College, Department of Chemistry, Dover, DE, 19901). **Project number:** D625F-014. **Contract:** R802890-03. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$7,000.
Related energy source: coal(100).

The proposed research program is designed to determine lead concentration in deciduous teeth of children under age 6, as well as in contaminating dust samples from the homes of the donors and air samples from the immediate area. In addition, automobile traffic rates in the immediate area will be studied and socio-economic data collected on the families of children under study. The teeth samples will be collected in Birmingham, England, a city which offers a unique laboratory for such a study, i.e., a tremendously large traffic cloverleaf, around which are constructed many high-rise apartments and a state housing development. In addition, England offers a state health program offering personal information on donors and their families. Samples of teeth will be collected in England, coded, and mailed along with data to Delaware State College, where they will

be freeze-ground, put into solution and volumetrically brought up to a predetermined volume. The concentration of lead will be determined through the use of a Jarrel-Ash 810 atomic absorption spectrophotometer. The results will add to knowledge presently being obtained concerning the ability to determine lead accumulated in the body by a technique which will cause little or no damage to the donor. The correlation between automobile traffic, lead accumulation levels, and morbidity patterns should be shown.
Keywords: LEAD; ECOLOGICAL CONCENTRATION; TEETH; CONTAMINATION; AUTOMOBILES; EXHAUST GASES; ENVIRONMENTAL IMPACTS; UPTAKE; METABOLISM.

71035 Comparative Toxicological Evaluation of Emission from Power Plants Using Eastern vs. Western Coal. Finelli, V.N. (University of Cincinnati, Department of Environmental Health, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** D625F-118. **Contract:** 68-03-2601. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$161,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The increased utilization of coal as an energy source may significantly alter the pollutant profile in the human environment. Reserves of coal far exceed the known reserves of all other mineral fuels. In the United States, from the Atlantic to the Pacific coasts, there are great reserves of various types of coal graded from the highest ranked Pennsylvania anthracite and the eastern and midwestern bituminous to the low ranked, softer coals such as western subbituminous and lignite. The objectives of this research are: (1) to determine the profiles of organic and metal constituents of emissions from coal-fired power plants using eastern or western coals and to analyze the results in view of the type of coal used and in awareness of the diverse plant designs and emission control devices at the various collection sites; and (2) to assess the toxicologic effects of collected emission samples and to compare the biological effects with the chemical characteristics of the samples. Collection of emission samples from the post-control-device combustion effluents (fugitive stack emission) will be performed using up-to-date sampling methodology. Metal analyses, fractionation and fingerprinting of organic constituents as well as in-vivo and in-vitro toxicological evaluation of unfractionated samples and their fractions will permit us to assess the role of metals and organic constituents in the toxicity of stack emissions. The biological tests proposed in this study include bacterial and mammalian cell mutagenesis, cytotoxicity and long and short term effects of intratracheally administered samples as seen by biochemical and pathological changes in the lungs of exposed rats.
Keywords: FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; COAL; TOXICITY; ORGANIC COMPOUNDS; METALS; BIOLOGICAL EFFECTS; COMBUSTION PRODUCTS.

71036 Effect of Pollutants from Energy Consumption and Environmental Trace Metals on Lung Metabolism. Mustafa, M.G. (University of California at Los Angeles, Department of Medicine, 405 Hilgard Avenue, Los Angeles, CA, 90024). **Project number:** D625F-130. **Contract:** 68-03-2221. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab. **Funding:** EPA-$38,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective is to determine qualitative and quantitative biochemical changes in the lungs of animals exposed to pollutants related to energy consumption, viz., ozone, nitrogen oxides, sulfur oxides, sulfuric acid, sulfates and environmental trace metals. Animals (rats) are exposed to pollutants and the effects in the lung are delineated using sensitive biochemical parameters. The findings of studies to date are summarized as follows. Although acute exposures to oxidant pollutants generally cause a depression of lung enzymatic activities, exposures of ozone at concentrations below 1 ppM (simulating ambient conditions in photochemical smog) and to nitrogen dioxide at 5 ppM (threshold limit value) for a few days or longer result in a stimulation of lung metabolism. As judged from enzymatic activities, lung metabolism may exhibit an initial depression (within 24 hours), but shows a subsequent elevation which attains the peak between 3 and 4 days of exposure. For exposures involving 0.8 ppM ozone, a 50 to 100 elevation of metabolic parameters has been observed. For lower levels of ozone (viz., 0.5 and 0.2 ppM) the metabolic changes are small, exhibiting prolonged exposures to ozone (viz., 0.8 ppM), and show that the biochemical changes in the lung remain elevated for as long as 50 days of exposure, but then decline almost to control level after 90 days of exposure. For lower levels of ozone, the changes are found to revert to control level within 20 days of exposure. If the exposure is discontinued after a few days, the biochemical changes in recovering animals return to control levels within a week. It may be concluded that low-level oxidant exposures cause biochemical changes in the lung, and that the changes are reversible.
Keywords: BIOLOGICAL EFFECTS; LUNGS; ENERGY CONSUMPTION; HEALTH HAZARDS; RATS; OZONE; NITROGEN OXIDES; SULFUR OXIDES; SULFURIC ACID; SULFATES; METALS; DYNAMIC FUNCTION STUDIES; METABOLISM.

71203 Los Angeles Catalyst Study (LACS). Parry, E.P. (Rockwell International Corp., 2421 West Hillcrest Avenue, Thousand Oaks, CA, 91320). **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-$420,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.
Keywords: LOS ANGELES; SMOG; AIR QUALITY; CARBON MONOXIDE; LEAD; SULFUR DIOXIDE; SULFURIC ACID; ECOLOGICAL CONCENTRATION; MONITORING.

71205 Benzene-Soluble Organics/Benzo(a)pyrene Method Comparison Study. Martin, B.E. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., Research Triangle Park, NC, 27711). **Project number:** E606A-17. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$100,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to compare the EPA sampling procedure for BSO/BaP with the OSHA (NIOSH) sampling procedure under field conditions. The two methods will be used to collect ambient samples in the vicinity of a coke oven for purposes of comparing the data obtained from the analysis of the filters.
Keywords: BENZOPYRENE; ORGANIC COMPOUNDS; SAMPLING; COMPARATIVE EVALUATIONS; COKE OVENS; AIR POLLUTION.

71206 NO2 Reclassification Study. Foster, T. (Bendix Corp., Process Instruments Div., Route 219 North, Lewisburg, WV, 24901). **Project number:** E606A-18. **Contract:** 68-02-1781. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives are to: measure continuously ambient NO2 concentration in 45 metropolitan areas to obtain data for re-evaluation of air quality control regions; measure continuously ambient NO2 concentrations in 19 metropolitan areas to support the possible establishment of a short-term ambient air quality standard; and measure continuously ambient NO2 concentrations in 9 metropolitan areas to support the NO2 air quality standard. These measurements are obtained using continuous chemiluminescent Bendix analyzers. Data is obtained on a continuous strip chart and results are reported on an hourly basis.
Keywords: NITROGEN DIOXIDE; AIR POLLUTION MONITORS; AIR QUALITY; AUTOMATION; CHEMILUMINESCENCE.

71210 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(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

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 DEVELOP-

MENT; AIR POLLUTION; WESTERN REGION; PACIFIC NORTHWEST REGION.

71220 Carbon Monoxide Intrusion Study Design and Literature Search. Ziskind, R. (Science Applications, Inc., 1200 Prospect Street, La Jolla, CA, 92037). **Project number:** E103-01. **Contract:** 68-02-2958. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$50,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to determine the sources and levels of carbon monoxide in the passenger area of sustained use motor vehicles in order to supply information which could be used to help establish air quality standards for the interior of sustained use vehicles. The data collected will consist of personal monitors which will collect integrated values and continuous monitors which will determine real time peak values. In addition, tracer studies will be conducted to determine how the exhaust gases are entering the vehicles. The study was initiated in May, 1978, in response to the Clean Air Act amendments. A literature survey has been completed and a study is being designed. Initial sampling is being conducted in order to evaluate some of the factors involved. The actual detailed study should begin in the fall of 1978 and last approximately one year.
Keywords: CARBON MONOXIDE; DATA COMPILATION; AUTOMOBILES; EXHAUST GASES; INDOOR AIR POLLUTION; AIR QUALITY; STANDARDS; ECOLOGICAL CONCENTRATION; OCCUPATIONAL DISEASES.

71221 Statistical Analysis to Determine Impact of Catalyst-Equipped Autos on the Environment Near a Los Angeles Freeway. Tiao, G.C. (University of Wisconsin at Madison, Department of Statistics, 500 Lincoln Drive, Madison, WI, 53706). **Project number:** E601B-13. **Contract:** 68-02-2261. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to study and document effects on pollutant concentrations of the catalytic converter on automobiles with special interest in possible H2SO4 emissions resulting from the converter. The approach will include a model development and time series analysis of cross-freeway data (Los Angeles Catalyst Study) specifically dealing with background assessment, wind effects, traffic effects, pollutant interrelationships, and trends analysis of TSP, SOx, CO, Pb, NOx, and NH4.
Keywords: CALIFORNIA; ROADS; ENVIRONMENTAL IMPACTS; AUTOMOBILES; EXHAUST GASES; CATALYTIC CONVERTERS; SULFUR OXIDES; CARBON MONOXIDE; LEAD; NITROGEN OXIDES; AMMONIA; HYDROCARBONS; ECOLOGICAL CONCENTRATION.

71223 X-Ray Fluorescence Analysis of Los Angeles Catalyst Study Samples. Giauque, R.D. (Lawrence Berkeley Lab., Energy and Environment Division, Berkeley, CA, 94720). **Project number:** E601B-15. **Contract:** 78-D-X-0067. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$40,000.

This program involves the analysis of approximately 2000 membrane filters/year collected by samplers operating the Los Angeles catalyst study. Analyses for nine selected elements are performed, including Pb, S, Si, Al, Zn, Ca, Ni, Fe, and Br. To date 4500 samples have been analyzed. Data will be published in the progress and final reports.**Keywords:** MEMBRANES; FILTERS; AIR SAMPLERS; PHYSICAL PROPERTIES; COMPARATIVE EVALUATIONS; SULFUR DIOXIDE; SULFATES; NITROGEN OXIDES; NITRATES; CARBON OXIDES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; AEROSOLS; LEAD; SILICON; ALUMINIUM; ZINC; CALCIUM; NICKEL; IRON; BROMINE.

71224 Neutron Activation Analysis of Fuel and Fuel Additives Samples. Rancitelli, L. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** E601B-17. **Contract:** D7-0473. **Supported by:** Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab. **Funding:** EPA.
Related energy source: coal(34); oil and gas(33); nuclear fuels(general)(33). **R and D categories:** Integrated assessment.

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.
Keywords: FUELS; FUEL ADDITIVES; ACTIVATION ANALYSIS; NEUTRON REACTIONS; ELEMENTS; TRACE AMOUNTS.

71225 Inhaled Particulate Matter Network. Rodes, C.E. (EPA, Office of Research and Development, Environmental Monitoring and Support Lab., Research Triangle Park, NC, 27711). **Project number:** E601B-20. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$400,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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 methods with respirable sampler.
Keywords: PARTICLES; AEROSOLS; INHALATION; HEALTH HAZARDS; AIR POLLUTION ABATEMENT; STANDARDS.

71226 Inhaled Particulate Matter Network. Weaver, R. (Systems Research and Development Corp., 3022 Chapel Hill Road, P.O. Box 12221, Research Triangle Park, NC). **Project number:** E601B-21. **Contract:** 68-02-2449. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$40,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives are to expand current data handling capabilities and to process incoming data from the inhaled particulate matter network. Outputs are to be in the form of quarterly and annual reports summarizing the data. Trial tests of current systems have been completed by the contractor and they can handle existing data formats. Systems analysis on siting expansion has been completed and programming has begun. Systems analysis of raw data file is scheduled to begin in August.
Keywords: AEROSOLS; INHALATION; DATA ACQUISITION SYSTEMS; SYSTEMS ANALYSIS; AIR POLLUTION; COMPUTER CODES; SULFATES; NITRATES; CARBON OXIDES; DUSTS; ENVIRONMENTAL TRANSPORT; DATA ANALYSIS.

71227 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-22. **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: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objectives are to develop analytical methodology and serve as a referee laboratory on matrices of an 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 will be provided.
Keywords: FUELS; FUEL ADDITIVES; EVALUATION; BIOLOGICAL MATERIALS; COMBUSTION; MASS SPECTROSCOPY; ISOTOPE DILUTION; GAS CHROMATOGRAPHY; ION MICROPROBE ANALYSIS; ELECTRON SCANNING; CHEMICAL ANALYSIS.

71307 Miniplant Studies in Support of the Fluidized-Bed Combustion Program. Bertrand, R.R. (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:** Physical and chemical processes and effects.

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 IM-

PACTS; REGENERATION; SULFUR DIOXIDE; NITROGEN OXIDES; AIR FILTERS.

71318 Demetallization of Residual Oils, Phase V: Denitrogenation Catalyst Evaluation. Kang, C.C. (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: oil shales and tar sands(100). **R and D categories:** Physical and chemical processes and effects.

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.

71319 Environmental Assessment of Coal Liquefaction. Emerson, D.B. (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 and chemical processes and effects; Integrated assessment; Health effects.

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.

71326 Measurement of High-Temperature, High-Pressure Processes. Masters, W. (Acurex Corp., Aerotherm Division, 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** F623A-26. **Contract:** 68-02-2153. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$98,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The objective is to develop measurement techniques to generate engineering data for environmental assessment and control technology development projects evaluating high-temperature, high-pressure processes. The process of interest is high-pressure fluidized bed combustion. EPA in-house research projects will be supported through review of program plans and test plans in the area of high-temperature, high-pressure processes. A summary report will be published which includes an assessment of the current state of the art in high-temperature, high-pressure (HTHP) measurements. The major output from this program has been the successful demonstration of a HTHP sampling system on an operating pressurized fluidized bed combustor (FBC). Two separate tests were conducted. In the first test, a cascade impactor was used to determine the particle size distribution in the high-pressure process stream of the FBC. The chemical composition of major species was determined for the size fractionated particulate by x-ray fluorescence. A second test was conducted to determine if particle condensation occurred between the process temperature of 500 degrees C and the impactor operating temperature of 200 degrees C. The data indicates that condensation is not a problem.
Keywords: FLUIDIZED-BED COMBUSTION; ENVIRONMENTAL IMPACTS; PARTICLE SIZE; HIGH TEMPERATURE; HIGH PRESSURE; FLUIDIZED-BED COMBUSTORS; COAL.

71332 Use of Electrostatically Charged Fog for Control of Dust from Open Sources. Hoenig, S.A. (University of Arizona, Department of Electrical Engineering, Tucson, AZ, 85721). **Project number:** F623A-34. **Contract:** R805228. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$106,000.
Related energy source: coal(100).

The objectives are to continue the studies of industrial dusts and fumes and the development and apparatus for inducing these pollutants to agglomerate and fall out, and 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. University of Arizona will make appropriate industrial measurements and studies to evaluate charging and dust control techniques in the factory environment. It has been demonstrated that these dusts and fumes can be induced to agglomerate and fall out when exposed to properly charged water fog. A numebr of industrial tests are underway to test prototype fog generators as mechanisms for dust control. 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: FOG; ELECTROSTATIC PRECIPITATORS; PARTICLES; AEROSOLS; FLY ASH; POLLUTION CONTROL EQUIPMENT; PERFORMANCE TESTING; COAL; POWER PLANTS; COKE; AIR POLLUTION.

71370 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:** Characterization, measurement, and monitoring.

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.

71371 Sulfur Dioxide Oxidation in Scrubber Systems. Hudson, J.L. (University of Virginia, Department of Chemical Engineering, Garrett Hall, Charlottesville, VA, 22903). **Project number:** F624A-046. **Contract:** R805227-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$89,000.
Related energy source: coal(100).

The objective is to perform a laboratory study to measure the oxidation kinetics of solutions and slurries of calcium sulfite. Using stirred reactors and flow reactors, the effects of solid dissolution, pH, temperature, concentration, and catalysts will be determined within the ranges experienced in lime/limestone FGD scrubbers. A mathematical model relating the principal process variables to SO2 oxidation in FGD scrubbers will be published as a final report in 1979. Batch reactor experiments show some effect of solid dissoluion on the overall oxidation rate of slurries of pH 4.5. The observed rates are higher than those reported by Soviet investigators at similar

conditions. This study shows a slurry oxidation rate of 6 x 10/sup -3/ mol/1 min at pH 5.3 and 40 degrees C.
Keywords: SCRUBBERS; SULFUR DIOXIDE; OXIDATION; CALCIUM COMPOUNDS; SLURRIES; CHEMICAL REACTION KINETICS; MATHEMATICAL MODELS; FLUE GAS; DESULFURIZATION; PERFORMANCE; AIR POLLUTION CONTROL.

71379 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: all(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

71416 Reduction of Hydrocarbon Emissions from Storage Tanks. Gunther, A. (Stop Los Co., 29 Lorelei Road, West Orange, NJ, 07052). **Project number:** F604B-302. **Contract:** 68-02-2679. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$36,000.

Objectives include the construction and evaluation on a pilot scale of a technology for achieving greater than 95% reduction in emissions from storage tanks compared to an uncontrolled fixed roof tank. Two 1200 gallon storage tanks are to be fitted with flexible plastic barriers, filled with a volatile organic material, and subjected to filling-emptying cycles equivalent to 20 years of service. The pilot unit has been installed, the initial shake-down completed, and the demonstration phase has begun.**Keywords:** HYDROCARBONS; VAPORS; STORAGE; AIR POLLUTION CONTROL.

71417 Assessment of Environmental Emissions from Oil Refining. Mesich, F. (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.

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.

71418 Source Assessment Program. Binning, R. (Monsanto Research Corp., 1515 Nicholas Road, Box 8, Dayton, OH). **Project number:** F610B-09. **Contract:** 68-02-1874. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$989,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

The project objectives are to quantify and verify discharges to the environment from a variety of industrial sources. The discharge concentrations are compared to estimated risk levels in the environment. Source assessment is a problem definition activity. Stationary sources in this category have been ranked in order of priority based on their potential for environmental damage. This potential is tested for validity for each of the source types in order of priority. Products include emissions reports which can be used by various groups, and environmental risk comparisons which can be used to judge the need to reduce the emissions to acceptable levels. Eight reports have been issued describing priority methodology, data base description, data accuracy requirements, and decision-making methodology. Thirty-one industry reports have been issued. Twenty-nine of the thirty-one have emissions levels which, according to the program criteria, should be reduced.
Keywords: INDUSTRIAL WASTES; ENVIRONMENTAL IMPACTS; RISK ASSESSMENT; ENERGY CONVERSION; STATIONARY POLLUTANT SOURCES; CHEMICAL EFFLUENTS; POLLUTION.

71419 New Concept for Fine Particle Control at High Temperature and Pressure. Calvert, S. (Air Pollution Technology, Inc., 4901 Morena Blvd., Suite 402, San Diego, CA). **Project number:** F623A-032. **Contract:** 68-02-2164. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$200,000.
Related energy source: coal(100).

The development of advanced energy sources such as coal and shale oil gasification result in high temperature and pressure process gas streams which require removal of particulates before utilization. The objective of this research is to evaluate a novel concept for fine particle control in these systems. The apparatus would collect fine particles by mechanisms such as diffusions, inertial impaction, interception and electrophoresis. A preliminary evaluation of the new concept will be performed, followed by experimental verification of fine particle collection. Presently theoretical calculations are being performed for mechanisms involved in particle collection and system regeneration. The power and residence time requirements for particle capture will be predicted for the most promising mechanisms. Based on these calculations, preliminary bench-scale experiments will be performed to demonstrate the feasibility of fine particle capture in the proposed particle collection system. This will be followed by the economic analysis and recommendations. The second phase of the project will consist of the construction and testing of a model of the new concept with at leat 500 scfm capacity. APT has proven feasibility of the dry scrubber concept for control of particulate at high temperature and pressure.
Keywords: AEROSOLS; CONTROL; COAL GASIFICATION; OIL SHALE INDUSTRY; COAL INDUSTRY; AIR POLLUTION CONTROL.

71420 Fine Particle Sizing Spectrometer. Knollenberg, R. (Particle Measuring Systems, 5469 Western Avenue, Boulder, CO, 80301). **Project number:** F623A-25. **Contract:** 68-02-2668. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring.

This project will design, develop, and demonstrate an in-situ instrument for real time particle sizing in stationary sources. The instrument under development will use light scattering to optically size particles in the range 0.4 to 10.0 micrometers. A field demonstrated prototype instrument will be delivered if the program is successful. A final report will be published. The laboratory evaluation has been completed with good results. Calibration using latex spheres and glass beads showed agreement to within 10% of the calculated values. Preliminary testing at a coal fired power plant showed that the instrument performed well in the stack. The size data obtained was deemed to be reasonable for plants, although no comparative measurements were made.
Keywords: PARTICLE SIZE; SPECTROMETERS; AEROSOLS; MONITORING; STATIONARY POLLUTANT SOURCES; PARTICLES; FOSSIL-FUEL POWER PLANTS; FLY ASH; PHYSICAL PROPERTIES.

71421 Design and Construction of a Gas Cleaning Test Facility. Thomas, R. (Acurex Corp., 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** F623A-301. **Contract:** 68-02-2157. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$239,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective is to design and construct a bench scale gasifier and gas cleaning facility. North Carolina State University will operate the gas cleaning test facility to determine operating characteristics and environmental impact of raw and acid gas cleanup systems for coal gasification. The facility has been designed and constructed. It is undergoing shakedown and acceptance test runs in the summer of 1978 with completion scheduled for October 1978.
Keywords: COAL GASIFICATION; FUEL GAS; CLEANING; COAL GAS; TEST FACILITIES; ENVIRONMENTAL IMPACTS.

71422 Fuel Gas Environmental Impact Study. Robson, F.L. (United Technologies Corp., Research Center, 400 Main Street, East Hartford, CT, 06108). **Project number:** F623A-309. **Contract:** 68-02-2179. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$19,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

United Technologies Research Center sought further investigation and definition of potential environmental and economic benefits of integrated coal gasification/gas cleanup/combined gas and steam cycle power plants. Major generic types of gasifiers are examined along with high and low temperature cleanup before advanced power cycles. Modelling techniques are applied to yield comparable integrated systems. The final report from this study

compares integrated power plants using advanced combined-cycle power systems. Emphasis is on low levels of resultant sulfur and nitrogen oxide emissions. Trace elements are also discussed. Comparisons made of integrated plants using air- and oxygen-blown gasifiers favor airblowing. Careful theoretical design of plants with low temperature sulfur cleanup reduces to marginal levels the performance and cost advantages of plants with high temperature cleanup. If gasifier steam feed rates are kept low in all but fixed bed types, choice of gasifier among other generic types is not critical to achieving attractive systems using low temperature cleanup. Excessive thermal NOx emissions may be avoided by departing from conventional combustor designs. Fuel NOx and particulates still pose problems with use of high temperature cleanup. Sulfur removal to very low levels is possible with integrated systems, but cost rises rapidly as it becomes necessary to remove most of the COS as well as the H2S.
Keywords: COAL GASIFICATION; FUEL GAS; CLEANING; ENVIRONMENTAL IMPACTS; COMBINED-CYCLE POWER PLANTS.

71423 Test and Evaluation of a Coal Gasifier--Gas Cleaning Facility. Ferrell, J.K. (North Carolina State University, Department of Chemical Engineering, Raleigh, NC, 27607). **Project number:** F623A-311. **Contract:** R804811. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$508,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The project seeks to determine the performance characteristics and the environmental impact of typical coal gasification and gas cleanup processes. Of special interest are the effects of processes used for raw gas cleaning and low temperature acid gas removal. The tests and evaluations include three areas of work: measurements and characterizations of emissios from the facility by means of sampling and analyses, material balances and evaluation of data; development and testing of models; and construction and operation of bench-scale rigs for supporting studies of process fundamentals. Of special note are comparative data on acid gas removal techniques. These data will be free from proprietary restrictions and of general use to the scientific community. Facility design, construction, and startup/shakedown are nearing completion. In anticipation of acceptance of the facility by EPA for use by North Carolina State University, testing on surrogate samples and development of procedures for operation, sampling and analysis have been done to date.
Keywords: COAL GASIFICATION; FUEL GAS; CLEANING; PERFORMANCE TESTING; TEST FACILITIES.

71424 Mineral Matter in Coal. Russell, S.J. (State Geological Survey, Coal Section, Natural Resources Building, Urbana, IL, 61801). **Project number:** F623A-312. **Contract:** R804403. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$56,000.
Related energy source: coal(100).

The objective of this project is to provide basic data on mineralogic constituents and trace element affinities in coals, primarily of the Illinois Basin. The outputs of this work include reports and articles on pollutants in coal, evaluations of their stability, and determinations of the mechanisms by which they can be released to the environment.
Keywords: COAL; CHEMICAL COMPOSITION; ELEMENTS; TRACE AMOUNTS; MINERALS.

71425 Coal Cleaning Technology Evaluation and Development. Shaver, R. (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).

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.

71426 Experimental and Engineering Support of the Fluidized Bed Combustion Program. Keairns, D.L. (Westinghouse Electric Corp., Research and Development Center, 3 Gateway Center, Pittsburgh, PA, 15222). **Project number:** F623A-336. **Contract:** 68-02-2132. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$337,000.
Related energy source: coal(100).

The objective is to provide engineering and small scale experimental support to the EPA fluidized-bed combustion program in the areas of: SO2 control with calcium-based and alternate sorbents; NOx control; particulates characterization; trace constituents emissions; solid residue disposal; and general engineering support. Outputs will include improved environmental understanding of fluidized-bed combustions, and thus an improved position to support environmental standards. Laboratory-scale experimental studies in support of the EPA fluidized-bed combustion program have resulted in engineering evaluations of a wide variety of subjects on the fluidized-bed combustion program to assess technical and economical feasibility of various factors associated with the fluidized-bed combustion process and to identify problem areas and data gaps.
Keywords: FLUIDIZED-BED COMBUSTION; FLUIDIZED-BED COMBUSTORS; FEASIBILITY STUDIES; SULFUR DIOXIDE; AIR POLLUTION CONTROL; WASTE DISPOSAL; FLUE GAS; NITROGEN OXIDES; RESEARCH PROGRAMS; DESULFURIZATION; DENITRIFICATION; POLLUTION CONTROL EQUIPMENT.

71427 Design and Fabrication of an Electrostatic Precipitator. Rinard, G. (University of Denver, Denver Research Inst., University Park, Denver, CO, 80210). **Project number:** F623A-337. **Contract:** 68-02-2682. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$125,000.
Related energy source: coal(100).

The objective is to design and construct an electrostatic precipitator (ESP) to clean a flue gas stream under the following conditions: 400 ACFM at 500 degrees F, maximum operating temperature of 850 degrees F. The ESP unit must be flexible and be representative of a unit that would be used by a large coal fired utility.
Keywords: ELECTROSTATIC PRECIPITATORS; DESIGN; FABRICATION; AEROSOLS; REMOVAL; FOSSIL-FUEL POWER PLANTS; FLUE GAS; CLEANING.

71428 Process Automation Investigations for Environmental Process Control. Garrett, P. (University of Cincinnati, School of Engineering, Department of Electronic Engineering, 101 Baldwin Hall, Cincinnati, OH, 45221). **Project number:** F623A-374. **Contract:** R805758. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$39,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The primary objective of this project is the investigation and application of process automation methods to environmental control processes. Subordinate objectives will be the contribution to improvement in acknowledged problems associated with the implementation of process automation methods. This effort will support IERL projects that require data acquisition and automatic control. Specific systems will be evaluated for selected control processes. The benefits obtained with the reductions in the variance of the controlled process variables will be better understood. Preliminary investigations of the limestone scrubber system has resulted in a recommendation for a control scheme that will assure high utilization of limestone in order to prevent scaling. The initial system will be based on a rcliable pH sensor.
Keywords: AUTOMATION; LIMESTONE; PH VALUE; AIR POLLUTION ABATEMENT; SCRUBBERS; SULFUR OXIDES; NITROGEN OXIDES; PARTICLES; AEROSOLS; DUSTS; PROCESS CONTROL; SCRUBBING; REMOVAL.

71429 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, Department of Environmental Science, 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:** Physical and chemical processes and effects; Health effects.

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 identifica-

tion 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 synthctic and real coal processing waters.
Keywords: WASTE WATER; ENVIRONMENTAL IMPACTS; SYNTHETIC FUELS; BIODEGRADATION; TOXICITY; COAL GASIFICATION; COAL LIQUEFACTION; WASTE PROCESSING.

71430 Development of Criteria for Extension of Applicability of Low-Emission, High-Efficiency Coal Burners. Nurick, W.H. (Energy and Environmental Research Corp., 8001 Irvine Blvd., Santa Ana, CA, 92705). **Project number:** F624A-005. **Contract:** 68-02-2667. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$900,000.
Related energy source: coal(100).

The objective of this study is to extend the applicability of advanced pulverized coal burner concepts to the full range of U.S. coals and to a variety of boiler firing configurations. The approach utilizes several scales of combustion systems to derive scale-up criteria for burners of practical size. The effects of fuel characteristics and burner design parameters are studied in a systematic fashion for a wide range of coal types. Inflame probing is used to extend the understanding of critical processes in coal combustion. Burner concepts that show promise are tested on a practical scale (120 x 10 to the 6th power Btu/hr). Results to date show that NOx emissions less than 0.2 lbs per 10 to the 6th power Btu can be achieved for several coals at a scale of 50 x 10 to the 6th power Btu/hr. A small-scale argon furnace has shown that for the same flame conditions, several coals give significantly different NOx levels.
Keywords: BURNERS; COAL; COMBUSTION; EFFICIENCY; NITROGEN OXIDES; AIR POLLUTION; DESIGN.

71431 Environmental Assessment of Stationary Source NOx Control Technologies. Mason, H.B. (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: all(100).

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.

71432 Field Testing: Application of Improved Combustion Technology to Power Generation Combustion Systems. Crawford, A.R. (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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

71433 Fundamental Combustion Research Applied to Pollution Control. Tyson, T.J. (Ultrasystems, Inc., 8001 Irvine Blvd., East Irvine, CA, 92650). **Project number:** F624A-016. **Contract:** 68-02-2631. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$893,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring.

This contract involves the formulation and execution of a comprehensive fundamental combustion research program to provide additional insight into the features of combustion controlling the formation of pollutants in flames. In formulating the program, primary emphasis is placed upon critically selecting tasks which will maximize the impact of fundamental combustion research (FCR) on commercial realization of pollution control technology. Execution of the program requires coordination with other elements of the EPA Combustion Research Program, and work being sponsored by other government agencies and by industry. Included in the program are studies of chemical kinetics, combustion aerodynamics, numerical modelling, and direct application of FCR to current problems in the fuels R and D, process R and D or field testing sections of the EPA Combustion Research Program. Additionally, a significant amount of subcontracted work is planned in order to utilize the talents, expertise and equipment at the various research establishments throughout the country.
Keywords: COMBUSTION KINETICS; AIR POLLUTION CONTROL; TECHNOLOGY ASSESSMENT; FLAME PROPAGATION; RESEARCH PROGRAMS; EXPERIMENT PLANNING; NITROGEN OXIDES; CARBON OXIDES; PARTICLES; AEROSOLS.

71434 Investigation of NOx, Nitrate and Sulfate Formation in Laboratory Flames. Seery, D.J. (United Technologies Corp., Kinetics and Environmental Sciences Section, 400 Main Street, East Hartford, CT, 06108). **Project number:** F624A-017. **Contract:** 68-02-2188. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$37,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring.

The current objective of this study is to investigate the influence of probe designs on the indicated concentration of combustion products and pollutant species in laboratory flames. Of primary concern is determination of the extent of species conversion within the probe to compounds other than those existing in the flame. The approach to this study has been to probe laboratory flames with a variety of microprobe designs to measure species concentrations and to compare those measurements with concentrations determined by molecular beam/mass spectrometry and optical spectroscopy techniques. Results to date show that the microprobe can be an accurate technique for making the required species measurements.
Keywords: NITRATES; SULFATES; NITROGEN OXIDES; FLAMES; COMBUSTION PRODUCTS; CHEMICAL REACTION YIELD.

71435 Advanced Combustion Systems for Stationary Gas Turbine Engines. Mosier, S.A. (United Technologies Corp., Pratt and Whitney Aircraft Group, P.O. Box 2691, West Palm Beach, FL, 33402). **Project number:** F624A-018. **Contract:** 68-02-2136. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$300,000.
Related energy source: oil and gas(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring.

An exploratory development program of analysis and experimentation will be conducted to identify new stationary gas turbine combustion designs which reduce pollutant emissions. Primary emphasis will be placed upon control of the oxides of nitrogen (NOx) from both the thermal and fuel-bound sources, via dry techniques, while at least maintaining current control of carbon monoxide (CO) and unburned hydrocarbon (UHC). The program is divided into four phases: (1) a review of the various combustor design approaches; (2) screening experiments of the various techniques; (3) design of full-scale combustors for a nominally 25 Mw stationary gas turbine engine; and (4) evaluation of the full-scale combustors in both test rings and in an engine. Through the performance of all four phases,

the NOx concentration goals for the combustor designs are 50 ppMV when burning gas or oil containing no more than trace quantities of bound nitrogen and 100 ppMV when burning oil containing up to 0.5 percent (by weight) of chemically bound nitrogen. The CO concentration goal is 100 ppMV regardless of the fuel type. Current status of the program is that a new combustor concept involving a fuel rich primary followed by a quick quench of the first stage products has met or exceeded all program goals in the bench-scale testing of Phase II. Full-scale hardware is being built for testing later this year.
Keywords: GAS TURBINE ENGINES; DESIGN; EXHAUST GASES; NITROGEN OXIDES; CARBON MONOXIDE; HYDROCARBONS; AIR POLLUTION ABATEMENT; COMBUSTORS.

71436 Effects of Fuel Properties and Atomization Parameters on NOx Control for Heavy Liquid Fuel-Fired Package Boilers. Heap, M.P. (Energy and Environmental Research Corp., 8001 Irvine Blvd., Santa Ana, CA, 92705). **Project number:** F624A-026. **Contract:** 68-02-2624. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring.

Combustion air staging has been demonstrated to be a viable technique for the control of NOx emissions from residual oil-fired package boilers. However, the reduction in oxides of nitrogen can be accompanied by an increase in carbonaceous particulate matter which eventually limits the amount of staging and thus the control of NOx. The formation of both pollutants is strongly linked to the fuel/air mixing process and the properties of the fuel. The overall objective of this program is to define the effect of fuel atomization techniques and of fuel properties on pollutant emissions. Commercially available fuel atomizers will be surveyed and their characteristic features defined. The influence of various crude oil properties and the petroleum refining process on the characteristics of residual fuel oils will be explored. The bulk of the program involves a series of experiments with a package boiler simulator to define the influence of various atomizers and fuel characteristics on pollutant formation. Two additional experiments are planned to aid in the interpretation of the experimental results generated by the package boiler simulator. These involve two specially built experimental systems to define the conversion of fuel-bound nitrogen to oxides of nitrogen and to characterize the details of the fuel spray under realistic conditions. Results to date have shown that for a given flow field and fuel, the NOx and smoke emissions can be significantly altered by changes in the fuel atomizer characteristics. For a given atomizer type a major influence of fuel characteristics has been observed. A range of fuels and atomizers have already been evaluated, but the results indicate the need for further evaluation of fuel types.
Keywords: LIQUID FUELS; ATOMIZATION; NITROGEN OXIDES; CONTROL; RESIDUAL FUELS; FUEL-AIR RATIO; AIR POLLUTION; BOILERS; BOILER FUEL; EVALUATION; PARTICLES.

71437 Development of Catalyst and System Design Criteria for Catalytic Combustors with Application to Stationary Sources. Kendall, R.M. (Acurex Corp., Energy and Environmental Division, 485 Clyde Avenue, Mountain View, CA, 94042). **Project number:** F624A-027. **Contract:** 68-02-2116. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$19,000.
Related energy source: all(100).

The objective of this program is to establish design criteria for application of catalytic combustion to low-emission, high-efficiency stationary combustion systems. To accomplish this, a research and development program consisting of experimental small-scale catalyst and combustor concept screening, experimental and theoretical scale-up work for promising concepts, and design development of prototype systems based on selected concepts has been completed. The major results include: (1) identification of the graded cell catalyst configuration as having the potential for high-energy release rates and operating capabilities to 3100 degrees F; (2) experimental scale-up of the catalyst technology by a factor of 10 based on energy release; (3) development of a radiative watertube concept for potential application to watertube boilers burning clean fuels at high thermal efficiency with emissions of NOx, CO and HC of less than 10 ppM; and (4) development of a cataytic staged combustion concept capable of 90% control of fuel NOx from model fuel nitrogen compounds.
Keywords: CATALYTIC COMBUSTORS; AIR POLLUTION CONTROL; BOILERS; NITROGEN OXIDES; CARBON MONOXIDE; HYDROCARBONS; BOILER FUEL; FLUE GAS; DESIGN.

71438 Evaluation of Fundamental Combustion Phenomena. Lanier, W.S. (EPA, Office of Research and Development, Combustion Research Branch, Research Triangle Park, NC, 27711). **Project number:** F624A-028. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This in-house research program is directed toward defining the interaction of external combustor and burner variables on the flow field structure and pollution formation process. The primary pollutants of concern are NOx, CO, unburned hydrocarbon and smoke or particulate. The approach is to utilize a laser Doppler velocimeter to map velocity and turbulence measurements in the furnace flow fields and to map out the flow field specie concentration fields using standard sampling techniques. Combution conditions to be investigated will include a range of burner confinement ratios, air swirl levels and distributions, fuels, and most importantly, special tests to precisely locate the position of heat release and rate of heat release. The project is currently at the point of final instrumentation checkout. The LDV system is operational and the standard sampling techniques are on-line. The combustion facility is also under preparation and final checkout.
Keywords: NITROGEN OXIDES; CARBON MONOXIDE; HYDROCARBONS; PARTICLES; SMOKES; COMBUSTION PRODUCTS; TURBULENCE; COMBUSTORS.

71439 Characterization of Emission and Combustion Performance of Alternate Fuels. Martin, G.B. (EPA, Office of Research and Development, Combustion Research Branch, Research Triangle Park, NC, 27711). **Project number:** F624A-031. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: oil and gas(50); oil shales and tar sands(50).

The objective of this project is to evaluate emission performance of alternate fuels and advanced concept control techniques. This evaluation provides an initial assessment of problems and/or promise of different technology approaches. The study utilizes a 300,000 Btu/hr versatile experimental furnace for comparison of alternate fuel performance to previously established baselines for conventional fuel. The basic furnace allows for burner design changes as well as staged combustion and flue gas recirculation. To date the project has evaluated: (1) fuel nitrogen conversion and control techniques for liquid fuels, and (2) alcohol fuels. The effectiveness of staged combustion for fuel NOx control has been evaluated as a function of: (1) fuel nitrogen level, (2) first stage stoichiometry, (3) first stage residence time, (4) air preheat, and (5) fuel sulfur.
Keywords: COMBUSTION; AIR POLLUTION; PERFORMANCE TESTING; BURNERS; LIQUID FUELS; NITROGEN; ALCOHOL FUELS; NITROGEN OXIDES; SULFUR; SYNTHETIC FUELS.

71440 Characterization and Design Evaluation for Commercial Combustion Systems. Hall, R.E. (EPA, Office of Research and Development, Combustion Research Branch, Research Triangle Park, NC, 27711). **Project number:** F624A-032. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

This in-house project is designed to provide the capability for fast response testing of commercially available and prototype combustion equipment and combustion improving devices. Measurements include oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbons, oxygen, carbon dioxide, smoke, and particulates (mass and size distribution). In some tests trace specie and efficiency measurements are made. Test equipment includes a residential warm-air furnace rated at 100,000 Btu/hr, a Scotch marine package firetube boiler rated at 2,400,000 Btu/hr, and a firebox firetube package boiler rated at 1,440,000 Btu/hr. Various burner designs are tested in these units. Fuels include natural gas, distillate oil, and low sulfur residual oil. Expected outputs include evaluations of water-in-oil emulsions, prototype or commercially available residential burners. Results to date have shown that water/oil emulsions can significantly reduce particulate mass emission levels without much effect on emissions of CO, HC, or NOx. The efficiency of a well adjusted burner is not significantly affected but on a poorly adjusted burner, efficiency can be improved by using water/oil emulsions.
Keywords: PERFORMANCE TESTING; SULFUR OXIDES; NITROGEN OXIDES; CARBON MONOXIDE; HYDROCARBONS; CARBON DIOXIDE; OXYGEN; NATURAL GAS; FUEL OILS; BOILERS; BURNERS; EMULSIONS; AIR POLLUTION CONTROL; FURNACES; FLUE GAS.

71441 Bench-Scale Evaluation of Simultaneous NOx/SOx Flue Gas Treatment Technology. Pohlenz, J.B. (Universal Oil Products Co., Process Division, 10 U.O.P. Plaza, Algonquin and Mt. Prospec, Des Plaines, IL). **Project number:** F624A-035. **Contract:** 68-02-2676. **Supported by:** Environmental Protection Agency, Research Triangle

Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$1,000.
Related energy source: coal(100). **R and D categories:** Integratcd assessment.

The objective of this project is to demonstrate on a bench-scale the feasibility of removing 90% of the NOx and SOx from combustion flue gas off an existing 0.6 Mw pilot plant which employs a utility boiler. An existing pilot plant (0.6 Mw) located at the Big Bend Station of Tampa Electric Company is to be modified to provide for the simultaneous reduction of sulfur and nitrogen oxides in flue gas from a coal-fired utility boiler. The objective is a 90-day test during which both SOx and NOx will be reduced by 90%. The design is based on the Shell flue gas treating (SFGT) process and uses a solid acceptor material containing copper oxide which is converted to copper sulfate. The process is dry and cyclic; as desulfurization proceeds, the SOx removal efficiency decreases and the loaded acceptor is regenerated in situ with diluted hydrogen to produced an SO2-rich off-gas. Two or more reactors are used in swing operation to achieve continuous desulfurization. The sulfated acceptor catalyzes the selective reduction of NOx and NH3 to nitrogen and water, therefore providing a basis for NOx reduction which is independent of desulfurization performance. Contact between flue gas and acceptor/catalyst occurs by radial diffusion in a parallel-passage reactor which operates effectively on flue gas with a full loading of flyash. The project will enable progress toward full-scale demonstration of NOx/SOx flue gas treatment technology. The technology will be applicable to large, stationary combustion sources.
Keywords: BENCH-SCALE EXPERIMENTS; NITROGEN OXIDES; SULFUR OXIDES; FLUE GAS; DENITRIFICATION; DESULFURIZATION; FOSSIL-FUEL POWER PLANTS; COAL; BOILERS; AIR POLLUTION CONTROL.

71442 Bench-Scale Evaluation of NOx Flue Gas Treatment Technology. Inaba, H. (Hitachi Zosen, 100, 1-1 Hitotsubashi 1, Chiyoda-ku, Tokyo, Japan). **Project number:** F624A-036. **Contract:** 68-02-2675. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$1,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The objective of this project is to demonstrate on a bench-scale the feasibility of removing 90% of the NOx from combustion flue gas of a coal-fired source in the presence of low and high SOx concentrations. The pilot plant shall be used to demonstrate Hitachi Zosen's catalytic reduction process for the treatment of flue gas with ammonia for the removal of nitrogen oxides, particularly to prove the performance of catalysts which have been developed by Hitachi Zosen for flue gas of high sulfur oxide and dust content, exhausted from coal-fired boilers. The pilot plant will be installed at the Mitchell Station of Georgia Power Co. in Albany, Georgia, and will have a capacity of about 1000 standard cubic feet per minute. It is planned to operate the pilot plant for about six months. The prime American subcontractor will be Chemico Air Pollution Control Corporation, a division of the Envirotech Corporation. The project will enable progress toward full-scale demonstration of NOx flue gas treatment technology. The technology will be applicable to large, stationary combustion sources.
Keywords: FOSSIL-FUEL POWER PLANTS; FLUE GAS; DENITRIFICATION; COAL; BOILERS; POLLUTION CONTROL EQUIPMENT; AIR POLLUTION CONTROL; NITROGEN OXIDES; FEASIBILITY STUDIES; DEMONSTRATION PROGRAMS; CATALYSTS; BENCH-SCALE EXPERIMENTS.

71443 Disposal of By-Products from Nonregenerable Flue Gas Desulfurization Systems. Rossoff, J. (Aerospace Corp., Environment and Energy Conservation Division, P.O. Box 95085, Los Angeles, CA, 90045). **Project number:** F624A-041. **Contract:** 68-02-2633. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$245,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective of the program is to evaluate techniques for the environmentally sound disposal of wastes from power plant nonregenerable flue gas desulfurization systems. Wastes from prototype scrubbers at the TVA Shawnee Power Station at Paducah, Kentucky, have been placed in eight ponds nearby. Two ponds contain untreated waste (one with limestone waste and one with lime), three ponds contain chemically treated waste (two limestone and one lime), and two ponds contain untreated waste with an underdrain (one lime and one limestone). An additional pond has been filled with oxidized sulfite waste (gypsum) which was piled in a mound above ground. Through periodic sampling and analysis of water, soil and sludge materials, an assessment is being made of current disposal technology. Engineering cost estimates for the alternative approaches are also being developed. Field studies have shown that the soluble salt leachate concentration of treated sludge is typically one half or less than that of untreated sludge. Furthermore, treated sludge has been shown to have permeabilities of up to one order of magnitude lower than untreated sludge and to exhibit far superior short-term structural stability.
Keywords: FLUE GAS; DESULFURIZATION; BY-PRODUCTS; WASTE DISPOSAL; COST; FOSSIL-FUEL POWER PLANTS; SLUDGES.

71445 Demonstration of Baghouse for Collection of Fly Ash from Low-Sulfur Coal. Ladd, K. (Southwestern Public Service Co., P.O. Box 1261, Amarillo, TX, 79105). **Project number:** F624A-059. **Contract:** 68-02-2659. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$1,282,000.
Related energy source: coal(100).

The objectives are to demonstrate the effectiveness of a baghouse for collection of fly ash from a power plant burning low-sulfur western coal; operate a full-scale baghouse for one year and collect information on operation, performance, cost, maintenance, and problems associated with the baghouse on a 350 Mw boiler; and conduct limited tests over an extended period (5 years) to evaluate the long-term effects on a baghouse on this source. The final output will be a demonstrated technology for control of power plants burning low-sulfur western coal. The baghousc was put into operation on June 21, 1978.
Keywords: FOSSIL-FUEL POWER PLANTS; BAGHOUSES; FLY ASH; PERFORMANCE; COST; OPERATION.

71446 Demonstration of Novel Fine Particulate Collection System. Norman, D. (Air Pollution Systems, Inc., 18642 68th Avenue South, Kent, WA, 98031). **Project number:** F624A-065. **Contract:** 68-02-2666. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.

The objectives are to: demonstrate at pilot scale the technical and economic feasibility of a novel particulate collection system for control of fine particulate emissions from industrial sources; select a novel particulate collection system which has promise for efficient fine particle collection; and design, fabricate, install and test this system on a fine particulate source. A new fine particulate control technology will be demonstrated. Air Pollution Systems was selected to demonstrate at pilot scale their electrostatic scrubber. A site has been selected for this evaluation on a magnesium recovery furnace. Design of the scrubber is underway.**Keywords:** PARTICLES; AEROSOLS; PILOT PLANTS; FEASIBILITY STUDIES; ECONOMICS; DESIGN; FABRICATION; PERFORMANCE TESTING; AIR POLLUTION CONTROL; MAGNESIUM; SCRUBBERS; FURNACES; RECOVERY; FLUE GAS.

71447 Coal Technology Assessment (CTA). Davidson, R.S. (Battelle Columbus Laboratories, 505 King Avenue, Columbus, OH, 43201). **Project number:** F624A-078. **Contract:** 68-02-2672. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$601,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The overall objectives are to identify environmentally, socially and economically acceptable alternatives for meeting national energy supply objectives, and to assist in the selection of optimum policies for the attainment of associated environmental quality goals. The approaches used to meet the overall objectives are: (1) integrating the results of the environmental research program with the remainder of the energy research program; (2) evaluating the cost/risk/benefit trade-offs of energy production and pollution control alternatives; (3) conducting technology assessments which evaluate alternative energy technologies and approaches for implementing energy development, preventing environmental damage, and securing related benefits; and (4) identifying gaps in present research programs and indicating new priority research topics which must be addressed in order to support direct agency responsibilities.
Keywords: ENERGY POLICY; TECHNOLOGY ASSESSMENT; COST BENEFIT ANALYSIS; COAL; ENERGY SOURCE DEVELOPMENT; PLANNING.

71448 Effect of Fuel Sulfur on Nitrogen Oxide Formation in Combustion. Wendt, J.O. (University of Arizona, Department of Chemical Engineering, Tucson, AZ, 85721). **Project number:** F624A-322. **Contract:** R803715. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring.

This study seeks to quantify the extent and mechanisms of interaction between SOx formation and NOx formation processes. It is also a part of this study to define under what combustion conditions such an interaction can be of first order importance and how the interactions can be utilized for enhanced NOx control. The

approach is to utilize a laminar flat flame burner, an opposed jet diffusion flame, and a turbulent diffusion flame under a variety of combustion conditions and fuel dopant levels to quantify the extent of interaction. Detailed flame measurements are being made to gain mechanistic insight. Under fuel rich conditions, as found in staged combustion and in the early region of a turbulent jet diffusion flame, a major enhancement has been observed on the conversion of fuel bound nitrogen to NOx when sulfur is added to the fuel. Work is continuing to determine if this effect is to limit formation of N2 from the fuel oxidation or is an interchange of NO with reduced nitrogen compounds such as ammonia or hydrogen cyanide.
Keywords: NITROGEN OXIDES; CONTROL; FLAMES; SULFUR; SULFUR OXIDES; CHEMICAL REACTION YIELD; CHEMICAL REACTION KINETICS.

71449 Acoustical Particle Sizing Instrument. Medecki, H. (KLD Associates, Inc., 300 Broadway, Huntington Station, NY, 11746). **Project number:** F624A-360. **Contract:** 68-02-2674. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$84,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring.

This project will design, develop, and demonstrate an in-situ instrument for real time particle sizing in stationary sources. The instrument being developed will use the effect of particle size on the change in the speed of sound in a gas to measure the aerodynamic particle size in the range 0.5 to 5.0 micrometers. A field demonstrated prototype instrument will be delivered if the program is successful. A final report will be published. The theoretical concept evaluation is nearing completion. Preliminary results indicate that the approach is feasible although it may be difficult to size the smallest particles in the range of interest.
Keywords: PARTICLE SIZE; AEROSOL MONITORING; AEROSOLS; GASES; IN-SITU PROCESSING; PARTICLES; COAL INDUSTRY; NATURAL GAS INDUSTRY; PETROLEUM INDUSTRY; GASEOUS WASTES; AIR POLLUTION; EQUIPMENT; FEASIBILITY STUDIES; ACOUSTIC MONITORING; AIR POLLUTION MONITORS; DESIGN.

71450 Light Scattering Impactor. Markowski, G. (Meteorology Research, Inc., 464 W. Woodbury Road, Box 637, Altadena, CA). **Project number:** F624A-363. **Contract:** 68-02-2669. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$100,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring.

This project will design, develop, and demonstrate an in-situ instrument for real time particle sizing in stationary sources. The instrument under development will employ a cascade impactor with a between stage optical readout to size particles in the range 0.5 to 5.0 micrometers. A field demonstrated prototype instrument will be delivered if the program is successful. A final report will be published. The initial design study and theoretical evaluation have been completed. The concept of using a light scattering sensor to detect the particulate betwen stages in a virtual cascade impactor looks promising. Data indicate that sharp size cuts can be obtained with the virtual impactor scheme. Ongoing testing will evaluate a laboratory prototype on test aerosols to evaluate the sizing ability of the instrument.
Keywords: CASCADE IMPACTORS; DESIGN; AIR POLLUTION MONITORS; PARTICLE SIZE; AEROSOLS.

71451 Environmental Assessment of Energy Supply Systems Using Fuel Cells. Steele, R.V. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** F624A-380. **Contract:** 68-02-2180. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$6,235,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Integrated assessment.

The objective of the project is to determine the environmental advantages and disadvantages of residential energy supply systems which use fuel cells as compared to systems which use more conventional technologies. Five scenarios will be studied: three involving fuel cells, two without fuel cells. All systems use coal as the primary energy resource and all provide heating, cooling, and basic electrical energy to residential applications. Energy efficiency, costs, environmental impacts, and feasibilities of each scenario will be addressed. The end result will be an assessment of the relative attractiveness of fuel cell systems, emphasizing the trade-offs between the environment, energy, and economics. Results to date indicate that a fuel cell system with waste heat recovery which is applied to a multi-family dwelling or cluster home complex is environmentally and economically feasible. Fuel remains as the longest cost item as it is assumed to be derived from coal.
Keywords: FUEL CELLS; ENVIRONMENTAL IMPACTS; COST BENEFIT ANALYSIS; COAL; ELECTRIC POWER; RESIDENTIAL SECTOR; ECONOMICS; FEASIBILITY STUDIES; ENERGY DEMAND; ENERGY EFFICIENCY.

71452 *Effects of Pathogenic and Toxic Materials Transported via* Cooling Device Drift. Freudenthal, H.D. (H2M Corp., Environmental Sciences Div., 500 Broad Hollow Road, Melville, NY, 11746). **Project number:** F624A-385. **Contract:** 68-02-2625. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$5,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of this project was to assess the potential effects of the possible toxic materials and pathogenic organisms in cooling device drift on plants and animals including humans. The pathogens and toxic substances present in cooling system make-up water were to be identified and screened for potential survival in the cooling device and passage into the aerosol state. The direct affect of these surviving pathogens and toxic substances was to be established for both plants and animals. The probability of occurrence of both normal and worst case situations were to be modeled. Although insufficient data was found to insure an accurate model, a hypothetical model of worst case conditions using polluted once-through cooling water indicates a significant probability of the transfer of pathogens. Additional research will be required before the limits of the potential problem can be defined.
Keywords: COOLING SYSTEMS; BIOLOGICAL EFFECTS; TOXICITY; AEROSOLS; PARASITES; INFECTIVITY; HEALTH HAZARDS; INHALATION; SURVIVAL CURVES.

71453 Ocean Disposal Test Program for Treated FGD Materials. McLeod, G.C. (New England Aquarium Corp., Central Wharf, Boston, MA, 02110). **Project number:** F624A-390. **Contract:** R805654. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The environmental effects of ocean disposal of treated flue gas desulfurization (FGD) wastes will be evaluated by conducting tests in three areas: (1) chemical effects--four or five representative treated FGD materials will be tested for release of sulfite and selected trace metal contaminants in seawater under varying conditions of temperature, salinity, and pressure (depth); (2) toxic effects--organisms representing three trophic levels of the marine food web (including vascular plants, primary consumers, and secondary consumers) will be tested for uptake, accumulation, and chronic toxicity potential of two or three FGD wastes; and (3) disposal simulation--one or two treated FGD wastes will be tested in a brackish water pond to observe physical/chemical/biological implications over a long term (18 months). A report will be issued which assesses the environmental effects and the feasibility of ocean disposal of treated FGD wastes.
Keywords: FLUE GAS; DESULFURIZATION; WASTE DISPOSAL; ENVIRONMENTAL IMPACTS; WATER POLLUTION; MARINE DISPOSAL; TOXICITY; SLUDGES; BIOLOGICAL EFFECTS.

71454 Evaluation of Alternatives for the Disposal of Flue Gas Desulfurization Sludges. Lunt, R.R. (Arthur D. Little, Inc., 15 Acorn Park, Cambridge, MA, 02140). **Project number:** F624A-391. **Contract:** 68-03-2334. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$118,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objectives are to: identify, assess, and demonstrate, on a pilot scale, disposal of flue gas desulfurization (FGD) wastes in coal mines and the oceans; and evaluate and assess the compatibility, capability, and adequacy of deep and surface coal mines and the oceans for handling and disposing of untreated and chemically treated FGD wastes. Environmental effects, operational feasibility, economics (costs), as well as applicable federal and state regulations will be assessed. Based on the assessment efforts, pilot disposal demonstrations of both coal mine and ocean disposal of FGD waste will be conducted. The preliminary assessment concluded that active area surface coal mines are the most promising mines for FGD waste disposal; chemically treated or oxidized (gypsum) FGD waste appeared to be most promising for ocean disposal, although further tests are needed. Currently, monitoring is underway on a portion of a commercial mine disposal operation in North Dakota. Field (brackish water pond) tests to simulate ocean disposal are planned.
Keywords: FLUE GAS; DESULFURIZATION; SLUDGES; WASTE DISPOSAL; EVALUATION; MARINE DISPOSAL; COAL MINES; COST; FEASIBILITY STUDIES; EVALUATION.

71455 Experimental Verification of Three-Dimensional Thermal Discharge Model. Sengupta, S. (University of Miami, Department of

Mechanical Engineering, Coral Gables, FL, 33124). **Project number:** F624A-396. **Contract:** D8-X0166. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects.

The objective of this work is to verify at two geographically diverse power plant sites the predictive capability of the thermal plume mathematical model developed by the University of Miami and to transfer the theory and operation of the computer program for this model to EPA. The model will be demonstrated in at least two 24-hour periods at both Anclote River and Anchorage, Florida, and Lake Keowee, South Carolina. Model predictions at various times in the 24-hour periods will be compared with remote sensing and field measurements in the verification process. The mathematical model theory and computer software books will follow verification of the model. The computer program for the verified model will be transferred to a designated EPA computer facility and instruction provided to EPA modelers on the application of the model. A final report will document both model theory and computer software information and information related to verification of the model.
Keywords: THREE-DIMENSIONAL CALCULATIONS; THERMAL EFFLUENTS; POWER PLANTS; PLUMES; MATHEMATICAL MODELS; COMPUTER CODES.

71456 High Voltage Control and Electrostatic Field Investigations. Rinard, G. (Denver Research Inst., University Park, Denver, CO, 80210). **Project number:** F624A-403. **Contract:** R805650. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$194,000.
Related energy source: coal(100).

The objective is to determine the effects of power supply design and control strategies on particulate collection by electrostatic precipitators. Laboratory scale, pilot scale experiments will be conducted to develop improved power supply control. Data from full scale electrostatic precipitators will also be used.
Keywords: ELECTROSTATICS; HVAC SYSTEMS; ELECTROSTATIC PRECIPITATORS; PERFORMANCE; ENVIRONMENTAL EFFECTS; AEROSOLS; CONTROL; AIR POLLUTION CONTROL.

71457 Analysis of Thermal Decomposition Products of Flue Gas Conditioning Agents. Dismukes, E. (Southern Research Institute, 2000 9th Avenue South, Birmingham, AL, 35205). **Project number:** F624A-404. **Contract:** 68-02-2200. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$35,000.
Related energy source: coal(100).

The project objective is to determine the chemical composition of possible reaction products and thermal decomposition products of conditioning agents. Experiments will be conducted in a laboratory scale system which simulates time, temperature, history and flue gas composition of power plants. Triethylamine produced significant amounts of nitrosoamine.
Keywords: FLUE GAS; CHEMICAL COMPOSITION; PYROLYSIS; PROCESSING; AMINES; CLEANING.

71458 Investigation of the Effect of Electrostatic Precipitators, Scrubbers and Baghouses on In-Stack Opacity. Ensor, D.S. (Atmospheric Research Group, Inc., Altadena, CA, 91001). **Project number:** F624A-405. **Contract:** R805650. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$73,000.
Related energy source: coal(100).

The objective is to develop methods for predicting plume opacity from point sources which use scrubbers, baghouses, or electrostatic precipitators to control particulate emissions. Light scattering predictive methods will be combined with mathematical models or particulate control to predict opacity. Techniques for measuring refractive index will be developed. Adequacy of available methods of measuring particle size distribution will be determined. Results will be compared with field data. Error analysis for particle size distribution measurement has been completed.
Keywords: ELECTROSTATIC PRECIPITATORS; SCRUBBERS; BAGHOUSES; STACK DISPOSAL; OPACITY; FLUE GAS; AIR CLEANING SYSTEMS; COMPARATIVE EVALUATIONS; MATHEMATICAL MODELS; AIR POLLUTION CONTROL; CARBON OXIDES.

71459 Effects of Conditioning Agents on Emission from Coal Fired Boilers. Calvert, S. (Air Pollution Technology, Inc., 4901 Morena Blvd., Suite 402, San Diego, CA). **Project number:** F624A-406. **Contract:** 68-02-2628. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$157,000.
Related energy source: coal(100).

The project objective is to determine impact of flue gas conditioning. The approach is to conduct field tests at power plants using conditioning agents. Tests with and without conditioning agent will be performed at each site. Two tests have been completed. SO3 conditioning improved performance of electrostatic precipitator at cost of the increased SO3 emissions. Results from other test are being analyzed.
Keywords: FLUE GAS; CLEANING; FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; SULFUR TRIOXIDE.

71460 Electrostatic Precipitators for Control of Fine Particles. Nichols, G. (Southern Research Inst., 2000 9th Avenue S, Birmingham, AL, 35205). **Project number:** F624A-407. **Contract:** 68-02-2114. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$102,000.
Related energy source: coal(100).

The objective is to develop improved electrostatic precipitators and methods for improving design of electrostatic precipitators. Theoretical, bench scale, laboratory scale, pilot scale studies combined with results of full scale field tests will be used to develop improved electrostatic precipitators. An improved computer model of electrostatic precipitation has been published.
Keywords: ELECTROSTATIC PRECIPITATORS; DESIGN; PARTICLES; AEROSOLS; AIR POLLUTION CONTROL; TECHNOLOGY UTILIZATION; REMOVAL.

71461 Mobile Bed Flux/Force Condensation Scrubbers for Collection of Fine Particles. Calvert, S. (Air Pollution Technology, Inc., 4901 Morena Blvd., Suite 402, San Diego, CA). **Project number:** F624A-410. **Contract:** 68-02-2124. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$11,000.
Related energy source: coal(100).

The objective is to determine the feasibility of using mobile bed scrubbers as flux force/condensation (F/C) scrubbers. An experimental study of F/C scrubbing to determine the effects of various operating parameters on performance of a mobile bed scrubber will be conducted. Field tests of mobile bed scrubbers have indicated that they are more efficient then would be theoretically predicted. This experimental study will determine if this observation is true. Experimental results have shown that the mobile bed scrubber does follow conventional theory and performs similar to other scrubbers with the same power requirements.
Keywords: SCRUBBERS; TECHNOLOGY ASSESSMENT; PARTICLES; AEROSOLS; PARTICLE SIZE; REMOVAL; MOBILITY.

71462 Evaluation of Industrial Particulate Scrubbers. Calvert, S. (Air Pollution Technology, Inc., 4901 Morena Blvd., Suite 402, San Diego, CA). **Project number:** F624A-411. **Contract:** 68-02-1869. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$3,000.

The objectives are to: (1) evaluate industrial fine particulate scrubbers; (2) locate and test fine particulate scrubbers which have potential for high efficiency, are widely used in industry, and control a major fine particle source; and (3) use results to evaluate performance and economics of the system. Performance capabilities of some industrial scrubbers will be documented and the Venturi scrubber model will be improved. Three scrubbers have been tested and evaluated. Generally the model and the measured performance agreed. However, it appears that the model may require modification if used in situations where conditions are significantly different from the assumptions in the model.**Keywords:** SCRUBBERS; AEROSOLS; PERFORMANCE TESTING; COMPARATIVE EVALUATIONS; AIR POLLUTION CONTROL.

71463 Evaluation of Novel Particulate Collection Devices. Calvert, S. (Air Pollution Technology, Inc., 4901 Morena Blvd., Suite 402, San Diego, CA). **Project number:** F624A-412. **Contract:** 68-02-1496. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$8,000.

The objectives are to identify novel particulate control devices which have potential for high efficiency collection of fine particulate, and evaluate and test those devices which show the greatest potential from a theoretical analysis. Four novel particulate collectors have been tested. These are: (1) APS electrostatic scrubber, (2) APS electro-tube, (3) CHEAF, and (4) TRW-charged droplet scrubber. A pilot scale demonstration of the TRW-charged droplet scrubber has been completed and a pilot scale demonstration of the APS electrostatic scrubber is underway.**Keywords:** AEROSOLS; AIR POLLUTION CONTROL; SCRUBBERS; ELECTROSTATIC PRECIPITATORS; PILOT PLANTS; TESTING.

71464 Demonstration of Flux Force/Condensation Scrubber on Secondary Metal Recovery Furnace. Calvert, S. (Air Pollution Technology, Inc., 4901 Morena Blvd., Suite 402, San Diego, CA). **Project number:** F624A-413. **Contract:** 68-02-1801. **Supported by:** Environ-

mental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$9,000.

The objective is to demonstrate a pilot scale flux force/condensation (F/C) scrubber on fine particulate emissions from an industrial source. A F/C scrubber system has been demonstrated on a secondary metal recovery furnace. The system was generally capable of 90% to 95% efficiency on particles with a mass mean diameter of 0.7 m. This efficiency was achieved with 68 cm W.C. gas phase pressure drop. A conventional high energy scruber without F/C effects would require pressure drops of 250 cm to 535 cm for the same efficiencies.**Keywords:** PILOT PLANTS; SCRUBBERS; AEROSOLS; METALS; RECOVERY; AIR POLLUTION CONTROL; FURNACES; EFFICIENCY; TESTING.

71465 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).

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.

71620 Assessment of the Long-Term Effects of Applying Domestic Wastewaters to the Land (Conduct Irrigation Study in the State of Utah). Reynolds, J.H. (Utah State University, Utah Water Research Lab., Main Building, Office 104, Logan, UT). **Project number:** L611C-31A. **Contract:** 68-03-2360. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA. **Related energy source:** all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to collect quantitative data to assess the long-term effect of applying municipal effluent to the land on the properties of crops, soils, and groundwater. The approach which will be employed is the direct comparison of data collected on site to data collected at a control site having like management except for the application of municipal effluent to the land. The work is divided into several phases--site selection, field data collection, laboratory data collection, data analyses, and report preparation. The site for study was located at Tooele, Utah. All field work and data collection have been completed. Final reports are now being prepared by the contractors.
Keywords: WASTE WATER; GROUND DISPOSAL; IRRIGATION; ENVIRONMENTAL IMPACTS; LAND USE; UTAH; MUNICIPAL WASTES; SOILS; SOIL MECHANICS; CROPS; GROUND WATER; FEASIBILITY STUDIES; WATER POLLUTION ABATEMENT; WASTE PRODUCT UTILIZATION; ENVIRONMENTAL IMPACTS; PLANTS; NUTRIENTS.

71718 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-AH-03. **Contract:** R803851-03. **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:** Physical and chemical processes and effects.

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.

71725 Fate of NOx and Transport of Oxidant. Spicer, C. (Battelle Memorial Institute, Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** G603A-AJ-07. **Contract:** 68-02-2439. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$120,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this program are to determine the distribution and relationships among atmospheric nitrogen compounds and to determine the propensity of air masses to generate and transport oxidant beyond urban areas. To achieve these objectives, an experimental program was conducted in Los Angeles during the fall of 1976. During this study period chemical and meteorological data were obtained from three instrumental ground stations and an instrumental twin-engine aircraft. In 1977, a study was undertaken in the midwestern part of the US to investigate the effect of the present and passage of high pressure system on O3 and NOx relationships. Similar measurements will be taken. These include PAN, O3, NO, NO2, CO, C1-C2, hydrocarbon, halocarbons, solar intensity, temperature, etc. These studies will be continued in 1978 at northeast sites to sample urban plumes transported over ocean bodies. The results from this study will be compared to past studies to identify and evaluate the important mechanisms that are affecting the nitrogen oxides lifetimes in ambient air.
Keywords: NITROGEN OXIDES; ENVIRONMENTAL TRANSPORT; PHOTOCHEMICAL OXIDANTS; URBAN AREAS; AEROSOL MONITORING; OZONE; AIR POLLUTION.

71735 Optical Effects of Atmospheric Aerosol. Waggoner, A.P. (University of Washington, Department of Civil Engineering, 206 Guggenheim Hall, Seattle, WA, 98105). **Project number:** G603A-AG-11. **Contract:** R800665-13. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
R and D categories: Physical and chemical processes and effects.

This project continues our past studies relating aerosol sources, physical and chemical properties of the particles, and effects of relative humidity to atmospheric optical properties such as radiative climate and visibility. Included will be studies of the relationships of particle properties and synoptic scale transport.
Keywords: OPTICAL PROPERTIES; EARTH ATMOSPHERE; AEROSOLS; MATHEMATICAL MODELS; CHEMICAL PROPERTIES; ENVIRONMENTAL TRANSPORT; DIFFUSION; AIR POLLUTION.

71737 Long Range Transport Modeling. Eskridge, R.E. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AB-12. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$13,000.
R and D categories: Physical and chemical processes and effects.

The purpose of this model development is the simulation of the transport, dispersion, and chemical transformation of species over large time and distance scales. The winds, temperature, eddy diffusion coefficients and other meteorological parameters will be furnished by a boundary layer model being developed by NOAA. Emissions will be calculated from the NEDS data base and will include plume rise. The model will calculate transport of pollutants using a flux-corrected advection scheme (SHASTA), while diffusion will be calculated using an implicit approximation. The model will also include deposition at the surface via boundary conditions.
Keywords: ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; DIFFUSION; BOUNDARY LAYERS; EARTH ATMOSPHERE; PLUMES; SULFUR DIOXIDE; AIR POLLUTION.

71746 Long-Range Transport and Transformation of Sulfur Dioxide and Sulfate. Reiter, E.R. (Colorado State University, Department of Atmospheric Science, Fort Collins, CO, 80523). **Project number:** G603A-AD-17. **Contract:** R805271-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$60,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.

The objectives are to develop a model of long-range transport and transformation of sulfur dioxide and sulfate, and to calculate concentration distributions of these pollutants. Using observed data of wind and concentration distributions of sulfur dioxide and sulfate, comparisons between the calculated concentrations and the observed concentrations will be made. Based upon these comparisons, refinements of various parameters in the model will be carried out. The parameters to be refined include deposition velocity and transformation rate. The computer program is, at present, capable of calculating the concentrations of pollutants along trajectories as well as the average concentrations over gridded regions. The program consists of two major routines: (1) a routine that calculates trajectories of plume increments over the regional scale area and dispersion parameters along trajectory segments using observed wind data over the region, and (2) a routine that calculates the concentrations along trajectories and interpolates the plume concentrations to grid intersections. Improvement will be made so that the program can calculate the average concentrations over longer time periods with greater numbers of source areas. Further improvement will be made to include the vertical transport of pollutants from the top of the mixed layer.
Keywords: SULFUR DIOXIDE; SULFATES; ENVIRONMENTAL TRANSPORT; ATMOSPHERIC CHEMISTRY; MATHEMATICAL MODELS.

71747 Sulfur Budget in Large Plumes. Husar, R.B. (Washington University, Department of Mechanical Engineering, 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G603A-AG-17. **Contract:** R803896-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$160,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

This task is part of a large program to determine the overall transport, transformation and removal (transmission) processes of atmospheric sulfur compounds. The main emphasis is on understanding sulfur transmission in well-defined plumes such as power plant and urban plumes as well as on the regional (1000 km) scale. As part of the STATE Program (Sulfur Transport and Transformation in the Environment), Washington University will be responsible for adapting several Meloy 285 sulfur analyzers for aircraft measurement of particulate sulfur prior to the Tennessee plume study. The grantee will also assist in the Operations Control Center during the August--September, 1978, intensive. He will be responsible for analyzing the continuous SO2, SF6, and particulate sulfur measurements in terms of sulfate formation rates. Sulfuric acid and related pollutant data will be analyzed in terms of long-range transport, transformation and deposition of sulfur compounds in St. Louis, MO, and State College, PA. In addition to measuring total particulate using thermal analysis flame photometric detection, there will also be a heated and an ambient integrating nephelometer and a Florida State streaker. In addition, Washington University will apply the information gained in MISTT (Midwest Interstate Sulfur Transformation and Transport) to examine a variety of possible techniques for controlling sulfate. These will include reductions in or removal of primary sulfate, changes in stack height or exhaust temperature, and variations in SO2 emission rates with time of data or season to promote deposition.
Keywords: PLUMES; SULFUR; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; EARTH ATMOSPHERE; FOSSIL-FUEL POWER PLANTS; URBAN AREAS; TENNESSEE; BASELINE ECOLOGY; AIR QUALITY; SULFUR FLUORIDES; SULFURIC ACID; SULFUR DIOXIDE.

71756 Identification and Measurement of Inorganic Compound Emissions. Henry. (Battelle Memorial Inst., Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Project number:** G625B-EB-01. **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:** Characterization, measurement, and monitoring.

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 plants, oil refineries, and coal conversion) will be conducted to obtain emission characterization data.
Keywords: INORGANIC COMPOUNDS; SAMPLING; PETROLEUM REFINERIES; FOSSIL-FUEL POWER PLANTS; GASEOUS WASTES; AIR POLLUTION; MEASURING METHODS; COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; MONITORING.

71761 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:** G625B-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).

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.

71763 Formation of Atmospheric Aerosols. Whitby, K.T. (University of Minnesota at Minneapolis, Department of Mechanical Engineering, 105 Morrill Hall, Minneapolis, MN, 55455). **Project number:** G625B-EA-08. **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:** Physical and chemical processes and effects.

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.

71764 Techniques for the Measurement of Aerosol Size Distribution and Carbon and Sulfur Content. Macias, E.S. (Washington University, Department of Chemistry, 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G625B-EB-08. **Contract:** R803115-03. **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).

The objective is to pursue work in three distinct areas of aerosol instrumentation and characterization, including development of: (1) a shape sensitive aerosol particle size spectrometer; (2) a nuclear gamma-ray method to measure the concentrations of light elements such as carbon, nitrogen, oxygen, and sulfur; and (3) a particular sulfur analyzer. During the current period the device and

techniques to measure particle size have been documented with laboratory aerosols. Additional measurements on atmospheric aerosols will be made in the upcoming period. In this period the nuclear gamma-ray method was brought into routine operation for all elements except oxygen, and this analytical technique will be developed in the next period. Some work has also been done on the in-situ analysis of sulfate aerosols using thermal analysis techniques. A Malloy FPD sulfur analyzer was obtained and laboratory tested and calibrated and will be field tested under a variety of conditions in the next year.
Keywords: AEROSOLS; AEROSOL MONITORING; PARTICLE SIZE; CARBON; SULFUR; ECOLOGICAL CONCENTRATION; NITROGEN; OXYGEN; SPECTRA; SPECTROMETERS.

71765 Intercomparison of Methods to Collect and Analyze Aerosols. Camp, D.C. (Lawrence Livermore Lab., P.O. Box 808, Livermore, CA, 94550). **Project number:** G625B-EB-09. **Contract:** D6-0800. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring.

The objective is to determine the ability of recently developed and previously available aerosol instrumentation to quantitatively determine the concentration of the total mass, sulfate, lead, and other chemical species in the atmosphere. The approach will be to conduct an intermethod comparison in which representative samplers of each type are included. An eight-day intercomparison in Charleston, WV, during May of 1977 will be conducted. The sampler types to be included are manual dichotomous, streaker, Battelle impactor, filters in series, HI VOL, two mass, diffusion battery, and Lundgren impactor. The participants will return the samples to the laboratory and perform the analyses. The results from each participant representing each method will be intercompared using appropriate statistical techniques. State-of-the-art instrumentation was intercompared for measuring airborne particulate mass, nitrate, sulfate, lead, and trace elements. A mathematical treatment of the data reveals the relative performance of the instruments.
Keywords: AEROSOL MONITORING; COMPARATIVE EVALUATIONS; AIR SAMPLERS; SULFATES; AEROSOLS; LEAD; ELEMENTS; NITRATES; TRACE AMOUNTS; AIR POLLUTION MONITORS; PERFORMANCE; TECHNOLOGY ASSESSMENT.

71769 Mesoscale Sulfur Balance Studies. Winchester, J.W. (Florida State University, Department of Oceanography, 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** G625B-EA-14. **Contract:** R803887-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$100,000.
R and D categories: Physical and chemical processes and effects.

A comprehensive study is being conducted to characterize the occurrence of sulfur in aerosol particles at sampling stations in 14 locations between the mid-continent and eastern seaboard of continental U.S. 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, a highly sensitive technique permitting both the extremely short 2-hour time resolution on a continuous basis for filter samples as well as the size resolution of particles as small as 0.25 micron diameter by cascade impactors. By means of the combination of sampling techniques, the impact of fossil fuel combustion and other anthropogenic sources of sulfur on the natural characteristics of the atmosphere may be precisely determined.
Keywords: SULFUR; SULFATES; METALS; INORGANIC COMPOUNDS; AEROSOL MONITORING; SAMPLING; BASELINE ECOLOGY; ECOLOGICAL CONCENTRATION; ENVIRONMENTAL TRANSPORT; EARTH ATMOSPHERE; MATHEMATICAL MODELS.

71772 Mobile Sampling and Analysis of Tracers for State. Shair, F.H. (California Inst. of Technology, Department of Chemical Engineering, 1201 E. California Blvd., Pasadena, CA, 91109). **Project number:** G625B-EA-18. **Contract:** R804990-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$46,000.
R and D categories: Physical and chemical processes and effects.

This task has been incorporated in a large program to determine transport, transformation, and removal processes and rates affecting atmospheric concentrations of sulfur compounds. Initial emphasis is on studies of definable plumes out to times and distances of 24 hours and 500 km, respectively. Intensive mobile ground-level measurements of a gaseous tracer released in a power plant stack will be made, particularly in the areas where maximum ground-level stack gas concentrations and maximum dry removal of sulfur species are expected to occur. Results of this task will quantify tracer concentrations at ground level and fill in gaps in discontinuous airborne tracer measurements to permit a more complete delineation of the three-dimensional structure of plumes under varying meteorological conditions. Previous work of this same kind was performed in the St. Louis, MO, area as part of the regional air pollution study, and has served to document the temporal variations of plume concentrations at ground level. Field work under the current program will be performed in August 1978.
Keywords: ENVIRONMENTAL TRANSPORT; REMOVAL; SULFUR DIOXIDE; GASEOUS WASTES; FLUE GAS; THREE-DIMENSIONAL CALCULATIONS; POWER PLANTS; AIR POLLUTION.

71780 Aerometric Field Study in Vicinity of a Large Power Plant in Complex Terrain. Koch, R. (Geomet, Inc., 15 Firstfield Road, Gaithersburg, MD, 20760). **Project number:** G625B-EA-25. **Contract:** 68-02-2260. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$25,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this field measurement program is to collect a set of reliable aerometric measurements in the vicinity of the Clinch River Power Plant in Russell County of southwestern Virginia. Continuous measurements of SO2, NO, wind, and temperature are made at eight fixed sites out to 30 km from the plant. An instrumented van routinely monitors air quality at likely receptor locations. SO2 and NO are monitored continuously at the plant and PIBAL and temperature soundings are made daily. After the field data are archived they will be analyzed to determine effects of complex terrain on transport and diffusion, and the aerometric data will be made available to analysts, modelers, and others.
Keywords: THERMAL POWER PLANTS; VIRGINIA; ENVIRONMENTAL IMPACTS; SULFUR DIOXIDE; NITROGEN OXIDES; SULFATES; MATHEMATICAL MODELS; AIR POLLUTION; CHEMICAL EFFLUENTS; DIFFUSION; AERODYNAMICS; TOPOGRAPHY; ENVIRONMENTAL TRANSPORT.

71787 Continuous Monitor of Mass Concentration of Particulate Emission from Stationary Sources. Reisman, E. (Ford Motor Co., Aeronutronic Division, Ford Road, Newport Beach, CA, 92663). **Project number:** G712B-BA-03. **Contract:** 68-02-2206. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$9,000.

The objective of the program is to construct an optical instrument that is capable of making measurements of mass concentration in times approaching real time. The technique makes use of the fact that the wavelength dependence of opacity varies with the size of the particles in the effluent. The instrument makes transmission measurements at several wavelengths free of absorption bands in the visible and ir. The data is fed into a computer that has been programmed for a particular type of site. The program contains information on the optical indices of the particulate as a function of wavelength, the form of the particle size distribution function, typical size ranges, etc. The computer makes a best fit of the optical data by adjusting the parameters of the size distribution function and computes the mass concentration. Since the computations occur very rapidly, the results are available in almost real time. The current system uses time sharing but future units will use an onboard minicomputer. The program will be accomplished in two phases. The first phase will involve the construction of a breadboard unit that will be checked out in the laboratory with controlled dust chambers and cells. The second phase involves the packaging of a field-worthy unit which will be tested at a coal-burning power plant and at a Portland cement plant. Concurrent probe measurements will also be made.**Keywords:** STATIONARY POLLUTANT SOURCES; PARTICLES; AEROSOLS; SPECTRA; COAL; FOSSIL-FUEL POWER PLANTS; PORTLAND CEMENT; CEMENT INDUSTRY; AEROSOL WASTES; FLY ASH; SAMPLERS.

71802 Measurement of H2SO4 Emissions from Selected Sources. Cheney, J. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BD-12. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$15,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective of this task is to adapt an extractive H2SO4 monitor developed for use at a contact H2SO4 plant for use in

measuring H2SO4 emissions from combustion sources. The conductivity detector currently incorporated in the system will be replaced with a pH monitor to facilitate measurement of H ion concentration resulting from the absorption of gaseous H2SO4 in solution. Currently, the prototype is undergoing evaluation at an acid plant. Upon completion of the testing, the system will be delivered to EPA for modification and use on combustion sources.
Keywords: SULFURIC ACID; MONITORING; AIR POLLUTION; ECOLOGICAL CONCENTRATION; FOSSIL-FUEL POWER PLANTS; BOILER FUEL; COMBUSTION PRODUCTS; FLUE GAS; COAL; CHEMICAL COMPOSITION; AIR POLLUTION MONITORS; OPTIMIZATION.

71803 Evaluation of Measurement Technology for Size and Composition of Particle Emissions. Conner, W.D. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-13. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$40,000.
R and D categories: Characterization, measurement, and monitoring.

The objectives of this task are to study various particle sizing devices for measurement of size and for measurement of particle size composition. Both extractive and in-stack sizing devices are being tested in the laboratory at a stationary source simulator and in the field at various sources. Optical and inertial type sampling methods will be studied and various types of impaction studies are being tested for their applicability to the impactors, to the source conditions (temperature, humidity, loading, velocity, etc.) and to the analytical method of analyses. Currently, two in-stack impactors, an extractive impactor and a series cyclone are being tested at oil-fired and coal-fired power plants, Portland cement plants and municipal incinerators. A two-wavelength transmissometer is being tested at oil-fired power plants and a four wavelength transmissometer is to be tested at the source simulator and in the field for particle size measurement.
Keywords: MEASURING METHODS; AEROSOLS; PARTICLES; AEROSOL MONITORING; TECHNOLOGY ASSESSMENT; PARTICLE SIZE; PETROLEUM; COAL; BOILER FUEL; FOSSIL-FUEL POWER PLANTS; GASEOUS WASTES; FLUE GAS.

71804 Measurement of SO2, SO3, and H2SO4 from Fossil-Fuel Fired Combustion Sources. Homolya, J.B. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BD-13. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$50,000.
Related energy source: oil and gas(100).

The objectives of this task are: to characterize sulfur emission from coal- and oil-fired combustion sources; to assess the adequacy of present emission factors; and to study the characteristics of SO3/H2SO4 formation and emission relative to operating parameters. Selected emission sources will be sampled which represent a cross-section of boiler size, combustion operating conditions, emissions controls and fuel type. Samples will be collected and analyzed for SO2, total water soluble sulfates, CO, CO2, and oxygen. In addition, research measurements will be carried out to evaluate the adequacy of advanced methods and monitors for the characterization of emissions. Currently, data has been obtained from three coal-fired sources and light oil-fired boilers which indicate a significant difference in emissions of SO4 between coal and oil fuels.
Keywords: SULFUR DIOXIDE; SULFUR TRIOXIDE; SULFURIC ACID; FOSSIL-FUEL POWER PLANTS; FLUE GAS; ECOLOGICAL CONCENTRATION; COAL; COMBUSTION PRODUCTS; PETROLEUM; BOILER FUEL; COMPARATIVE EVALUATIONS.

71808 Development of In-Stack and Remote Plume Opacity Measurement Technology. Conner, W.D. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-17. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$35,000.
R and D categories: Characterization, measurement, and monitoring.

The objectives of this task are to develop technology for plume opacity measurement both in-stack and remote and to evaluate the application to various industrial sources. Simultaneous plume opacity measurements are made at a selected site by in-stack transmissometers, remote methods such as LIDAR, visual observers, sun photometer, and telephotometers. Particulate loadings are determined by EPA Reference Method 5 to provide information on possible correlation between mass and opacity for various types of emissions. Studies have been conducted on a series of sources including coal- and oil-fired power plants, Portland cement plants, a Kraft recovery furnace, and a phosphate fertilizer plant. Reports on tests and technology are available or are being prepared. Additional measurement method development and evaluation will continue.
Keywords: PLUMES; FLUE GAS; OPTICAL PROPERTIES; OPACITY; MEASURING METHODS; AIR POLLUTION; REMOTE SENSING; VISIBLE RADIATION; PARTICLES; AEROSOL MONITORING; AEROSOLS; COAL; PETROLEUM; CEMENTS; FURNACES; FERTILIZERS; PRODUCTION; INDUSTRY; TECHNOLOGY ASSESSMENT.

71809 Evaluation of a System for Direct Output of Pollutant Mass Emission Rate Data. Rollins, R. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-18. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$5,000.

The objectives of this task are to evaluate a commercially available monitoring system which provides sulfur dioxide mass emission rate data as a direct output. The system will be operated continuously for extended periods at a coal-fired power plant and a sulfuric acid production facility. Field performance will be verified by comparing output data with the results obtained by EPA reference method tests. Currently, field evaluation at the power plant has been completed without any major malfunctions. The system's accuracy was found to be about 17% relative to the compliance tests. Evaluation of the sulfuric acid plant is in progress.**Keywords:** SULFUR DIOXIDE; MONITORING; POWER PLANTS; FLUE GAS; SULFURIC ACID; PRODUCTION; INDUSTRIAL WASTES.

71813 Evaluation of Sulfuric Acid Dewpoint Monitor. Cheney, J. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-20. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$15,000.
R and D categories: Characterization, measurement, and monitoring.

The objectives of this task are to evaluate the utility of measuring the sulfuric acid dewpoint temperature as an indirect measurement of the sulfuric acid concentration in combustion source emissions. A laboratory study will investigate the adequacy of existing empirical relationships between acid dewpoint and concentration. A commercially available dewpoint monitor will be used in conjunction with a gas phase H2SO4 generator in the laboratory. The monitor will then be used in the field and results will be compared with the isopropanol absorption and controlled condensation methods for SO3/H2SO4 determinations. Currently, a laboratory evaluation of the system has been completed. Comparative field data has also been obtained at residual oil-fired sources which indicate the applicability of calibrated dewpoint probe. Future studies will be made to determine the viability of the method as applied to coal, gas turbine, and advanced power generation combustion processes.
Keywords: SULFURIC ACID; FLUE GAS; PETROLEUM; BOILER FUEL; ENVIRONMENTAL IMPACTS; AEROSOL MONITORING; SULFUR TRIOXIDE; AIR SAMPLERS; COMPARATIVE EVALUATIONS.

71819 Development of Particulate Emissions Sampling Technology. Knapp, K.T. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-26. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$35,000.
R and D categories: Characterization, measurement, and monitoring.

The objectives of this task are to develop sampling interfaces and study these and other interfaces with various particulate emissions sampling devices and measurement systems. The various components of the sampling systems will be carefully evaluated. This includes nozzles, probes, both standard and boundary layer dilution, filter types and sizes and gas flow measuring systems. Currently, a boundary layer dilution probe is being tested both at the stationary source simulator and in the field at oil-fired and coal-fired power plants. Special sampling boxes for temperature control have been built and are now being used with various sampling devices.
Keywords: AEROSOLS; PARTICLES; SAMPLING; AEROSOL MONITORING; AIR SAMPLERS; FOSSIL-FUEL POWER PLANTS; FLUE GAS; TECHNOLOGY ASSESSMENT.

71834 Determination of SO2 Mass Emission Rates by Remote Sensing. Sperling, R.B. (Environmental Measurements, Inc., 215 Leidesdorff Street, San Francisco, CA, 94111). **Project number:** G712B-BA-59. **Contract:** 68-02-2711. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$5,000.
R and D categories: Characterization, measurement, and monitoring.

The project objective is to determine the relative accuracy of remotely measured SO2 mass emission rates from a power generating station with respect to standard reference methods. Under a

preceding contract, two types of remote sensing air quality instruments (spectrometers) were used to measure fence-line vertically integrated burdens of SO2. Concurrent wind velocity measurements were made by means of a laser Doppler velocimeter, a tethersonde, and a pilot balloon. The current contract will provide two stages of data evaluation: data processing and data analysis. The SO2 mass emission rates will be calculated from the SO2 and wind data. Comparisons of these results will be made with in-stack and cross-stack results. An analysis will be made of the effect on accuracy made by each wind measuring system.
Keywords: SULFUR DIOXIDE; EMISSION; REMOTE SENSING; MONITORING; POWER PLANTS; FLUE GAS; STANDARDS.

71845 Develop Techniques for Measuring Total Carbon in Fine and Course Particles Collected with the Dichotomous Sampler. Sawicki, C.R. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BE-30. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$50,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to develop an accurate and sensitive method to measure total carbon and extractable carbon in ambient aerosols collected with dichotomous samplers. Aerosols collected on fluoropore filters are extracted with organic solvents. A fraction of the extract is deposited on a platinum strip, the solvent evaporated and the Pt strip heated to 100 degrees C with N2 flowing over the strip to a flame ionization detector (FID). The signal from the FID is proportional to the carbon content of the extract. A second aliquot is deposited in a Pt boat containing MnO2 oxidizer and the solvent evaporated before heating to 800 degrees C. The products of this treatment are also directed to an FID. The signal produced by the FID is proportional to the carbon content of the extract.
Keywords: CARBON; AEROSOLS; PARTICLES; AIR SAMPLERS; SAMPLING.

71862 Natural Hydrocarbon Emissions. Gay, B.W. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AJ-09. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$125,000.

The objectives are to: determine emissions of natural hydrocarbons over several differing areas of vegetation in the United States; determine the contribution of natural to anthropogenic hydrocarbon emissions as oxidant precursors; and determine ozone formation attributed to natural hydrocarbon emissions and its effects on urban and rural areas. Cryogenic concentrating of sample and gas chromatographic techniques is used in measuring natural hydrocarbons at extremely low concentrations in the ambient atmosphere. The emissions or flux of natural hydrocarbons are obtained by mathematically combining data of natural hydrocarbon measurements taken concurrently with micrometeorological data. Chemiluminescence techniques are employed to measure ozone and oxides of nitrogen. Measurements of natural hydrocarbons (terpenes) and anthropogenic hydrocarbons are being made at a rural pine forest site to determine emissions of terpenes from the trees. The forest, part of the International Biological Project (IBP) is operated by Duke University. Through an EPA grant, Duke provides micrometeorological data (energy balances of CO, H2O, temperature) obtained simultaneously with natural hydrocarbon flux. Ozone measurements are being made to determine the effects natural terpenes have on rural oxidant. Continued measurements at the IBP site of natural and anthropogenic hydrocarbons, ozone and NOx will provide a data base from which seasonal variations and effects on rural oxidant due to natural emissions can be established. Future studies will be directed toward emissions of leafy trees, grasslands and swamplands.**Keywords:** HYDROCARBONS; NATURAL OCCURRENCE; USA; OZONE; NITROGEN OXIDES; PINES; FORESTS; ECOLOGICAL CONCENTRATION.

71877 Air Pollution Climatology. Holzworth, G.C. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AD-06. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$100,000.
R and D categories: Physical and chemical processes and effects.

The objective is to develop climatological information that contributes to the understanding of atmospheric transport and diffusion processes and to the ability to assess the environmental impact of air pollutants. Routine ground-level and free-air observations/measurements, made throughout the United States by the National Weather Service, are specially processed and summarized in terms of their impact on transport and diffusion. A very comprehensive summary of lapse rate and temperature inversion characteristics (base height, thickness, intensity) is being prepared for more than 60 locations, two soundings/day, five years of observations. A climatology of effective chimney heights, based on vertical profiles of temperature and wind speed and for hypothesized chimney heights of 50, 100, 200, 300 and 400 meters throughout the United States is in progress. Studies of the trends of stagnating anticyclones in the eastern U.S. and of limited mixing episodes will be prepared for comparison to trends in air quality. Statistics on wind direction persistence over periods of hours will be developed for applications in receptor-oriented diffusion models.
Keywords: AIR POLLUTION; ENVIRONMENTAL EFFECTS; CLIMATES; ENVIRONMENTAL TRANSPORT; DIFFUSION; MATHEMATICAL MODELS; EARTH ATMOSPHERE; WEATHER; WIND; STATISTICS.

71909 Report on Sampling and Analysis Techniques for Condensable Emissions from Stationary Sources. Bennett, R.L. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BA-09. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$4,000.

The objective of this task is to prepare a review report on the progress of collection and analysis of vaporous emissions from stationary sources. The task will include a careful study of the work on collection and analysis methods for toxic organic and inorganic compounds that have vapor pressures sufficiently high so that filtration does not yield efficient collection. Included in this group of compounds are arsenic, selenium, lead and mercury. Currently, only information gathering is in progress. Industries under study are oil-fired power plants, coal-fired power plants, basic oxygen furnaces and municipal incinerators.**Keywords:** STATIONARY POLLUTANT SOURCES; EMISSION; GASEOUS WASTES; ORGANIC COMPOUNDS; INORGANIC COMPOUNDS; TOXIC MATERIALS; ARSENIC; SELENIUM; LEAD; MERCURY; ECOLOGICAL CONCENTRATION; QUANTITATIVE CHEMICAL ANALYSIS; PETROLEUM; COAL; BOILER FUEL; FURNACES; FOSSIL-FUEL POWER PLANTS; INCINERATORS; FLUE GAS; ENVIRONMENTAL IMPACTS.

71910 Measurement of POM and Other Organic Pollutant Emissions. Jones, P.W. (Battelle Memorial Institute, Organic and Structural Chemistry Section, 505 King Avenue, Columbus, OH, 43201). **Project number:** G712B-BA-10. **Contract:** 68-02-2457. **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).

The objectives of this program are to evaluate and make recommendations with regard to the present Battelle procedures for sampling and analysis of POM and other hazardous organic materials in order to establish valid procedures which will result in a more unified and logical approach to the measurement of these species in a wide variety of industrial effluents. The existing methods for sampling and analysis of POM will be evaluated and modified as necessary, and applied to other hazardous organic species, in order to provide reliable measurement methods for a wide range of such pollutants. The evaluation program will include measurement of representative organic emissions in the field, combined with state-of-the-art laboratory analytical techniques.
Keywords: SAMPLING; HYDROCARBONS; RECOMMENDATIONS; QUANTITATIVE CHEMICAL ANALYSIS; TECHNOLOGY ASSESSMENT; FOSSIL-FUEL POWER PLANTS; BOILER FUEL; MONITORING; COAL; PETROLEUM; LEAD; SMELTING; INCINERATORS; ENVIRONMENTAL IMPACTS; FLUE GAS; HAZARDOUS MATERIALS; MEASURING METHODS; ECOLOGICAL CONCENTRATION; AIR POLLUTION; CARCINOGENS.

71920 Dye Laser LIDAR System for Remote Monitoring of Air Pollution Produced by Stationary Sources, Area Sources, and Present in Ambient Conditions. Ahmed, S.A. (City University of New York, Department of Electrical Engineering, Convent Avenue and 138th Street, New York, NY, 10031). **Project number:** G712B-BA-37. **Contract:** R803109-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

A development program is proposed to define the working parameters for a practical LIDAR system for remote monitoring and tracking of specific air pollutants. The system is designed to be of particular use in the monitoring and tracking of molecular pollutants produced by stationary and area sources as well as for measuring ambient pollution conditions. A multifrequency dye laser will be used to detect pollutants by measuring the differential absorption of atmospheric elastic backscatter on and off resonance absorption peaks. The proposed scheme therefore combines the sensitivity of resonance absorption measurements with range information to provide an accurate method of determining pollutant concentration and

its spatial distribution. **Keywords:** REMOTE SENSING; AIR POLLUTION; LASERS; DYES; OPTIMIZATION.

71949 Cost of Sulfur Reduction in Mobile-Source Fuels to the Petroleum Refining Industry. Short, W.L. (KSE, Inc., P.O. Box 368, Amherst, MA, 01002). **Project number:** G601B-CA-06. **Contract:** 68-02-2929. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA-$15,000.
R and D categories: Integrated assessment.

The objective is to prepare a cost impact report on the effects of desulfurizing all mobile source fuels in response to 403G of Clean Air Act. Available data to determine costs to desulfurize the mobile source portion of the petroleum supply will be utilized. A report has been prepared which delineates definitively the costs associated with desulfurizing gasoline to 100 ppM and diesel and jet fuels to 200 ppM. Additional impact of possible future dieselization of light duty vehicles is also considered. By 1990, the investment costs (1977 dollars) would approach $7 billion with operating costs of $4 billion per year for the base case. The impact on individual refiners could exceed the average substantially.
Keywords: SULFUR; REMOVAL; PETROLEUM REFINERIES; AIR POLLUTION ABATEMENT; DESULFURIZATION; GASOLINE; DIESEL FUELS; JET ENGINE FUELS; COST; ECONOMIC IMPACT; MODIFICATIONS.

71950 Development of Hydrogen Cyanide Monitors for Vehicle Emission. Burch, D.E. (Ford Aerospace and Communications Corporation, Ford Road, Newport Beach, CA, 92663). **Project number:** G601B-CA-13. **Contract:** 68-02-2716. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring.

The objective is to develop instruments for the real-time monitoring of hydrogen cyanide (HCn) in the exhaust of automotive engines. The instrument is to make use of the unique infrared absorption properties of HCn and will employ a gas-filter cell filled with this gas species. This CTC will be the key component responsible for the sensitivity of the instrument to HCn as well as the discrimination against other gas species that occur in auto exhaust. An existing EPA instrument will be converted for use as an HCn monitor. During this first phase of the contract, the instrument will be used to determine the optimum spectral bandpass, sample cell length, and other important parameters. This design information will then be used in the second phase to design, assemble, evaluate and deliver three additional monitors for the same gas.
Keywords: HYDROCYANIC ACID; MONITORING; SAMPLERS; AUTOMOBILES; EXHAUST GASES; INFRARED SPECTRA; AIR POLLUTION MONITORS.

71951 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:** G601B-CA-14. **Contract:** 68-02-2497. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$25,000.
R and D categories: Characterization, measurement, and monitoring.

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.

71952 Sulfur Budget in Large Plumes. Husar, R.B. (Washington University, Department of Mechanical Engineering, 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G603A-AA-014. **Contract:** R803896-02. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$100,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

This task is part of a large program to determine the overall transport, transformation and removal (transmission) processes of atmospheric sulfur compounds. The main emphasis is on understanding sulfur transmission in well defined plumes such as power plant and urban plumes as well as on the regional (1000 km) scale. As part of the STATE Program (Sulfur Transport and Transformation in the Environment), Washington University will be responsible for adapting several Meloy 285 sulfur analyzers for aircraft measurements of particulate sulfur prior to the Tennessee plume study. The grantee will also assist in the Operations Control Center during the August--September, 1978, intensive. He will be responsible for analyzing the continuous SO2, SF6, and particulate sulfur measurements in terms of sulfate formation rates. Sulfuric acid and related pollutant data will be analyzed in terms of long-range transport, transformation and deposition of sulfur compounds in St. Louis, MO, and State College, PA. In addition to measuring total particulate using thermal analysis flame photometric detection, there will also be a heated and an ambient integrating hephelometer and a Florida State streaker. In addition, Washington University will apply the information gained in MISTT (Midwest Interstate Sulfur Transformation and Transport) to examine a variety of possible techniques for controlling sulfate. These will include reductions in or removal of primary sulfate, changes in stack height or exhaust temperature, and variations in SO2 emission rates with time of data or season to promote deposition.
Keywords: PLUMES; SULFUR; ECOLOGICAL CONCENTRATION; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; REMOVAL; URBAN AREAS; FOSSIL-FUEL POWER PLANTS; TENNESSEE; BASELINE ECOLOGY; SULFUR FLUORIDES; PARTICLES; AEROSOLS; MISSOURI; PENNSYLVANIA; AIR POLLUTION CONTROL; TECHNOLOGY ASSESSMENT; NITROGEN OXIDES; SULFATES; NITRATES.

71953 Airborne LIDAR Measurements of Plume Structure. McNelis, D.N. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** G603A-AA-034. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$55,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

A LIDAR unit mounted in an aircraft will be used to locate the plume and measure its shape and structure during Project STATE and Project SCRUB, summer, 1978. It is particularly effective in locating plumes at night. Data collected will be used for calculating mass flow rates and for input to dispersion models.
Keywords: PLUMES; MATHEMATICAL MODELS; AERIAL MONITORING; AIR POLLUTION; SHAPE; DIFFUSION; ENVIRONMENTAL TRANSPORT; SULFUR DIOXIDE; NITROGEN OXIDES; SULFATES; NITRATES; PARTICLES; AEROSOLS.

71954 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

71955 Aircraft Measurements of Plume Dispersion and Chemistry. Vaughan, W.M. (Environmental Measurements, Inc., 8506 Delmar Blvd., University City, MO, 63124). **Project number:** G603A-AA-102. **Contract:** 68-02-2709. **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:** Physical and chemical processes and effects.

To acquire the data base necessary for the development of control strategies for the reduction of ambient air concentrations of sulfates and nitrates, the Environmental Sciences Research Laboratory, EPA, will conduct a large scale program of discrete, intensive experimental field studies during the years FY 78 to FY 81. The proposed field studies are identified by the acronym STATE (Sulfur Transport and Transformation in the Environment). Air quality simulation models are the expected end product. In support of the summer 1978 field studies, the contractor will supply two moving laboratory platforms for studying plume transport and transforma-

tion 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 surface measurements in the downwind plume. The aircraft will sample and/or measure SO2, SO4 (continuous and integrated), B SCAT, NO, NO2, NH4, SF6 (continuous), and hydrocarbons over a four-week period involving approximately 100 flight hours. The AQML will be equipped with a navigational data acquisition system for controlling the digital recording of data and mapping out the vehicle's sample route. Sampling and measurements will be made for SO2 at the surface, SO2 aloft by remote sensor (cospec), SF6 (continuous) and hydrocarbons. In addition, the contractor will perform GC analysis for detailed trace hydrocarbons (2-C10), selected balocarbons, and sulfur hexafluoride (SF6) in grab samples collected by Sandia Laboratories and EMI.
Keywords: PLUMES; DIFFUSION; ATMOSPHERIC CHEMISTRY; ENVIRONMENTAL TRANSPORT; TENNESSEE; FOSSIL-FUEL POWER PLANTS; MATHEMATICAL MODELS; SULFUR DIOXIDE; SULFATES; NITROGEN OXIDES; AMMONIA; SULFUR FLUORIDES; HYDROCARBONS.

71956 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). **Project number:** G603A-AA-13. **Contract:** 68-02-2500. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$63,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The contractor provides specialized meteorological support for field investigations conducted by the EPA, Environmental Sciences Research Laboratory, to determine the formation and removal rate, transport, and chemical nature of aerosols from power plants and urban areas. This support consists of providing meteorological forecasts for experiments of plume transport in the meso and synoptic scales. Also, the contractor measured vertical wind and temperature profiles using pilot balloons and a tether sonde. A report has been written on the meteorological conditions and wind fields during an EPA-ARB study of the Anclote Keys plume. The contractor also made vertical wind and temperature profiles for the EPRI--Battelle PNL oil-fired power plant plume studies in Muskegon, Michigan, and Greenville, Mississippi. These profiles were provided to Battelle for reporting.
Keywords: FOSSIL-FUEL POWER PLANTS; AIR POLLUTION ABATEMENT; METEOROLOGY; PETROLEUM; BOILER FUEL; PLUMES.

71957 Atmospheric Transport and Transformation from Coal-Fired Power Plants. Jones, H.C. (TVA, Air Quality Branch, Muscle Shoals, AL, 35660). **Project number:** G603A-AA-130. **Contract:** D8-E721-DL. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$95,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The major objective of this project 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; EARTH ATMOSPHERE; MATHEMATICAL MODELS; ENVIRONMENTAL TRANSPORT; AIR POLLUTION; FLUE GAS; ENVIRONMENTAL IMPACTS.

71958 Airborne Solar Radiation Measurement for State. Albrecht, B.A. (Pennsylvania State University, Department of Meteorology, 116 Deike Building, University Park, PA, 16802). **Project number:** G603A-AA-134. **Contract:** R806048-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$12,000.
R and D categories: Physical and chemical processes and effects.

This task is part of a large program to determine transport, transformation, and removal processes and rates affecting atmospheric concentrations of sulfur compounds. Initial emphasis is on studies of definable plumes out to times and distances of 24 hrs and 500 km, respectively. Measurements of solar and longwave (thermal) radiation will be made using upward and downwind facing sensors to characterize the radiant fluxes and flux divergence which are fundamental parameters affecting boundary layer structure. Output of this task will be radiation data for a variety of meteorological conditions encountered during the study period, and analyses of the boundary layer radiation balances.
Keywords: SOLAR FLUX; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; AEROSOLS; PARTICLES; OZONE; BOUNDARY LAYERS; AERIAL MONITORING; AIR POLLUTION; ENVIRONMENTAL TRANSPORT; METEOROLOGY.

71959 Provision of Samplers for State Tracer Studies. Johnson, W.B. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** G603A-AA-135. **Contract:** DA-8-4980. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$5,000.
R and D categories: Physical and chemical processes and effects.

This task is part of a large program to determine transport, transformation, and removal processes and rates affecting atmospheric concentrations of sulfur compounds. Initial emphasis is on studies of definable plumes out to times and distances of 24 hrs and 500 km, respectively. Samplers furnished under this task will provide integrated sequential measurements to aid in defining dispersion of the plume from a large power plant, with analyses made in the field. Results of this task will be used with other measurements to quantify the transport and dispersion of an inert tracer gas not affected by transformation and removal processes.
Keywords: ENVIRONMENTAL TRANSPORT; REMOVAL; SULFUR COMPOUNDS; SULFUR DIOXIDE; PLUMES; POWER PLANTS; TRACER TECHNIQUES; MATHEMATICAL MODELS.

71960 Sulfur Budget in Power Plant Plume. Gillani, N.V. (Washington University, Department of Mechanical Engineering, 4559 Scott Avenue, St. Louis, MO, 63130). **Project number:** G603A-AA-15. **Contract:** R805918-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$50,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The primary objectives are: (1) centralized data processing and data base management of aircraft and selected meteorological data collected in the field programs of project state; and (2) analysis of field data to obtain quantitative estimates of plume sulfur dispersion, conversion and ground removal rates, to identify chemical-meteorological factors and mechanisms governing SO2 oxidation reactions, and to develop a detailed plume model applicable for 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. The approach will be to seek out the best possible parameterization of each atmospheric process affecting plume sulfur, particularly SO2 oxidation, in terms of measured quantities. These parameterization schemes will be used in a diagnostic plume model to determine plume sulfur budgets under field conditions as well as under hypothetical plume and background conditions, in mesoscale and long range plume transport.
Keywords: SULFUR; ENVIRONMENTAL TRANSPORT; FOSSIL-FUEL POWER PLANTS; FLUE GAS; PLUMES; DIFFUSION; REMOVAL; DEPOSITION; AERIAL MONITORING; DATA PROCESSING; MATHEMATICAL MODELS; ATMOSPHERIC CHEMISTRY.

71961 Lagrangian Air Measurement Platform. Zak, B.D. (Department of Energy, Albuquerque Operations Office, Albuquerque, NM, 87115). **Project number:** G603A-AA-35. **Contract:** D8-X0332. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$40,000.
R and D categories: Physical and chemical processes and effects.

The objective is to provide a Lagrangian air marker in a power plant plume through the use of a manned and instrumented super-pressure balloon and thereby evaluate the usefulness of this technique for EPA's pollution transport and transformation program. Sandia Laboratories will carry out two or more balloon flights in conjunction with an ESRL field study to be conducted in the Cumberland, Tennessee, area during late summer. The manned balloon will make on-board air quality measurements and will broadcast its position so that instrumented aircraft can make cross section

measurements of the same part of the plume at various downwind time and distance intervals. The final output will be a report documenting in detail all of the work performed including an overall analysis of the Lagrangian experiments as well as recommendations and conclusions based upon results obtained. Field preparations for launching balloon into the air parcel containing the power plant plume are underway.
Keywords: POWER PLANTS; PLUMES; ENVIRONMENTAL TRANSPORT; LAGRANGIAN FUNCTION; MATHEMATICAL MODELS; AIR POLLUTION.

71962 Aircraft Radiation Measurements over St. Louis. Carlson, T.N. (Pennsylvania State University, Department of Meteorology, 116 Deike Building, University Park, PA, 16802). **Project number:** G603A-AA-36. **Contract:** R805500-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

Aircraft radiation measurements made on board the Penn State Aerocommander during the 1976 and 1974 St. Louis RAPS project will be processed and the data reduced for the purposes of assessing the effects of aerosols in the urban boundary layer on transmission and for testing of radiative transfer models.**Keywords:** MISSOURI; RADIATION MONITORING; AERIAL MONITORING; RADIOACTIVE AEROSOLS; AEROSOL MONITORING; URBAN AREAS; BOUNDARY LAYERS.

71963 Tower Turbulence Measurements for State. Dickson, C.R. (National Oceanic and Atmospheric Administration, Air Resources Field Research Office, 550 2nd Street, Idaho Falls, ID, 83401). **Project number:** G603A-AA-55. **Contract:** D8-0305. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects.

This task is part of a large program to determine transport, transformation, and removal processes and rates affecting atmospheric concentrations of sulfur compounds. Initial emphasis is on studies of definable plumes out to times and distances of 24 hrs and 5000 km, respectively. Work to be performed under this task will provide measurements of turbulence parameters at a 120-meter tower located near the power plant being studied, and at a 10-meter tower to be installed in an area of flatter terrain. Measurements will be used to aid in characterizing the evaluation of the diurnal variation of the boundary layer in which the pollutant plume is transported. Output will consist of validated turbulence data to be subsequently analyzed.
Keywords: ENVIRONMENTAL TRANSPORT; AIR POLLUTION; PLUMES; REMOVAL; SULFUR DIOXIDE; SULFATES; MATHEMATICAL MODELS; DAILY VARIATIONS; TURBULENCE.

71964 Studies of Planetary Boundary Layer. Blackadar, A.K. (Pennsylvania State University at University Park, Department of Meteorology, 116 Deike Building, University Park, PA, 16802). **Project number:** G603A-AB-05. **Contract:** R806048-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$102,000.
R and D categories: Physical and chemical processes and effects.

This study of the planetary boundary layer (PBL) will include further development of new treatments of the convective mixed layer, the surface energy budget and the surface flux of a pollutant. A second part of the study will be a multi-platform field study of the PBL.
Keywords: BOUNDARY LAYERS; MIXING; AIR POLLUTION; ENVIRONMENTAL TRANSPORT; EARTH ATMOSPHERE; MATHEMATICAL MODELS.

71965 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 Environment, 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.
R and D categories: Physical and chemical processes and effects.

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.

71966 Planetary Boundary Layer Studies. Ching, J. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AB-41. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$70,000.
R and D categories: Physical and chemical processes and effects.

A planetary boundary layer model based on data obtained from RAPS intensive studies, as part of the development of an improved urban AQSM, will be developed. As part of this effort, the temporal and spatial variation of turbulence in an urban area, the representativeness of meteorological measurements in urban areas, energy budgets of urban areas, energy budgets of concrete, blacktop, and soil, and the vertical distribution of wind temperature, and air quality in the urban boundary layer will be examined.
Keywords: BOUNDARY LAYERS; URBAN AREAS; TURBULENCE; METEOROLOGY; CONCRETES; SOILS; WIND; TEMPERATURE INVERSIONS; AIR QUALITY; BUDGETS.

71967 Relationship Between Air Quality, Emissions and Meteorology. DeMarrais, G.A. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G603A-AD-07. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$20,000.
R and D categories: Physical and chemical processes and effects.

Te objectives are to: examine air quality data, mainly ozone, and determine whether there is a greater potential for high concentrations with flows from urban than from non-urban areas; and examine prolonged (three or more days) periods when widely-separated urban areas (cities more than 200 kilometers apart) simultaneously had high concentrations and determine the meteorological conditions which contributed to the high concentrations. Trajectory analyses for the surface-to-700 meters or surface-to-1000 meters layer of air are used to estimate the source-receptor relationships. In the second part, it will be determined whether phenomena previously associated with high ozone concentrations (intense solar radiation, low wind speeds, high temperatures) occurred with the high concentrations found in this study. Ozone data for the Hampton Roads, Virginia, area have been analyzed and summarized. Ozone data for the Richmond--Washington--Baltimore corridor are being analyzed and evaluated.
Keywords: AIR QUALITY; MONITORING; OZONE; METEOROLOGY; URBAN AREAS; RURAL AREAS; USA; MATHEMATICAL MODELS.

71968 Outdoor Smog Chamber Experiments to Test Photochemical Models. Jeffries, H.E. (University of North Carolina, Department of Environmental Sciences and Engineering, Chapel Hill, NC, 27514). **Project number:** G603A-AD-18. **Contract:** R805843-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$60,000.
R and D categories: Physical and chemical processes and effects.

The purpose of this research is to measure smog chamber reactant and product concentrations in outdoor chambers as a function of time in specific chemical systems which are of immediate interest to mathematical modellers. Smog chamber experiments will be conducted in the UNC dual outdoor chamber and will have the feature of realistic diurnal light, temperature, and water vapor. Different hydrocarbon NOx systems (formaldehyde--NOx, propylene--NOx, butane--NOx, toluene--NOx, and ethylene--NOx) will be run simultaneously in the two chamber halves. This will give modellers the opportunity to simulate two different hydrocarbon/NO systems under the same variable light and temperature conditions; this situation is not available in existing smog chamber data bases.
Keywords: SMOG; TIME DEPENDENCE; DAILY VARIATIONS; WATER VAPOR; FORMALDEHYDE; PROPYLENE; BUTANE; TOLUENE; ETHYLENE; MATHEMATICAL MODELS; ACETALDEHYDE; CHEMICAL REACTIONS; AIR POLLUTION; NITROGEN OXIDES; PHOTOCHEMICAL OXIDANTS.

71969 Houston Aerosol Characterization Study. Tannahill, G.K. (Radian Corp., 8500 Shoal Creek Blvd., Austin, TX, 78766). **Project number:** G603A-AH-18. **Contract:** 68-02-2954. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$214,000.

R and D categories: Physical and chemical processes and effects.

The objective of this contractual effort is to obtain evidence on the physical and chemical nature and sources/causes of ambient, ground level aerosols in the Houston area (including the City of Houston, the Houston shipchannel and surrounding areas). Because of concern about the health impact of aerosols, first priority will be given to the characterization of aerosols in the respirable size range. A sampling strategy will be developed based on historical meteorological, air quality and emissions data. A mobile van will obtain preliminary data from 15--31 August 1978. Intensive sampling will be conducted 15 September--15 October 1978. Parameters to be measured at two relocatable sites include O3, NOx, SO2, wind speed and direction, dew point, total hydrocarbons, CH4, C2H2, C2H4, total aerosol number concentration, size classification from 0.01 to 10 microns, light scattering, upper air speed, direction and temperature, and size-fractionated particulate samples for organic, inorganic and microscopic analysis. The resulting field measurements will be reduced to engineering units daily and summarized by 15 November 1978. A final report giving sampling procedures, data listings and data interpretation is due in April 1979.

Keywords: TEXAS; AIR QUALITY; AEROSOL MONITORING; HEALTH HAZARDS; RESPIRATORY SYSTEM DISEASES; SAMPLING; METEOROLOGY; OZONE; NITROGEN OXIDES; SULFUR DIOXIDE; VELOCITY; WIND; DEW POINT; HYDROCARBONS; QUANTITY RATIO; PARTICLE SIZE; INORGANIC COMPOUNDS.

71970 Airborne LIDAR Measurements of Plume Structure. McNelis, D.N. (EPA, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** G625B-EA-017. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$50,000.

Related energy source: *coal(100).* **R and D categories:** *Physical and* chemical processes and effects.

A LIDAR unit mounted in an aircraft will be used to locate the plume and measure its shape and structure during Project STATE and Project SCRUB, Summer 1978. It is particularly effective in locating plumes at night. Data collected will be used for calculating mass flow rates and for input to dispersion models. Flights will be made in August 1978.

Keywords: PLUMES; MATHEMATICAL MODELS; AERIAL MONITORING; AIR POLLUTION; DIFFUSION; ATMOSPHERIC CHEMISTRY.

71971 Aircraft Measurement in Support of Sulfur Transformation and Transport Studies. Blumenthal, D. (Meteorology Research, Inc., 3401 Mendocino Avenue, Santa Rosa, CA, 95401). **Project number:** G625B-EA-018. **Contract:** 68-02-2713. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$148,000.

Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

To acquire the data base necessary for the development of control strategies for the reduction of ambient air concentrations of sulfates and nitrates, the Environmental Sciences Research Laboratory, EPA, will conduct a large scale program of discrete, intensive experimental field studies during the years FY 78 to FY 81. The proposed field studies are identified by the acronym STATE (Sulfur Transport and Transformation in the Environment). Air quality simulation models are the expected end product. In support of the summer 1978 field studies, the contractor will provide one aircraft to make measurements of SO2, O3, B SCAT, NO and NO2. Integrated samples will be collected for measurement of aerosol size distribution (bag samples) and aerosol composition as a function of size (impactor samples). In 1975, EPA initiated a field program to investigate the transport-transformation theory as an explanation for the non-reduction in sulfates during the period of time when urban SO2 emissions and ambient concentrations were declining. The technical approach for project MISTT (Midwest Interstate Sulfur Transformation and Transport) was to study the transformations of SO2 to sulfate in polluted air masses undergoing transport and use the data with physical and mathematical models to derive rate parameters which characterize the transformation processes. This project will use a simple model to predict plume shape and structure up to 48 hours after emission for a variety of emission times and meteorological conditions and then compare actual plume cross sections from MISTT with those predicted by the simple stability conditions.

Keywords: SULFUR; ENVIRONMENTAL TRANSPORT; AERIAL MONITORING; SULFATES; NITRATES; SULFUR DIOXIDE; OZONE; NITROGEN OXIDES.

71972 Northrop Support Services to Aerosol Research. Coloff, S. (Northrop Services Inc., P.O. Box 12313, Research Triangle Park, NC, 27709). **Project number:** G625B-EA-088. **Contract:** 68-02-2566. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$435,000.

R and D categories: Physical and chemical processes and effects.

The contractor, Northrup Services, Inc., operates and maintains government provided facilities at EPA's Environmental Research Center, Research Triangle Park, NC, in providing technical support to the Environmental Sciences Research Laboratory. The technical support services provided to the Aerosol Research Branch of ESRL includes: (1) conducting and participating in aerosol field studies (FY-78 field studies include Gulf Coast pollutant deposition study, Houston study, coal-gasification plant studies at Kingsport, TN, and Pristina, Yugoslavia); (2) laboratory studies on humidity effect on aerosols; (3) set-up and operation of a GCIMS laboratory for analysis of organic fraction in aerosol samples; and (4) determination of the morphological characteristics of aerosols.

Keywords: AEROSOLS; PARTICLES; MATHEMATICAL MODELS; DEPOSITION; TEXAS; GULF OF MEXICO; COAL GASIFICATION PLANTS; TENNESSEE; YUGOSLAVIA; AIR QUALITY; HUMIDITY; MORPHOLOGY; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; FLY ASH.

71973 Aerosol Deposition Rates. Hicks, B. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL, 60439). **Project number:** G625B-EA-24. **Contract:** D8-X0193. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$50,000.

R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Atmospheric measurements will be made to determine the rate of dry deposition at a variety of surfaces, including grass, crops, forest, snow, and water. These data are needed for calculation of long-range aerosol transport. The eddy correlation method will be used to measure the vertical fluxes.

Keywords: AEROSOLS; DEPOSITION; PARTICLES; SULFUR OXIDES; PHOTOCHEMICAL OXIDANTS; GRASS; CROPS; FORESTS; SNOW; WATER; ENVIRONMENTAL TRANSPORT; LAKES.

71974 AQSM: LIDAR Measurements of Aerosol Structure in the Planetary Boundary. Uthe. (SRI International, Palo Alto, CA). **Project number:** G625B-EA-32. **Contract:** 68-02-2418. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.

R and D categories: Physical and chemical processes and effects.

The objective is to determine aerosol structure in planetary boundary layer. The approach will be to measure the vertical aerosol distribution in the planetary boundary layer using a LIDAR system and obtain a time dependent display of boundary layer structure using an acoustic sounder. The boundary layer study will be used in the MISTT study.

Keywords: AEROSOLS; BOUNDARY LAYERS; LASERS; ACOUSTIC MONITORING; SULFATES; DUSTS; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; AIR POLLUTION; PLANETARY ATMOSPHERES.

71975 Aircraft Measurements of Plume Dispersion and Chemistry. Vaughan, W.M. (Environmental Measurements, Inc., 8506 Delmar Blvd., University City, MO, 63124). **Project number:** G625B-EA-36. **Contract:** 68-02-2709. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$209,000.

Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

To acquire the data base necessary for the development of control strategies for the reduction of ambient air concentrations of sulfates and nitrates, the Environmental Sciences Research Laboratory, EPA, will conduct a large scale program of discrete, intensive experimental field studies during the years FY 78 to FY 81. The proposed field studies are identified by the acronym STATE (Sulfur Transport and Transformation in the Environment). Air quality simulation models are the expected end product. In support of the summer 1978 field studies, the contractor will supply two moving laboratory platforms for studying 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 surface measurements in the downwind plume. The aircraft will sample and/or measure SO2, SO4 (continuous and integrated), B SCAT, NO, NO2, NH4, SF6 (continuous), and hydrocarbons over a four-week period involving approximately 100 flight hours. The AQML will be equipped with a navigational data acquisition system for controlling the digital recording of data and mapping out the vehicle's sample route. Sampling and measurements will be made for SO2 at the surface, SO2 aloft by remote sensor (cospec), SF6 (continuous) and hydrocarbons. In addition, the contractor will perform GC analysis for detailed trace hydrocarbons (2-C10), selected balocarbons, and sulfur hexafluoride (SF6) in grab samples collected by Sandia Laboratories and EMI.

Keywords: PLUMES; ATMOSPHERIC CHEMISTRY; DIFFUSION; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; SULFATES; NITRATES; FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; TENNESSEE;

SULFUR FLUORIDES; HYDROCARBONS; REMOTE SENSING; AERIAL MONITORING.

71976 Outdoor Smog Chamber Studies of Sulfur Emissions from Fuel Conversion Facilities. Sickles, J.E. (Research Triangle Institute, Atmospheric Chemistry Section, P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** G625B-EA-41. **Contract:** 68-02-2437. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$85,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective of this investigation is to conduct smog chamber studies of the atmospheric chemistry of sulfur containing chemical species in the presence of hydrocarbons, nitrogen oxides, and sunlight. The sulfur compounds chosen for testing are expected to be present in emissions from fuel conversion facilities. The study is to be conducted in outdoor smog chambers using a surrogate hydrocarbon mix at concentrations of 0 to 2 ppMC and NOx of 0 to 0.4 ppM to which sulfur containing species such as thiophene, Ch3SH, H2S, CoS, and others will be added. The experiments are designed to determine or estimate the following: profiles of reactants and products with time; NO conversion, NO--NO2 crossover times for systems with and without added sulfur compounds; generation of SO2 in system; aerosol sizes, fractions, and numbers; and sulfate production and material balances for sulfur.
Keywords: SMOG; SULFUR; ATMOSPHERIC CHEMISTRY; HYDROCARBONS; NITROGEN OXIDES; PHOTOCHEMICAL OXIDANTS; ORGANIC SULFUR COMPOUNDS; AEROSOLS; AIR POLLUTION; SULFATES.

71977 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:** G625B-EA-60. **Contract:** 68-02-2759. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$75,000.
R and D categories: Physical and chemical processes and effects.

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.

71978 Investigation of Filter Artifacts when Sampling Airborne Organic Particulates. Pitts, J.N. (University of California at Riverside, Department of Chemistry, Riverside, CA, 92502). **Project number:** G625B-EA-83. **Contract:** R806042-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$60,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objectives of this two-year research program are directed toward (1) developing particulate sampling methods for organic particulates which are free of error due to filter artifacts, and (2) applying these methods in evaluating the impact of alternative fossil fuel technologies on atmospheric pollution. The approach includes analysis by GC/MS supplemented by HPLC and mutagenic assays using the Ames test are used to detect and study artifacts and to evaluate the air pollution impact of fossil fuel emissions and their secondary atmospheric products. Extensive effort required for analysis and assay determines the scope of the program. Artifacts are investigated using both particulate samples from polluted air and a surrogate mixture of organic compounds as a simulant for organic particulate. The experimental plan is designed to study the effects of reactive gaseous pollutants, humidity, filter material, and inorganic particulates on the organic fraction of particulate samples. Data from the artifact study will be used in developing improved sampling methods. The plan under this project is to employ these methods when evaluating, in smog chamber irradiation experiments, the potential emissions from alternative fuel technologies as precursors of secondary pollutants. The study will be conducted in a dual outdoor chamber designed to unambiguously determine effects due to added emissions to polluted atmospheres. These effects include differences in chemical composition (both gaseous and particulate), in mutagenic activity, and in particle size distribution between the two chamber compartments.
Keywords: AEROSOLS; AEROSOL MONITORING; PARTICLES; AIR FILTERS; MUTAGEN SCREENING; SAMPLING; AIR POLLUTION; FOSSIL FUELS; ENVIRONMENTAL IMPACTS; ATMOSPHERIC CHEMISTRY; EVALUATION; CHEMICAL COMPOSITION; HYDROCARBONS.

71979 Characterization of Secondary Organic Pollutants from Second Generation Fossil Fuel Technologies. Guerin, M.R. (Oak Ridge National Lab., Analytical Chemistry Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** G625B-EA-85. **Contract:** D8-X0228. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$184,000.
R and D categories: Physical and chemical processes and effects.

The objective of this project is to characterize the particulate and vapor phase organic constituents of atmospheric emissions collected in the vicinity of operating advanced fossil fuel technologies, such as coal gasification. A secondary objective is to provide a collection system for organic vapors which is compatible with existing particulate sampling devices. The approach utilized in the analysis phase includes radioactive tagging, solvent extraction, thermal desorption, and high performance liquid chromatography and GC/MS. The approach to the collection system involves the use of Tenex and/or XAD-2 resins. Samples were collected near a coal gasification facility in Kingsport, TN, and the results obtained from the Kingsport study will be used in the planning and execution of a study in Pristina, Yugoslavia, where a full scale low-Btu Lurgi coal gasification facility is in full operation. In Yugoslavia, simultaneous measurements will be made by the Industrial Environmental Research Laboratory (IERL) on the process streams.
Keywords: PARTICLES; AEROSOLS; ORGANIC COMPOUNDS; HYDROCARBONS; COAL GASIFICATION PLANTS; AEROSOL WASTES; GASEOUS WASTES; TENNESSEE; YUGOSLAVIA; ENVIRONMENTAL IMPACTS; MONITORING.

71980 Project MISTT Summary. English, T.D. (Jet Propulsion Lab., 4800 Oak Grove Drive, Pasadena, CA, 91103). **Project number:** G625B-EA-92. **Contract:** D8-F0279. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$14,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The Midwest Interstate Sulfur Transformation and Transport (MISTT) Program, a multi-million dollar research program of the Environmental Protection Agency, was conducted to increase the nation's understanding of the transport, dispersion, chemical transformations and removal mechanisms affecting airborne sulfur compounds in the midwestern region of the United States. It has shown that air quality management strategies must be improved to include the influence of sulfur compounds that have been transported over multistate regions. This agreement will provide for the preparation of a summary report on the research results of the MISTT Program for the Decision Report Series of the Federal Interagency Energy/Environment Research and Development Program. This report series presents the key issues and findings resulting from the 17-agency R and D program in a format conducive to efficient information transfer. The MISTT summary report is intended for both energy and environment decision makers and the interested public.
Keywords: SULFUR DIOXIDE; ENVIRONMENTAL TRANSPORT; DIFFUSION; SULFUR; MIDWEST REGION; AIR QUALITY; MANAGEMENT; AEROSOLS; ATMOSPHERIC CHEMISTRY.

71981 Low Cost, Portable, Sulfur Analyzer for Field Use. Birks, L.S. (Department of the Navy, X-Ray Optics Branch, Washington, DC, 20375). **Project number:** G625D-EB-09. **Contract:** D5-F490. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
Related energy source: coal(50); oil shales and tar sands(50).

A portable vacuum wavelength-dispersive x-ray analyzer has been constructed for on-site measurement of the sulfur content of filter-deposited airborne particles. Although designed to analyze for sulfur, the spectrometer is adjustable over a limited range providing the potential for determining other elements. With the x-ray tube rated at 50 watts, the instrument achieves a 100-second 3 omega detection limit for sulfur of better than 0.5 micrograms/cm2. A final report entitled Portable Vacuum X-Ray Spectrometer-Instrument for On-Site Analysis of Airborne Particulate Sulfur and Other Elements is scheduled for publication in June 1978.
Keywords: SULFUR; MOBILITY; AIR POLLUTION MONITORS; X-RAY SPECTROMETERS.

71982 Design and Performance of an Aerosol Mass Distribution Monitor. Stoeber, W. (Fraunhofer Gesellschaft, Institut fur Aerobiologie, 5948 Schmallenberg Graf, Munich, Federal Republic of Germany). **Project number:** G625D EB-10. **Contract:** R803592-02. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Air, Land and Water Use. **Funding:** EPA.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects.

The objectives are to fabricate, test, and deliver an instrument capable of (1) detailed and rapid measurement of mass vs. size distributions of airborne particle emissions, and (2) collection of size fractions for chemical and physical analysis. The project was initiated with FY 75 funds. Incremental funds in FY 77 will be used to build and test a supplementary device for measurement of total particle mass concentration of samples analyzed by the aerosol centrifuge.
Keywords: AEROSOLS; MASS TRANSFER; AIR POLLUTION MONITORS; PARTICLE SIZE; DESIGN; PERFORMANCE TESTING.

71983 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). **Project number:** G625D-EB-15. **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: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

71984 Laser Raman Monitoring of Sulfuric Acid, Sulfates, Sulfur Trioxide, and Sulfur Dioxide in Stack Emissions. Chang, R.K. (Yale University Graduate School, Department of Engineering and Applied Science, 206 Elm Street, New Haven, CT, 06520). **Project number:** G625D-EB-16. **Contract:** R805458-01. **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:** Characterization, measurement, and monitoring.

The goals of the research are to demonstrate that sulfur-containing emissions from oil-fired and/or coal-fired stacks can be chemically specified and that their individual concentrations can be monitored by laser Raman scattering. Chemical speciation and concentration monitoring in real time of the sulfur dioxide emissions will advance the state-of-the-art of pollution abatement. In particular, such measurements will further our knowledge of the effects of catalysts (such as vanadium), the total content in oil or coal, and boiler operating conditions (such as temperature and oxygen content) on the generation of these individual sulfur-containing emissions. We will investigate the Raman shifts and linewidth of H2SO4, SO3, and SO2 in the gaseous phase and sulfates in the solid phase (particulates). The Raman shifts and linewidth will be used as unique signatures of the chemical compounds and their phases. We will also measure the absolute Raman cross sections of these gaseous and solid sulfur-containing molecules. The combination of the Raman shift, the linewidth, and the cross section will enable us to estimate the sensitivity (in terms of ppM or mole g/m3) and the number of different pollutants (in terms of chemical species and phase) which can be simultaneously monitored and distinguished in a stack emission when the laser Raman technique is applied.
Keywords: RAMAN SPECTRA; SULFURIC ACID; SULFATES; SULFUR TRIOXIDE; SULFUR DIOXIDE; FLUE GAS; AEROSOL MONITORING; AIR POLLUTION ABATEMENT; BOILER FUEL; PETROLEUM; COAL; ECOLOGICAL CONCENTRATION.

71985 Aerosol Instrumentation Development. Goulding, F.S. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** G625D-3B-13. **Contract:** D8-X-0148. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$120,000.
R and D categories: Characterization, measurement, and monitoring.

There are two components to the project. The first is to design and construct semi-automatic continuous tape aerosol samplers for operation in an aircraft. The samples shall be compatible with a previously designed elemental sulfur analyzer using x-ray fluorescence. The second component is to design a series of jets for operation in virtual impactors in order to perform dichotomous particle separation over a range of cut points from 1 to 5 micron particle diameter. A semi-automated instrument has been developed to measure particulate mass and sulfate in the atmosphere. Additional research is conducted on the design of aerosol sampling devices that fractionate particles into fine and coarse particles fractions.
Keywords: AEROSOL MONITORING; SAMPLERS; OPTIMIZATION; AUTOMATION; AERIAL MONITORING; DESIGN; SULFUR.

71986 Task Orders on Measurements for New Source Performance Standards. Eggleston, T.E. (TRW, Inc., Energy Systems Group, 1 Space Park, Redondo Beach, CA, 90278). **Project number:** G712B-BA-56. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$61,000.
Related energy source: coal(100).

A technical data base will be provided in support of reference measurement methods prescribed in new source performance emission standards (NSPS). Task orders are issued to contractor to conduct field measurements complementary to and in support of in-house field studies.
Keywords: MEASURING METHODS; AIR POLLUTION; EMISSION; STANDARDS.

71987 Plume Opacity Related to Particle Size and Chemical Composition. Pilat, M.J. (University of Washington, Dept. of Civil Engineering, 206 Guggenheim Hall, Seattle, WA, 98105). **Project number:** G712B-BA-72. **Contract:** R803897-03. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$40,000.
R and D categories: Characterization, measurement, and monitoring.

The objective of the proposed research is to continue work on improving the relationship between instrumentally measured in-stack light transmittance and the aerosol properties. The research approach calls for simultaneous measurements to be taken of particle size distribution, particle mass concentration, and in-stack light transmittance. A novel approach is suggested for obtaining cascade impactor samples suitable for x-ray spectroscopy analysis. Results of the past year have served to validate a theoretical expression relating in-stack transmittance to particle mass concentration for a pulverized coal-fired boiler and with only partial success for an oil-fired boiler. Specific objectives for the proposed project include testing of coal and oil-fired boilers and other industrial sources. The final output will be a report on the relation between particle characteristics and emission opacity. Opacity measurements and aerosol sample collection have been made at several sources including oil-fired and coal-fired boilers.
Keywords: PLUMES; OPACITY; PARTICLE SIZE; CHEMICAL COMPOSITION; FLY ASH; STACK DISPOSAL; FLUE GAS; AEROSOLS; X-RAY SPECTRA; COAL; FOSSIL-FUEL POWER PLANTS; BOILER FUEL; PETROLEUM; ENVIRONMENTAL IMPACTS; AEROSOL MONITORING.

71988 Determination of Be and Other Low Atomic Numbered Elements by Proton Scattering. Nelson, J.W. (Florida State University, Department of Physics, 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** G712B-BA-73. **Contract:** R804376. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$45,000.
Related energy source: all(100).

The objective of this work is to develop a method for the analysis of aerosol samples for Be and other low atomic numbered elements by proton scattering and the higher atomic numbered elements by proton induced x-ray fluorescence. The final output will be the method and supporting data. The proton scattering work has been completed and the x-ray wavelength dispersion spectrometer is now under construction.
Keywords: BERYLLIUM; RADIATION SCATTERING ANALYSIS; AEROSOLS; CHEMICAL ANALYSIS.

71989 Engineering and Development of Dichotomous Sampler. (Beckman Instruments, Inc., 1630 S. State College Blvd., Anaheim, CA, 92806). **Project number:** G712B-BB-26. **Contract:** 68-02-2715. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$135,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective is to design and fabricate two lost cost manual dichotomous samplers and two low cost automated dichotomous

samplers. The approach is to develop complete engineering drawings and design concepts to simplify the systems, reduce production cost by using molded parts, improve reliability and compatibility with operation at unprotected sites under full range of weather conditions. Two prototype samplers have been delivered to Texas A and M for environmental and particle loss studies, 1 June 1978; samplers are to be delivered to EPA 15 July 1978. An order of 20 additional samplers was submitted 1 April 1978 with delivery requested for 1 September 1978.
Keywords: AIR POLLUTION; AIR SAMPLERS; DESIGN; FABRICATION; AUTOMATION; AEROSOLS; SULFATES; NITRATES; PARTICLES; METALS.

71990 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:** G712B-BB-64. **Contract:** R804370-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring.

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.

71991 Report on Characterization of Toxic Trace Metals from Stationary Sources. Bennett, R.L. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-07. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$6,000.

The objective of this task is to prepare a summary report on the significant toxic metal data obtained during specified reporting periods from various source industries. The data obtained from the in-house work on the toxic trace metal content of various source industries will be supplemented by contract and literature data and summary report. Currently, the data is being collected on oil-fired power plants, coal-fired power plants, basic oxygen furnaces and municipal incinerators.**Keywords:** FOSSIL-FUEL POWER PLANTS; BOILER FUEL; ENVIRONMENTAL EFFECTS; PETROLEUM; COAL; OXYGEN; FURNACES; MUNICIPAL WASTES; INCINERATORS; METALS; TOXICITY; BIOLOGICAL EFFECTS; AIR POLLUTION.

71992 Study of Fuel-Additive Combustion Products Using a Single Cylinder Engine. Boekhaus, K.L. (Atlantic Richfield Co., Harvey Technical Center, 400 E. Sibley Blvd., Harvey, IL, 60426). **Project number:** G712B-BC-11. **Contract:** 68-02-2486. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring.

The objective is to determine the efficiency and degradation rate of noble metal exhaust gas treatment catalysts using a single cylinder engine fueled with a range of base fuel and additive combinations. A single cylinder CLR engine will supply exhaust feed gas to five different automotive exhaust oxidation catalysts, chosen to represent current production. The engine will be operated on a two mode cycle representing vehicle operation at both idle and a 55 mph cruise. The base fuels tested will be iso-octane, a 20% aromatic fuel, and a 30 to 40% aromatic fuel. The additives to be tested include tetraethyl lead, methylcyclopentadienyl manganese tricarbonyl (MMT) at three treat levels. An attempt will be made to develop an exhaust manifold system for aging the five catalyst charges simultaneously. The exhaust feed gases from two current production cars were examined under several steady state conditions. These feed gases will be simulated by the CLR in a two mode catalyst aging cycle. At present the engine operating conditions to simulate these feed gases are being determined. Using these operating conditions a catalyst aging test will be developed to investigate the effects of the three additives and three base fuels on catalyst durability.
Keywords: ADDITIVES; COMBUSTION PRODUCTS; CATALYSTS; LEAD; GASOLINE; AUTOMOTIVE FUELS; EXHAUST GASES; AIR POLLUTION ABATEMENT; AUTOMOBILES; AIR POLLUTION.

71993 Construction of Pulse Flame Catalyst Testing System and Tests on Emission Catalysts. Meguerian, G.H. (Standard Oil Co. of Indiana, Fuels Division, Box 400, Naperville, IL, 60540). **Project number:** G712B-BC-16. **Contract:** 68-02-2748. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$20,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The objectives are to construct and test a pulsed flame combustor for use in the evaluation of catalysts and fuel additives. A pulsed flame combustor simulates the type of combustion that occurs in an internal combustion engine. As a small laboratory system, it allows evaluations of catalysts and additives economically. The pulsed flame system has been designed, constructed and delivered. Initial evaluations on a three-way catalyst have been performed using pure fuels, pure fuel and lead, and pure fuel and manganese, by the contractor prior to delivery.
Keywords: CATALYSTS; PULSES; FABRICATION; COMBUSTORS; INTERNAL COMBUSTION ENGINES; AIR POLLUTION ABATEMENT; AUTOMOTIVE FUELS; FUEL ADDITIVES; EVALUATION; COMBUSTION CONTROL.

71994 Impact of Fuel Switching on Primary Sulfate Emissions. Nader, J.S. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-20. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$10,000.
Related energy source: coal(50); oil and gas(50).

The objective is to analyze emission data for utilities burning different fuels and to determine impact on sulfate emissions when utilities switch to different fuels. Emission inventories will be reviewed and sulfate emissions will be calculated for various scenarios of fuel-switching. Scenarios for potential switching strategies will be developed and implemented. Emission factors for oil-fired and coal-fired utilities have been experimentally verified and data are being generated on sulfate emissions associated with current fuel utilization.
Keywords: BOILER FUEL; FUEL SUBSTITUTION; SULFATES; FOSSIL-FUEL POWER PLANTS; FLUE GAS; DESULFURIZATION; AIR POLLUTION ABATEMENT.

71995 Task Order to Support Stationary Source Particulate Emissions Characterization. (Engineering Science Co., 7903 Westpark Drive, McLean, VA, 22101). **Project number:** G712B-BC-27. **Contract:** 68-02-2815. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$38,000.
Related energy source: all(100).

This task is to provide contract services to support in-house field studies in particulate emissions characterization. This support will include running EPA Method 5 and particle size measurements. The final output will include the samples collected and the particulate emission mass concentration data. Tests have been run at several oil-fired power plants, coal-fired power plants, and incinerators.
Keywords: PARTICLES; AEROSOLS; STATIONARY POLLUTANT SOURCES; PARTICLE SIZE; PHYSICAL PROPERTIES; FOSSIL-FUEL POWER PLANTS; INCINERATORS; BOILER FUEL; COAL; ENVIRONMENTAL IMPACTS; SMELTING; FLUE GAS; FLY ASH.

71996 Morphology and Composition of Particulates Emitted by Stationary Sources. Miller, J.L. (EPA, Office of Research and Development, Special Techniques Group, Research Triangle Park, NC, 27711). **Project number:** G712B-BC-33. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$25,000.
R and D categories: Characterization, measurement, and monitoring.

The objective is to determine the morphology and elemental composition of particulate matter emitted by stationary sources using electron optical techniques. The analyses will be carried out using transmission and scanning electron microscopy in conjunction with electron diffraction, electron microprobe measurements, and advanced image analysis techniques. Sources under study include oil-fired and coal-fired power plants, incinerators, and basic oxygen furnaces.
Keywords: PARTICLES; AEROSOLS; MORPHOLOGY; CHEMICAL COMPOSITION; FLY ASH; OPTICAL PROPERTIES; ELECTRON MICROSCOPY; PETROLEUM; COAL; BOILER FUEL; INCINERATORS; FOSSIL-FUEL POWER PLANTS.

71997 Determination and Characterization of Fuel Effects on Diesel Particulate Emissions. Risby, T.H. (Pennsylvania State University, Department of Chemistry, 211 Whitmore Lab., University Park, PA, 16802). **Project number:** G712B-BC-37. **Contract:** R803651. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$52,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective is to identify the particulate combustion products from a wide range of fuel components. Using a single cylinder

engine to generate exhaust particulate, a range of simple fuel components will be tested. The particulate will be characterized for organic matter using a variety of mass spectrometric techniques. A single cylinder engine has been set up and is being maintained to tight specifications. Baseline fuel is a mixture of tetradecone and isooctane. Aromatic and naphthoner will be blended with the base components on an individual basis maintaining cetane number. Analysis is being performed on the collected particulate using positive and negative CI/MS techniques combined with thermal evolution. Computer mapping of the results is in progress.
Keywords: DIESEL ENGINES; DIESEL FUELS; COMBUSTION PRODUCTS; EXHAUST GASES; PARTICLES; MIXTURES; ANTIKNOCK RATINGS.

71998 Task Orders on Characterization of Emissions from Newly Designated Industries. Chehaski, J. (Engineering Science Co., 7903 Westpark Drive, McLean, VA, 22101). **Project number:** G712B-BC-47. **Contract:** 68-02-2815. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$60,000.

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.**Keywords:** AEROSOL MONITORING; STANDARDS; PARTICLES; AEROSOLS; OPACITY; NITROGEN OXIDES; SULFATES; SULFUR DIOXIDE; MONITORING; FLUE GAS; FLY ASH.

71999 Physical Properties of Particle Emission from Selected Sources Categories. Knapp, K.T. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-48. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$72,000.
Related energy source: coal(50); oil and gas(50).

The objective of this task is to determine the size distribution, density, shape and optical properties of particles emitted from various source industries. Particles are collected from various preselected source industries by filters and size fractioning devices. The samples are analyzed in the lab for the physical properties of the particulate. Currently, emissions from oil-fired and coal-fired power plants and municipal incinerators are being sampled.
Keywords: PARTICLES; AEROSOLS; PARTICLE SIZE; FILTRATION; PHYSICAL PROPERTIES; MUNICIPAL WASTES; INCINERATORS; COAL INDUSTRY; PETROLEUM INDUSTRY; ENVIRONMENTAL IMPACTS; BOILER FUEL; FLUE GAS.

72000 Detailed Organic and Inorganic Analysis of Particle Emissions from Selected Sources. Bennett, R.L. (EPA, Office of Research and Development, Environmental Sciences Research Lab., Research Triangle Park, NC, 27711). **Project number:** G712B-BC-49. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$63,000.
Related energy source: coal(50); oil and gas(50).

The objective of this task is to obtain chemical analyses on particulate samples of the emissions from various preselected source industries. The analysis will be for both organic and inorganic compounds. The samples will be collected by various filters and special solid sorbent systems. The analyses will be by x-ray fluorescence for trace element and ir and other methods of spectroanalysis for the organic content. Currently, emission samples from oil-fired and coal-fired power plants are being analyzed.
Keywords: PARTICLES; AEROSOLS; CHEMICAL ANALYSIS; X-RAY FLUORESCENCE ANALYSIS; FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; ORGANIC COMPOUNDS; INORGANIC COMPOUNDS.

72078 Enzymatic Characterization and DNA Binding of Carcinogens in Short-Term Bioassays. Weinstein, I.B. (Columbia University, College of Physicians and Surgeons, Department of Medicine, 630 W. 168th Street, New York, NY, 10032). **Project number:** H625F-7156. **Contract:** R805482. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$104,000.
R and D categories: Health effects.

Several short-term in-vitro tests for mutagenicity and carcinogenicity are currently being evaluated for monitoring the thousands of environmental agents which require screening as possible carcinogens. There is a paucity of information on whether or not the activation of a known carcinogen and its covalent binding to cellular DNA in these in-vitro systems is quantitatively and qualitatively similar to that which occurs in intact mammalian cells or in the whole animal. The objective of this project is to examine the modified DNA from cells used in these assays after exposure to the ubiguitous carcinogen benzo(a)pyrene (BP). The approach will be to incubate tritium labeled BP with microsomes and Salmonella typhimurium tester strains, or with various mammalian cell lines. Cellular DNA will then be extracted, analyzed for radioactivity and fluorescence, and then hydrolyzed to nucleosides which will be analyzed by high pressure liquid chromatography, utilizing appropriate BP-nucleoside derivatives prepared chemically as markers to determine the nature of the BP-nucleoside adducts present. Parallel assays will be done for mutagenicity and transformation and of aryl hydrocarbon hydroxylase and epoxide hydratase activities. The data will be correlated with our results obtained in intact human tissues where it has been possible to determine the structure of the major adduct formed. Progress has been made in isolating and characterizing the BP-DNA adducts from the following two test systems: (1) Salmonella typhimurium mutagenesis bioassay; and (2) 10T1/2 neoplastic transformation bioassay. In both cases the major BP-DNA adduct found in human bronchus and other mammalian cells was identified, however, additional adducts were also found.
Keywords: ENZYMES; DNA; CHEMICAL BONDS; BIOASSAY; MUTAGENESIS; CARCINOGENESIS; CARCINOGENS; BENZOPYRENE; TRITIUM; SALMONELLA TYPHIMURIUM; MAMMALS; ANIMAL CELLS; HYDROCARBONS; EPOXIDES.

72079 Studies on the Relationship Between Carcinogen Metabolism in the Alveolar Macrophage and the Induction of Lung Cancer. Garrett, N.E. (Northrop Services, Inc., P.O. Box 12313, Research Triangle Park, NC, 27709). **Project number:** H625F-7157. **Contract:** 68-02-2566. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$260,000.
Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

The objective of this task is to study the relationship between carcinogen metabolism in the alveolar macrophage and in other lung cells and the induction of lung cancer. Ultimately it should be possible to develop in vitro model(s) upon which to base prediction of pulmonary oncogenic potential of unknown samples for whole animals. Using in vitro methods the course of metabolic activation/detoxification of procarcinogens will be investigated in alveolar macrophages and other cell types. Biochemical methods will be used in monitoring induction of metabolic activation/detoxification systems. Microbial mutagenesis will be used to monitor the extent of metabolic activation/detoxification by the various cell types. The isolated perfused lung will be used in secondary stages of this investigation. Once the conditions for maximal activation/detoxification of carcinogens have been established using in vitro methods, whole animals studies will be initiated employing intratracheal instillation techniques to administer particulates and appropriate procarcinogens. The metabolic activation of procarcinogens will be monitored as described above using macrophages obtained by saline lavage of carcinogen-exposed animals. When optimal conditions have been established, experiments will be performed to demonstrate the relationship between elicitation of macrophage influx, pulmonary metabolic activation/detoxification of carcinogens, and the induction of lung tumors in animals. This is a long-range project that will be approached sequentially with continuation from year to year being dependent upon demonstrated success of initial studies. Rabbit alveolar macrophage (RAM) S-9 has been demonstrated to be fully capable of metabolically converting 2-anthramine and 2-acetylaminofluorene to active mutagens when used in place of liver S-9 in the Ames test. Sporadic positive results have been obtained when intact RAM were cocultivated with S. typhimurium to provide metabolic activation. Intact liver cells provide clearly positive results with cocultivation.
Keywords: CARCINOGENESIS; METABOLISM; MACROPHAGES; LUNGS; NEOPLASMS; BIOCHEMICAL REACTION KINETICS; PHYSIOLOGY; TOXICITY; CARCINOGENS; RABBITS; SALMONELLA TYPHIMURIUM; LIVER; RATS.

72080 Effects of Sulfuric Acid Aerosol upon Respiratory Function in Normal Human Subjects. Kerr, H.D. (University of Maryland, Baltimore Professional Schools, Department of Medicine, 1420 N. Charles Street, Baltimore, MD, 21201). **Project number:** H625F-7160. **Contract:** R804803. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$450,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Health effects.

The objective of the project is to determine the effects of low concentration (100 mg/cubic m) H2SO4 aerosol of small particle size (0.1 to 0.3 micron m) on the mechanical factors of breathing in normal human subjects. A modified double-blind study is planned. Subjects will be studied in pairs and will spend 6 hrs daily in a Class 100 environmentally controlled chamber on 3 successive days. They will not be told which day the 4-hr exposure to H2SO4 aerosol will occur or which 2 days they will simply breathe filtered clean air.

Pulmonary function tests will be done immediately before entering the chamber and every 2 hrs thereafter. Smokers and non-smokers will be studied. Pulmonary function tests will include the following: spirometry, plethysmographic determination of specific airway conductance and FRC, closing volume and nitrogen plateau, and dynamic compliance.
Keywords: SULFURIC ACID; AEROSOLS; INHALATION; CHRONIC EXPOSURE; MAN; EXPOSURE CHAMBERS; BIOLOGICAL EFFECTS; RESPIRATION; PATHOLOGICAL CHANGES; LUNGS; DYNAMIC FUNCTION STUDIES.

72085 Operation and Maintenance of the Community Health Air Monitoring Program to Quantitate Air Pollution Exposure in Selected Health Study Areas. Sullivan, R.J. (Xonics, Inc., Environmental Systems Division, 6911 Hayvenhurst Avenue, Van Nuys, CA, 91406). **Project number:** H625F-7167. **Contract:** 68-02-2493. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$400,000. **Related energy source:** coal(100). **R and D categories:** Integrated assessment; Health effects.

The objective of the project is to quantitatively characterize air pollutants in selected health study communities. A Champ monitoring site (fixed or mobile) is located within potential study communities to obtain measurements representative of the air pollutant exposure to select populations at risk for prospective health studies.
Keywords: USA; URBAN AREAS; AIR POLLUTION; HEALTH HAZARDS; HUMAN POPULATIONS; PUBLIC HEALTH; RISK ASSESSMENT; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON MONOXIDE; CARBON DIOXIDE; PHOTOCHEMICAL OXIDANTS; PARTICLES; DUSTS; MONITORING; AIR QUALITY; DATA; AIR POLLUTION MONITORS; OPERATION; MAINTENANCE.

72086 Biological Assessment of Exposure to Sulfur Dioxide and Acid Sulfate. Rajagopalan, K.V. (Duke University, School of Medicine, Department of Biochemistry, Box 3711, Durham, NC, 27706). **Project number:** H625F-7187. **Contract:** R805622-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$91,000.
R and D categories: Health effects.

The use of high-sulfur coal as a source of energy is expected to generate higher atmospheric concentrations of sulfur dioxide and acid sulfate. It is generally believed that these compounds could affect the health of human populations which may be exposed to them. Because of this, it is advantageous to have available reliable biological indices for detection of exposure to these chemicals. The relevant tests should be applicable to blood samples obtained from samples of human population. In the case of sulfur dioxide, it is conceivable that metabolites such as sulfite, thio-sulfate and S-sulfocysteine may be present in the blood of exposed individuals in concentrations higher than those in normal populations. Using the rat as the experimental animal, this project will explore the possibility of developing sensitive tests for the presence of these compounds in blood of animals exposed to various levels of SO2. Development of procedures for assessing exposure to acid sulfate may also be possible. Since sulfite oxidase is an enzyme capable of detoxifying SO2, methods for epidemiological testing of sulfite oxidase in human populations will also be investigated.
Keywords: SULFUR DIOXIDE; ACID SULFATES; BIOLOGICAL EFFECTS; AIR POLLUTION; HUMAN POPULATIONS; BIOLOGICAL INDICATORS; BLOOD; RATS; EPIDEMIOLOGY.

72094 Application of Automated Behavioral Testing System to Monkeys Exposed to Coal Conversion Pollutants. Lloyd, W.E. (Iowa State University of Science and Technology, School of Veterinary Medicine, Beardshear Hall, Ames, IA, 50010). **Project number:** H601E-8898. **Contract:** 68-02-2288. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$80,000.
Related energy source: coal(100). **R and D categories:** Health effects.

The study will evaluate the CNS toxicity of energy related pollutants (mercury and thallium) in monkeys using automated testing procedures. The adverse effects of these two metals on both spontaneous and operant behavior will be evaluated. Acute and subacute exposure to mercury and thallium will be performed in Macaca facilularis. Longitudinal sampling of spontaneous and operant behavior will be performed and behavioral changes will be correlated with body burden of these two metals.
Keywords: COAL; COMBUSTION PRODUCTS; MERCURY; THALLIUM; TOXICITY; BIOLOGICAL EFFECTS; CENTRAL NERVOUS SYSTEM; PATHOLOGICAL CHANGES; MACACUS; BEHAVIOR; DOSE-RESPONSE RELATIONSHIPS; BODY BURDEN; ACUTE EXPOSURE; PERFORMANCE TESTING; AUTOMATION.

72095 Studies on Carcinognesis and Mutagenesis of Pesticides/Metabolites by In Vitro/In Vivo Test Systems. Nesnow, S. (EPA, Office of Research and Development, Health Effects Research Lab., Metabolic Effects Section, Research Triangle Park, NC, 27709). **Project number:** H615A-7513. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$225,000.
R and D categories: Health effects.

Pesticides may cause genotoxic damage to man by direct single exposure. These agents may also affect incipient genotoxic damage by modifying the enzymes involved in the activation of environmental carcinogens and mutagens. This research program is designed to study these types of pesticide-carcinogen interactions. The effect of pesticides on the enzymes which metabolize carcinogens was studied. Male rats were treated with a series of standard inducers of mixed-function oxidase enzymes and pesticides and their hepatic enzymes isolated for biochemical analysis. The following analyses were performed: change in liver weight, microsomal levels of phosphatidyl ethanolamine, phosphatidyl inositol, phosphatidyl serine, phosphatidyl choline, sphingomyelin and cholesterol, cytochrome P-450, cytochrome 85, cytochrome C reductase, benzo(a)pyrene metabolites, and aminopyrene N-demethylase. Additionally, each induced enzyme was characterized by its susceptibility to a series of cytochrome specific inhibitors. The induced enzymes were also used as metabolic activation systems in the Ames Salmonella typhimurium bacterial mutagenesis bioassay. Using this protocol, the following agents were studied: phenobarbital; Aroclor-1254; beta-naphthoflavone; pregnenolone-16-alpha-carbonitrile; acephate; malathon; P,P'-DDT; trifluralin; hexachlorobenzene; and toxaphene. The urine of rats treated with trifluralin, siduron, monuron, crotoxyphos, simazine, acephate, captan, trichlorofon, and folpet was tested for the presence of bacterial mutagens by the Ames test.
Keywords: PESTICIDES; BIOLOGICAL EFFECTS; METABOLISM; CARCINOGENESIS; MUTAGENESIS; IN VITRO; IN VIVO; ANIMALS; TISSUE CULTURES; ENZYMES; SALMONELLA TYPHIMURIUM.

72096 Effects of Pesticides on Smooth Muscle Contractibility. Whitcomb, E.R. (EPA, Office of Research and Development, Health Effects Research Lab., Research Triangle Park, NC, 27711). **Project number:** H615A-7518. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$30,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to determine if chronic low level exposures of either pyrethrin, acepate or monitor would alter the contractibility of smooth muscle. White male rats were dosed daily for 60 days at 5 mg/kg/day with the respective insecticide. At the end of the exposure period, the animals were sacrificed. A segment of the duodenum was excised and bathed in Ringer's solution. A frequency distribution of the spontaneous rate of contraction was determined. This study suggested that at this exposure neither pyrethrin, monitor nor acepate altered the myogenic properties of smooth muscle.
Keywords: PESTICIDES; MUSCLES; PHYSIOLOGY; CHRONIC EXPOSURE; BIOLOGICAL EFFECTS; HERBICIDES; HYDROCARBONS; NEUROLOGY; ANIMALS.

72097 Application of Automated Behavioral Testing System to Monkeys Exposed to Coal Conversion Pollutants. Lloyd, W.E. (Iowa State University of Science and Technology, School of Veterinary Medicine, Beardshear Hall, Ames, IA, 50010). **Project number:** H615A-8975. **Contract:** 68-02-2288. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$170,000.
Related energy source: coal(100). **R and D categories:** Health effects.

The study will evaluate the CNS toxicity of energy related pollutants (mercury and thallium) in monkeys using automated testing procedures. The adverse effects of these two metals on both spontaneous and operant behavior will be evaluated. Acute and subacute exposure to mercury and thallium will be performed in Macaca facilularis. Longitudinal sampling of spontaneous and operant behavior will be performed and behavioral changes will be correlated with body burden of these two metals.
Keywords: COAL; COMBUSTION PRODUCTS; MERCURY; THALLIUM; TOXICITY; BIOLOGICAL EFFECTS; ACUTE EXPOSURE; MACACUS; CENTRAL NERVOUS SYSTEM; BEHAVIOR; PATHOLOGICAL CHANGES; DOSE-RESPONSE RELATIONSHIPS; BODY BURDEN; PERFORMANCE TESTING; AUTOMATION.

72098 Effects of Sulfur Oxide Pollutants on Respiratory Function, Particle Deposition and Bronchial Clearance. Lippmann, M. (New York University, School of Medicine, Department of Environmental Medicine, 550 1st Avenue, New York, NY, 10016). **Project number:** H625-6704. **Contract:** 68-02-1726. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
R and D categories: Health effects.

Changes in pulmonary function, mucociliary clearance, and the regional deposition of an inert test aerosol will be studied to characterize the dose effects relationships produced in donkeys by

inhaled sulfuric acid and ammonium sulfate aerosols. The donkey will be exposed without sedation or rigid restraint and represents an analogue for man. The human dose-response to a one hour exposure at low concentrations (less than 1 mg/m3) of sulfuric acid mists 0.5 micron m in diameter will be evaluated. Two animals have undergone exposure to 100 micron/m3 H2SO4 acid mist (0.3 micron m) for one hour a day and five days a week. Two additional donkeys have been evaluated for normal (base line) measurements and are presently undergoing an identical six month exposure regimen. Bronchial clearance rates were slower initially and were faster thereafter. However, there is considerable variation and no definite pattern has emerged. Human testing has commenced with each subject being exposed to 0, 100, 300, or 1000 micron g/m3 of H2SO4 in a random fashion in a blind test.
Keywords: SULFUR DIOXIDE; RESPIRATORY SYSTEM; LUNGS; PARTICLES; DEPOSITION; LUNG CLEARANCE; BRONCHI; DYNAMIC FUNCTION STUDIES; BURROS; MAN; SULFURIC ACID; AMMONIUM SULFATES; AIR POLLUTION; BIOLOGICAL EFFECTS; HEALTH HAZARDS.

72099 Hematologic and Mutagenic Effects of Arsine. Goldstein, B.D. (New York University, Department of Environmental Medicine, 550 1st Avenue, New York, NY, 10016). **Project number:** H625F-8050. **Contract:** R805711-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$36,000.
Related energy source: all(100). **R and D categories:** Health effects.

The objective of this study is to investigate the hematologic and mutagenic effects of arsine gas. Hematological investigations will be performed on rats, mice and rabbits inhaling various levels of arsine gas. Dose-response data and no-effect levels will be obtained. Specific areas to be investigated are: (1) arsine levels which induce hemolysis; (2) effect on acetylcholinesterase activity; (3) glycerol lysis time; (4) native protein fluorescence; (5) intracellular sulfhydryl levels; (6) Na-K ATPase activity; and (7) alteration of membrane proteins as determined by SDS polyacrylamide gel electrophoresis. Mutagenesis studies will be performed on E. coli strain WWP2. The goal of these studies will be to evaluate the possibility that arsine interferes with DNA repair mechanism. A dose curve will be obtained for any arsine effects observed in each of the studies listed above.
Keywords: MUTAGENESIS; HEMATOLOGY; RABBITS; RATS; MICE; INHALATION; DOSE-RESPONSE RELATIONSHIPS; DNA; BACTERIA; MUTANTS; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; ARSENIC COMPOUNDS; HYDROGEN COMPOUNDS; TOXICITY; BIOLOGICAL MODELS.

72100 Whole Animal Exposure to Acid Mists and Particulates on Pulmonary Metabolism of Benzopyrene in the Isolated Perfused Lung. Warsharsky, D. (University of Cincinnati, School of Medicine, Department of Enironmental Health, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** H625F-8147. **Contract:** 68-02-1678. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$90,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Physical and chemical processes and effects; Health effects.

The long-term goal of this research is to assess the effects of environmental contaminants on the pulmonary metabolism and distribution of the carcinogen benzo(a)pyrene. This research is attempting to clarify whether a change in metabolic rate, metabolic pathway or distribution in the tissues could account for differences in the carcinogenic response using the isolated lung perfusion model. An isolated perfused lung preparation, developed previously by the investigators of this contract, is being used for this study. Various combinations of crude air particulates, microsomal enzyme inducers, and acid mists are used as a pretreatment regimen before the intratracheal administration of 14C-benzo(a)pyrene alone or in combination with crude air particulate. Blood taken at various times throughout the perfusion and tissues are extracted with organic solvents and concentrated. The metabolites are chromatographed and quantitated using liquid scintillation counting. The metabolites of benzo(a)pyrene, their rates of formation, and their distribution in various tissues are determined. The isolated lung perfusion technique was used to study an in-vivo situation, the effects of SO2, crude air particulate, and benzo(a)pyrene treatment on benzo(a)pyrene metabolism. The influences of these agents on the metabolism of benzo(a)pyrene, an environmental carcinogen, may explain differences in the carcinogenicity of this agent. SO2, crude air particulate, and benzo(a)pyrene pretreatment increased benzo(a)pyrene metabolism in the isolated lung perfusion system and increased the formation of specific activated metabolites indicating that these agents may have carcinogenic activities.
Keywords: ANIMALS; PH VALUE; VAPORS; PARTICLES; AEROSOLS; LUNGS; METABOLISM; BENZOPYRENE; PHYSIOLOGY; PERFUSED ORGANS; SULFUR DIOXIDE; HEALTH HAZARDS; CARCINOGENS; BIOLOGICAL PATHWAYS.

72101 Assessment, Control and Health Effects of Indoor Air Pollution. Moschandreas, D. (Geomet, Inc., 15 Firstfield Road, Gaithersburg, MD, 20760). **Project number:** H625F-8169. **Contract:** 68-02-2294. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$11,000.
R and D categories: Health effects.

The objective is to develop a model for estimating extent of indoor air pollution. The approach will include monitoring indoor/outdoor levels of selected air pollutants in order to develop and verify the model. A model that will relate levels of outdoor pollution to levels of pollutants expected in adjacent indoor structures, particularly residences, will be developed. Currently under consideration is a plan to develop a prototype mobility and health status information survey document and test the practicality of its use through field sampling and analyses.
Keywords: INDOOR AIR POLLUTION; AIR POLLUTION CONTROL; HEALTH HAZARDS; MONITORING; MATHEMATICAL MODELS; HOUSES; BUILDINGS; AIR QUALITY.

72102 Application of Salmonella typhimurium Histidine-Deficient Strains to the Screening of Selected Air Pollutants for Potential Carcinogenicity. Little, L. (Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC, 27709). **Project number:** H625F-8191. **Contract:** 68-02-2724. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$35,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

Recent work in microbial genetics suggests that the histidine deficient strains of Salmonella typhimurium can be used for preliminary rapid detection of presumptive carcinogens. Although more than 400 pure compounds have been evaluated in the Salmonella system, very few crude mixtures have been evaluated using this or other systems. The purpose of this contract is to apply this system to the screening of selected ambient air samples. The application of the test system is carried out together with the development of appropriate chemical fractionation techniques which will separate fractions containing the mutagens and presumptive carcinogens. Modifications of the analytical and bioassay techniques are required to handle the uniquely small air samplers. Several modifications of the chemical fractionation techniques have been tried and assessed. One scheme yielding an initial group of seven fractions has been found most appropriate for air particulate samples. A modification of the Salmonella test system, the well test, has decreased by one half the amount of sample needed for initial screening. Work is now progressing on the evaluation of vapor phase components and gases.
Keywords: SALMONELLA TYPHIMURIUM; MUTAGEN SCREENING; CARCINOGENESIS; AIR POLLUTION; HISTIDINE; IMMUNOLOGY; MUTAGENESIS; CARCINOGENS; CHEMICAL ANALYSIS; BIOASSAY; GASES; VAPORS; AEROSOLS.

72103 Development of Cellular Model Systems to Determine Cytotoxicity of Alternate Sources. Bomers, W.E. (Rockefeller University, Biochemical Cytology Lab., 66th and York Avenue, New York, NY, 10021). **Project number:** H625F-8193. **Contract:** 68-02-2420. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.
Related energy source: all(100). **R and D categories:** Health effects.

The objective of the project is to develop a quantitative bioassay system to evaluate the effects of pollutants on lymphocyte cytotoxic activity. A number of cytological and biochemical experimental approaches will be made to define the nature of lymphocyte cytology. A quantitative lymphocyte transformation assay has been developed using a soluble mitogen, and a detailed change in lymphocyte size and number in response to a foreign stimulus has been studied. Development of an in-vitro cytotoxicity bioassay is proceeding.
Keywords: ANIMAL CELLS; BIOLOGICAL MODELS; BIOASSAY; CYTOLOGY; LYMPHOCYTES; TOXICITY.

72104 Protocol Development for Analytical Procedures: National Environmental Specimen Bank. Lafleur, P. (National Bureau of Standards, Washington, DC, 20234). **Project number:** H625F-8194. **Contract:** D5-0568. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$100,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The Analytical Chemistry Division of the National Bureau of Standards is a recognized leader in the collection and handling of

many different matrices for the production of Standard Reference Materials. This expertise will be utilized in the research and development of specimen sampling, storage, and analysis protocols to detect trace quantities of elemental and organic substances in a variety of matrices. This information will be utilized in the operation of the National Environmental Specimen Bank. Protocols have been prepared for specimen sampling and analysis of selected trace elements in human tissue. Preliminary data has shown that mammalian liver samples, stored for one year at -80 degrees C, are stable for selected trace element composition.
Keywords: BIOASSAY; STANDARDS; MAN; TISSUES; LIVER.

72105 Detection of Genotoxic Effects of Environmental Chemicals in Cultured Liver Cells. Williams, G.M. (American Health Foundation, Inc., 1370 Avenue of the Americas, New York, NY, 10019). **Project number:** H625F-8197. **Contract:** 68-02-2483. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
R and D categories: Health effects.

The main objective of this program is to develop and test in-vitro liver cell systems for assessing potential carcinogenicity via the quantitative assay of genotoxic effects such as DNA breakage, repair and mutagenic effects of environmental effluent chemicals potentially emitted from alternate energy sources. A useful in vitro bioassay system for potential carcinogenicity should contain the broadest possible metabolic activation capability for procarcinogens. It is anticipated that the development of a liver culture system for quantitatively assessing genotoxic effects of environmental effluents would provide a mammalian in-vitro test system with maximum intracellular metabolic activation capability. The approach being utilized includes the exposure of primary rat liver cells (hepatocytes) and liver cell lines to a variety of organic chemicals representing known carcinogens and non-carcinogens from different chemical classes. The end points being measured include unscheduled DNA synthesis by autoradiographic techniques and gene mutations in the dividing cell lines. Upon validation of each test system with pure chemicals, environmental samples will be examined where available. This research effort shall be subject to continuation for two additional phases. Upon validation of the assay systems developed, environmental chemicals will be screened. Final phases of this program will include the testing of these chemicals for transformation and malignant conversion of liver cell lines, and correlation of these results with the genotoxic assays developed in this program.
Keywords: CHEMICAL EFFLUENTS; CELL CULTURES; BIOLOGICAL EFFECTS; TOXICITY; LIVER; DNA; BIOLOGICAL REPAIR; MUTAGENESIS; METABOLISM.

72106 Defense Specific Absorption Frequencies of Nonionizing Radiation in Biological Systems. Allis, J.W. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H628A-7404. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$20,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

This project will study the interaction of nonionizing radiation with biological systems, identifying frequency ranges which preferentially interact with isolated molecular, subcellular and cellular components and tissues. The interaction will be observed through changes in absorption dielectric constant or insertion/reflection loss as a function of radiation frequency. A microwave spectrometer will be constructed and used to determine interaction frequencies in the microwave region. Results from these experiments will define frequencies of interaction with biological systems and will be used in the design of bioeffects studies using these systems. Two instrumental designs have been found not workable. A third is under study and has given preliminary evidence of reproducing literature data for the one molecular system in solution. Refinement of the instrumentation and further experiments are in progress.
Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; EXPERIMENT PLANNING; BIOCHEMISTRY; BIOLOGICAL STRESS; MOLECULAR STRUCTURE; ANIMAL CELLS; TISSUES.

72107 Interaction of Amplitude-Modulated (AM) Nonionizing Electromagnetic Radiation with Biological Systems. Blackman, C.F. (EPA, Office of Research and Development, Health Effects Research Lab., Developmental Biology Branch, Research Triangle Park, NC, 27711). **Project number:** H628A-7405. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$35,000.
R and D categories: Integrated assessment; Health effects.

The objective is to determine if amplitude modulated nonionizing radiation causes changes in physiological activity. The approach is to employ bench-top exposure facilities to confirm and extend the results previously reported by Adey and co-workers. The results to date confirm the presence of a frequency window cited by Adey and demonstrate a power window in which calcium association with brain tissue is altered.
Keywords: ELECTROMAGNETIC RADIATION; BIOLOGICAL EFFECTS; ANIMAL CELLS; TISSUE CULTURES; BRAIN.

72108 Effects of Amplitude Modulated Nonionizing Radiation on Membranes and Biopolymers Using Spectrophotometric and Fluorometric Measurements. Allis, J.W. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H628A-7409. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$21,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

Amplitude modulated or pulsed nonionizing electromagnetic radiation has been shown to affect animal behavior and to effect the chemistry and physiology of certain isolated organ systems. These results have been attributed to interaction between the radiation and cellular membranes, but has not as yet been experimentally verified. This work will utilize membranes and membrane bound enzyme systems during irradiation by amplitude modulated radiation in order to determine if such effects can be inferred from changes in fluorescence or enzyme activity. Fluorometric or spectrophotometric measurements will be conducted during exposure to nonionizing radiation using equipment developed specifically for this purpose. Results will indicate whether amplitude modulated nonionizing radiation will effect membranes such that changes in membrane bound enzyme activity or membrane structural properties are detected in vitro. Mode of interaction will be investigated if changes are found. A dose series for the red cell membrane bound enzyme, ATPase has been completed at several amplitude modulation frequencies between 16 and 150 Hz. Similar measurements have been completed at one exposure level for the mitochondrial membrane bound enzyme, cytochrome oxidase. Enzyme activity was measured spectrophotometrically during irradiation and no changes were found as compared to controls.
Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; CELL MEMBRANES; ELECTROMAGNETIC RADIATION; BIOCHEMISTRY; PHYSIOLOGY; ENZYMES; BIOCHEMICAL REACTION KINETICS; ANIMAL CELLS.

72109 Genetic and Cellular Effects of Microwave Radiation. Dutta, S.K. (Howard University, School of Liberal Arts, Department of Botany, 2400 6th Street, NW, Washington, DC, 20001). **Project number:** H628A-7413. **Contract:** R803561. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$3,000.
R and D categories: Integrated assessment; Health effects.

The objective is to determine whether microwave radiation can affect normal cellular processes associated with the utilization of genetic information. The approach is to use a battery of cellular systems, having a variety of gentic structures and functions, to distinguish betweeen perturbations caused solely by temperature rise and those caused by other mechanisms. The result will be scientific publication of the research data and interpretations in the open literature, both in peer-reviewed journals and in EPA technical publications. Under the conditions used for exposure, indications are that no changes can be shown in normal cellular processes that could not be due to temperature changes in the medium.
Keywords: MICROWAVE RADIATION; GENETIC EFFECTS; ANIMAL CELLS; TEMPERATURE EFFECTS; CYTOCHEMISTRY.

72110 Effects of Microwave Exposure on Immune Defense Mechanisms. Liddle, C.G. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H628A-7424. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.
Related energy source: solar(100). **R and D categories:** Health effects.

Reports from eastern European and Soviet investigators suggest that exposure to microwaves alters the immunological competence of humans and experimental animals. The objective of this research project is to examine the effects of low-level microwave exposure on immunological responses in laboratory animals. Mice are immunized against Type III Streptococcus pneumoniae and then exposed to 9 GHz pulsed microwaves for two hours/day for five days and the circulating antibody response is measured the day after the last exposure. The results should give an indication as to whether or not low-level microwaves alter the immunological competence of laboratory animals. If an alteration is found, further investigation will be conducted to try and determine the lowest exposure level that produces an effect. Three groups of approximately 24 mice with appropriate controls have been irradiated at an incident power density of 10 Mw/sq cm. All three groups showed an increased antibody response among the irradiated animals. Composite results show an average titer of 7.89 +- 1.39 for the irradiates vs. 7.47 +- 1.31 for the controls ($P < 0.05$). Titers are exposed as the reciprocal power to the base 2, i.e., 1/2x. Hematology results are presently being analyzed.

Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; IMMUNOLOGY; BIOCHEMICAL REACTION KINETICS; HUMAN POPULATIONS; IMMUNE REACTIONS; STREPTOCOCCUS; INFECTIVITY; LABORATORY ANIMALS.

72111 Microwave Dosimetry in Biological Systems. Tripathi, V.K. (Oregon State University, Department of Electrical and Computer Engineering, 200 Covell Hall, Corvallis, OR, 97331). **Project number:** H628A-7441. **Contract:** R804697-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: solar(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to better understand the interaction of electromagnetic energy with biological objects (animal and man size, etc.). Very simplified models, composed of dissipative dielectric media which simulate biological tissues, readily lend themselves to mathematical solutions, using high speed machine techniques. Such models possess very simple geometries and the incident radiation is a simple plane wave. In this study, solutions will be attempted for a model of prolate spheroid shape and incident frequencies near resonance (incident wavelength and object size of comparative magnitude).
Keywords: MICROWAVE RADIATION; DOSIMETRY; BIOLOGICAL MATERIALS; ELECTROMAGNETIC RADIATION; ANIMALS; MAN; BIOLOGICAL EFFECTS; BIOLOGICAL MODELS.

72112 Define the Radiation Exposure Received by Animals in the 85-Kr Whole-Body Exposure System. Kirk, W.P. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H628A-7452. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective of the project is to obtain dosimetry data to analyze results of health effects studies involving exposure of animals to 85-Kr in a chamber large enough to deliver 99% of the calculated infinite cloud beta dose to objects on its centerline. Skin dose is reduced by cage shielding (5%) and the animal's fur (10 to 50%). Thermally stimulated exoelectron emission (TSEE) dosimetry using BeO discs is being used to directly measure surface and depth doses under various exposure conditions. A product of the study will be the design, fabrication, and testing of a TSEE reader and data relating the following to 85-Kr concentration in the system: (1) free air dose; (2) surface dose in cages used; (3) depth dose curves; and (4) fractions of dose from beta, gamma, and bremsstrahlung. The TSEE reader has been designed, tested, modified, retested, and is now operational. Individual calibration of an initial batch of dosimeters has been accomplished and preliminary cage shielding and depth dose data obtained. Work is proceeding with calibration of more dosimeters, refinement of shielding and depth dose curves, and absolute calibration of the system.
Keywords: EXPOSURE CHAMBERS; RADIOACTIVE CLOUDS; KRYPTON 85; WHOLE-BODY IRRADIATION; RATS; DEPTH DOSE DISTRIBUTIONS; BETA DOSIMETRY; EXOELECTRON DOSEMETERS; DESIGN; PERFORMANCE TESTING; SKIN; CALIBRATION.

72113 Maintenance of Rats and Guinea Pigs Exposed to Krypton-85 for Observation of Carcinogenic and Life Span Effects. Kirk, W.P. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27711). **Project number:** H628A-7453. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

This project completes late effects observations on guinea pigs exposed to 85-Kr in beta-infinite cloud geometry in LD/sub 50/ studies done in 1973--1975 and rats exposed in skin tumor induction studies in 1976. Animals are conventionally maintained with daily checks for death/morbidity, biweekly weights and examination, bimonthly blood smears, and detailed hematologic workup when smears indicate preleukemic changes. Animals are sacrificed in extremis when possible to ensure fresh tissues. Decedents and sacrificed animals are necropsied and 80 tissues examined. Analysis of preliminary data (25% of animals still alive) indicates a very high risk of lymphocytic leukemia in female guinea pigs. While the dose delivered by 85-Kr beta radiation is almost totally to the skin, the lymphocytic leukemia risk resulting is comparable to that reported for exposure of guinea pigs to gamma radiation from radium and is in the range of 1 to 3 x 10/sup -5/ leukemias per rad (skin) years at risk. Ninety-five percent of the rats in the skin tumor study are dead and histopathological evaluations of tissues is proceeding. Necropsy data indicate the overall skin tumor risk is in the range of 10/sup -5/ to 10/sup -4/ tumors per rad (skin) year at risk for female Sprague-Dawley rats.
Keywords: EXPOSURE CHAMBERS; RADIOACTIVE CLOUDS; KRYPTON 85; BETA PARTICLES; WHOLE-BODY IRRADIATION; GUINEA PIGS; RATS; DELAYED RADIATION EFFECTS; LIFE SPAN; SKIN; LEUKEMIA; NEOPLASMS; RADIOINDUCTION; CARCINOGENESIS; LEUKEMOGENESIS.

72114 Application of Fluorescence to Determine the Effects of Nonionizing Radiation on Membranes and Biopolymers. Allis, J.W. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H628A-8412. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$31,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

This project will define changes in properties of biological membranes, membrane model systems and/or biopolymers as measured by fluorescence techniques. Work will be performed using a fluorometer modified to accept a microwave exposure system so that measurements may be made during exposure of the sample. If changes in properties are found, the mode of interaction of radiation with the biological system will be investigated. Results will indicate whether or not changes in properties of biological membranes can be detected during exposure of samples in vitro to microwave radiation. Mode of interaction will be investigated if changes are detected. The microwave exposure facility has been successfully mated to the fluorometer. Exposure system parameters have been characterized showing a useful range of 500 to 1700 MHz. Fluorescence measurements can be made using the system. Data have been obtained for unirradiated red cell membranes using a membrane lipid probe.
Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; CELL MEMBRANES; BIOLOGICAL MODELS; BLOOD CELLS; ANIMALS; PHYSIOLOGY.

72115 Effects of Chronic Exposure to EMR on Immune Defense Mechanisms of Animals. Smialowicz, R.J. (EPA, Office of Research and Development, Health Effects Research Lab., Research Triangle Park, NC, 27711). **Project number:** H628A-8424. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$25,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

The objective is to determine if long-term exposure of rats to 100 MHz (CW) in utero and/or through early life causes changes in lymphocyte function of these rats. Effect of 915 MH on the immune function of exposed rats will also be determined. Rats are exposed daily to a forward power of 500 W at 100 MHz (CW) under controlled, environmental conditions, throughout gestation and early post-natal life. Adult rats will be exposed for at least 20 hours/day to 915 MHz for 1 to 2 months. Hematologic and immunologic indices are measured and compared between sham- and microwave-exposed rats. Complete blood counts, enumeration of frequencies of B- and T-lymphocytes in lymph nodes, nitrogen-stimulated lymphocyte responses, and growth rates in rats are compared. Rats are presently being exposed to 100 MHz in a chronic study. These rats were exposed in utero and will be exposed through 90 days of age. Data from rats sacrificed at 22 and 42 days of age show no difference in the hematologic and immunologic indices measured between sham- and microwave-exposed rats. Exposure of rats to 915 MHz is anticipated to begin in a few months.
Keywords: ANIMALS; IMMUNOLOGY; BIOLOGICAL MODELS; MICROWAVE RADIATION; BIOLOGICAL EFFECTS; RATS; CHRONIC EXPOSURE.

72116 Relative Effectiveness of Pulsed Versus CW Exposure to EMR on Immune System. Smialowicz, R.J. (EPA, Office of Research and Development, Health Effects Research Lab., Research Triangle Park, NC, 27711). **Project number:** H628A-8428. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$4,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

The objectives are to determine relative effectiveness of pulsed versus CW exposure to EMR on the immune system, antibody response to antigen, and response to lymphocytes in vitro to mitogen stimulation of mice exposed at 425 MHz. Mice will be exposed to 425 MHz in the pulsed or continuous wave mode at several power densities for a period of 1 hour on each of 5 consecutive days. The response to antigenic challenge with SRBC in exposed mice will be assessed by the direct-plaque-forming cell assay. Circulating antibody titers will also be determined. Mitogen-stimulated response of lymphocytes will be assessed.
Keywords: ELECTROMAGNETIC RADIATION; MICROWAVE RADIATION; BIOLOGICAL EFFECTS; IMMUNOLOGY; BIOLOGICAL MODELS; MICE.

72117 Effects of Long and Short Term Exposure to EMR on Specific Learned Behavior of Animals. Gage, M.I. (EPA, Office of Research and Development, Health Effects Research Lab., Research Triangle Park, NC, 27711). **Project number:** H628A-8430. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$25,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

The objectives are to: (1) determine the lowest levels of microwave exposure needed to alter ability of rodents and primates to learn, remember, and perform specific behavioral tasks; (2) determine conditions of electromagnetic radiation exposure which alter behavioral performance and changes in conditions of exposure which alter the effects of specific power densities of radiation on behavior; and (3) measure learning and previously trained operant behavior in rodents and monkeys by comparing performance after single exposures or during the course of chronic exposures with baseline behavior. Current work has shown that increased ambient temperature exacerbates the effect of a given power density of microwaves on behavior of rats. The next phase will be to repeat these experiments with monkeys.
Keywords: MICROWAVE RADIATION; ELECTROMAGNETIC RADIATION; BIOLOGICAL EFFECTS; RATS; BEHAVIOR; DYNAMIC FUNCTION STUDIES; MODIFICATIONS; BIOLOGICAL STRESS; RODENTS; MONKEYS; TEMPERATURE EFFECTS; CHRONIC EXPOSURE.

72118 Multi-Parameter Study of the Rats Pre- and Postnatally Exposed to 85-Kr at Multiples of MPCA. Kirk, W.P. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27711). **Project number:** H628A-8454. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA. **Related energy source:** nuclear fuels(general)(100). **R and D categories:** Health effects.

The objective of the project is to determine some immunological, neurobiological, hematopoietic, and carcinogenic effects of continuous exposure of rats to 85-Kr in beta-infinite geometry during gestation and 6 hrs daily for 90 days after birth. Time-pregnant Sprague Dawley rats will be exposed for 23 hrs/day in our beta-infinite cloud 85-Kr chamber from day 6 through 20 of pregnancy. Male pups will be irradiated postnatally for 6 hrs daily, 5 days/week for 13 weeks, and reflex development, spontaneous activity, hematopoietic effects, and late effects will be compared with sham irradiates and cage controls. Antibody formation will be tested at weaning in female pups using vaccination and challenge with D. pneumoniae. Dams and male offspring will be maintained for life to study late effects. Exposure levels planned are 0.01, 0.03, and 0.09 mCi/cubic m. Open literature reports on carcinogenic, hematopoietic, immunological, and neurobiological effects vs. dose for protracted pre- and postnatal exposure of rats to 85-Kr will be made. The original protocol was tested in a series of sham exposures and proved defective in several respects. A revised protocol has been designed and tested successfully. Actual Kr-85 exposures will begin after completion of outside review of the protocol by the Department of Energy.
Keywords: EXPOSURE CHAMBERS; RADIOACTIVE CLOUDS; KRYPTON 85; INHALATION; RATS; PREGNANCY; CHRONIC IRRADIATION; INTERNAL IRRADIATION; PERINATAL IRRADIATION; EARLY RADIATION EFFECTS; DELAYED RADIATION EFFECTS; ANTIBODY FORMATION; IMMUNE REACTIONS; NERVOUS SYSTEM; HEMATOPOIETIC SYSTEM; FETUSES; NEOPLASMS; RADIOINDUCTION; CARCINOGENESIS; DOSE-RESPONSE RELATIONSHIPS.

72119 Relative Effectiveness of Short-Term Versus Long-Term EMR Exposure on Immune Defense. Smialowicz, R.J. (EPA, Office of Research and Development, Health Effects Research Lab., Research Triangle Park, NC, 27711). **Project number:** H628A-8467. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

The objectives are to determine the effects of short-term versus long-term EMR exposure on the immune system, as well as the effects of cellular and humoral immunocompetence of animals exposed to 2450 MHz microwaves. Mice are exposed to 2450 Mhz at several power densities ranging from 0 to 30 Mw/cm2 for periods of 15 to 30 minutes daily for 1 to 22 consecutive days. The parameters examined include: colonic temperature measurements; complete blood counts; assessment of immunocompetence employing in-vitro mitogen-stimulated lymphocyte response; enumeration of frequencies of T- and B-lymphocytes; and measurement of antibody response to sheep erythrocytes. No significant differences in the hematologic or immunologic indices examined have been observed between sham- and microwave-exposed mice. The duration of microwave exposure does not appear to affect immune function in these animals.
Keywords: IMMUNOLOGY; MICROWAVE RADIATION; BIOLOGICAL EFFECTS; DYNAMIC FUNCTION STUDIES; MICE.

72120 Effects of Microwave Exposure on Infectious Agents in Laboratory Animals. Liddle, C.G. (EPA, Office of Research and Development, Developmental Biology Branch, Research Triangle Park, NC, 27711). **Project number:** H628A-8469. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.
Related energy source: solar(100). **R and D categories:** Health effects.

The purpose of this study is to determine if microwaves alter the course of disease in animals exposed to an infectious agent. Animals are infected with Type III Streptococcus pneumoniae and then exposed to various frequencies and power densities of microwaves, and the course of the disease process is monitored. The results should provide information as to whether or not microwave exposure is deleterious to sick or debiliated individuals. This information will be useful in setting a standard for population exposures to microwaves. The first exposure group of mice infected and then exposed to 2450 Mhz microwaves at an incident power density of 10 Mw/cm2 for five hours per day for six days is just being completed. Preliminary results indicate that at this frequency and power density there is no difference in acute mortality between the exposed animals and the sham irradiated controls.
Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; INFECTIVITY; DISEASE RESISTANCE; LABORATORY ANIMALS; STREPTOCOCCUS; STANDARDS; MORTALITY.

72121 Microwave Dosimetry in Biological Systems. Weil, C.M. (EPA, Office of Research and Development, Health Effects Research Lab., Research Triangle Park, NC, 27711). **Project number:** H628A-8476. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$15,000.
Related energy source: solar(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to verify temperature data obtained with an infrared thermographic camera during and following microwave irradiation of phantoms through use of implantable temperature probes which do not perturb the microwave field. The final output will be a report detailing the results of measurements which will provide quality control validation of the thermographic camera measurements. Progress on this task has been held up pending the completion of a data processing software package which will plot iso-temperature contours from the thermographic pictures.
Keywords: MICROWAVE RADIATION; DOSIMETRY; PHANTOMS; INFRARED SPECTRA; THERMOLUMINESCENCE; BIOLOGICAL EFFECTS; BIOASSAY.

72122 Mutagenicity Studies of Environmental Chemicals Using In Vitro and In Vivo Bioassays. Simmon, V. (SRI International, 300 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** H629A-7912. **Contract:** 68-01-2458. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects.

The objective of this contract is to examine the mutagenic potential of a series of pesticides, toxic substances and complex mixtures in a battery of bacterial, yeast, mammalian cell, and conventional in vivo test systems. The battery consists of: reverse mutation assays in Salmonella typhimurium strains TA-1535, TA-1537, TA-1538, TA-98, and TA-100 and in Escherichia coli WP2; mitotic recombination in Saccharomyces cerevisiae D3; preferential toxicity assays in DNA repair-proficient and -deficient strains of E. coli and Bacillus subtilis; induction of unscheduled DNA synthesis in strain WI-38 human lung fibroblast mammalian cell mutagenesis in L5178Y mouse lymphoma and/or Chinese hamster ovary (CHO) cells, sister-chromatid-exchange in CHO cells, oncogenic transformation in Syrian hamster embryo cells or in BALB/C3T3 or C3H10T1/2 mouse fibroblasts, the sex-linked recessive lethal test in drosophila, the dominant lethal and heritable translocation test in mice. Other tests may be included. Not all samples will be evaluated in all tests. The contract has just been signed. Samples for testing are being prioritized.
Keywords: MUTAGENESIS; BIOASSAY; PESTICIDES; TOXIC MATERIALS; SALMONELLA TYPHIMURIUM; ESCHERICHIA COLI; SACCHAROMYCES CEREVISIAE; MICE; DNA; BIOLOGICAL REPAIR; BACILLUS SUBTILIS; LUNGS; MAN; HAMSTERS; SISTER CHROMATID EXCHANGES; EMBRYOS; DROSOPHILA; HEALTH HAZARDS; BIOLOGICAL EFFECTS; ORGANIC COMPOUNDS.

72311 Technical Support of Water Quality and Interdisciplinary Programs. Landers, B. (EPA, Office of Research and Development, Remote Sensing Operations Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J613B-54. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$1,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of the Technical Support Program is to provide research, developmental, documentary and environmental assessment support to agency operating programs through application of state-of-the-art advanced and specialized monitoring techniques and systems. Technical support is provided to the requestors, to the extent that resources permit, so long as it has been specifically identified as supportive of agency objectives and is not otherwise available. The program gives priority to requested services which require unique ORD personnel or equipment and relative priorities among a given user's requests are established by that user. Technical support output is a continuing service of (1) responding to scheduled, unscheduled and emergency requirements for field, analytical, and data analysis support through specialized field and analytical studies, organizing these data into summaries and providing interpretive reports; (2) adapting and modifying state-of-the-art techniques to gather empirical evidence of environmental levels of specified or suspected pollutants; (3) performing complex chemical and physical analyses; (4) testifying as expert witnesses at administrative and judicial proceedings; and (5) consulting. Advancement has been achieved in new-technology applications to agency environmental investigative needs, particularly in the use of remote sensing technology through aircraft and satellite borne data collection systems, including multispectral scanning and laser systems.
Keywords: WATER QUALITY; TECHNOLOGY ASSESSMENT; INVENTORIES; RESEARCH PROGRAMS; ENVIRONMENTAL IMPACTS; US EPA; MONITORING.

72312 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:** J620A-34. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$57,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

72314 Development of Environmental Keys. Webb, V. (EPA, Environmental Photographic Interpretation Center, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J620A-38. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$59,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of this program is to develop aerial photography environmental keys to serve both as a training material for new EPA personnel and as an analysis aid for the experienced photointerpreter. Development of these keys is a continuous and integral part of remote sensing programs conducted by EPA, using imagery collected for various technical support studies. Publications of the key description documents serve other interpreters or analysts in conducting environmental assessment through the use of aerial imagery. Two imagery interpretation keys are nearly complete, one dealing with detection of landfill leaching contamination and the other dealing with potential pollution sources in a typical harbor. In addition, work has begun in several areas of the country to determine where aerial imagery can be used to detect septic tank leach field failures.
Keywords: REMOTE SENSING; ENVIRONMENT; DATA ANALYSIS; STANDARDS; AERIAL MONITORING; LAND USE; BEHAVIOR; ENVIRONMENTAL TRANSPORT; POLLUTION; BIOLOGICAL MODELS; SURFACE WATERS; ENVIRONMENTAL EFFECTS.

72318 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:** J620A-44. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$50,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are to design, construct and test a two-frequency downward looking airborne Lidar system. Lidar systems have demonstrated capability in solving current pollution monitoring problems such as: (1) rapid assessment of mixing layer height over large areas, (2) determining point source plume dimensions, and (3) determining dimensions and structure within an urban plume. An innovative feature of the current system is the use of two frequencies for signature analysis of specific sources. The technical approach dictates maximum utilization of off-the-shelf hardware with emphasis on the use of microcomputer systems for maximum system flexibility. The 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.
Keywords: EARTH ATMOSPHERE; AEROSOLS; AEROSOL MONITORING; AERIAL MONITORING; AIR SAMPLERS; AIR; PARTICLES; REMOTE SENSING; OPTICAL RADAR; DESIGN; AIR POLLUTION.

72321 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

72329 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:** J624B-64. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.
Keywords: UTAH; TERRESTRIAL ECOSYSTEMS; MONITORING; CONTAMINATION; BASELINE ECOLOGY; IMPERIAL VALLEY; GEOTHERMAL ENERGY.

72331 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:** J625C-66. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$75,000.
Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Integrated assessment.

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 and a method for measuring plutonium in air will be prepared. Characterization will be made of particle emissions from a mixed uranium-plutonium oxide fuel fabrication facility and from selected coal-fired power plants to assess potential health hazards. Collaborative testing of the plutonium in soil methods has been completed. Testing of the plutonium in air method is in progress. The study characterizing emissions from a nuclear fuel fabrication plant has demonstrated the existence of techniques which fill many gaps in the information obtained in conventional environmental and source monitoring for particulates.
Keywords: RADIOACTIVE EFFLUENTS; MONITORING; PLUTONIUM; SOILS; AIR; MEASURING METHODS; RADIOACTIVE AEROSOLS; PARTICLES; FOSSIL-FUEL POWER PLANTS; HEALTH HAZARDS; URANIUM; FUEL FABRICATION PLANTS.

72334 Development of Background Evaluations for Validations of Groundwater Quality Monitoring Methodology. Mullican, J.W. (State Department of Water Resources, Solid Waste Underground Injection Section, Capitol Station, P.O. Box 13087, Austin, TX). **Project number:** J625C-69. **Contract:** 68-03-2564. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives are to: (1) field validate a research-developed methodology for monitoring groundwater quality as presented in EPA-600/4-76-026, Monitoring Groundwater Quality--Monitoring Methodology; (2) demonstrate how groundwater-quality impacts can be assessed in advance of significance damage; and (3) show how the EPA monitoring methodology can best be adapted to existing state monitoring programs. The project involves validation of the first 6 steps of the 15-step methodology. The study area is four counties in East Texas, where vast lignite deposits are being developed. The final report will: (1) identify pollution sources, causes, and methods of waste disposal; (2) identify potential pollutants; (3) quantify groundwater usage; (4) describe hydrogeologic setting; and (5) describe the existing monitoring efforts in the area. The report will provide the background information needed for incorporating mobility transport factors and designing the monitoring program.
Keywords: GROUND WATER; WATER QUALITY; MONITORING; TEXAS; LIGNITE; WASTE DISPOSAL; INVENTORIES; POINT POLLUTANT SOURCES; STANDARDS.

72336 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:** J625C-71. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$225,000.
Related energy source: coal(34); oil shales and tar sands(33); geothermal(33). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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. A comprehensive summary report detailing the development and application of passive remote sensing technology for assessing the environmental impact of energy related activities will be prepared. 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.

72338 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:** J625C-73. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$99,000.
Related energy source: coal(34); oil shales and tar sands(33); all(33). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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. A Western Energy Resources Atlas has been published in conjunction with a similar effort on air monitoring. A subbasin report on the San Juan River is currently being reviewed and progress on subbasins reports on the Tongue/Powder River, the Belle Fouche-Little Missouri, and others is well advanced.
Keywords: WATER QUALITY; MONITORING; USA; WESTERN REGION; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; BASELINE ECOLOGY.

72339 Four Corners Ambient Air Monitoring Network. Smith, D.E. (UTE Research Lab., Box 119, Fort Duchesne, UT, 84026). **Project number:** J625C-74. **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:** Integrated assessment.

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.

72340 Energy-Related Ambient Air Quality Monitoring in th 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-75. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$368,000.

Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Integrated assessment.

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.

72341 Animal Investigation Program. Smith, D.D. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627C-36. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$106,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives of the project are to assess the potential hazard to man through food-chain animals feeding on plutonium-contaminated land and to investigate claims of radiation damage to domestic animals living on 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 radiotelemetry 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. During recent years, gamma-emitting radionuclides were detected infrequently and strontium-90 concentrations in bones continued in a downward trend. Femur and lung concentrations of plutonium-239 in NTS cattle were nearly identical for the last six years with liver concentrations being a factor of 2 or 3 lower. Hypothetical dose estimates to man were estimated to be less than 11 millirems on the basis of the daily consumption of 0.5 kilogram of liver or muscle from animals that contained peak radionuclide levels. No gross or microscopic lesions were found in necropsied animals that could be directly attributable to the effect of ionizing radiation. Deer migrated up to 50 kilometers during the winter months.

Keywords: NEVADA TEST SITE; CONTAMINATION; SOILS; FOOD CHAINS; RADIONUCLIDE MIGRATION; PLUTONIUM 239; STRONTIUM 90; RADIOECOLOGICAL CONCENTRATION; CATTLE; DEER; RADIONUCLIDE KINETICS; SKELETON; LUNGS; LIVER; MUSCLES; RADIOACTIVITY; RADIATION MONITORING; MAN; ENVIRONMENTAL EXPOSURE PATHWAY; RADIATION DOSES.

72344 In Vitro Solubility of Plutonium, Americium, and Uranium as Influenced by Chemical Form. Barth, J. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627A-84. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$45,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The objective of the project is to study and compare the solubility of transuranium radionuclides in an artificial bovine ruminal-gastrointestinal system in order to predict the biological availability of various forms of these nuclides in vivo. A viable rumen juice preparation is augmented with a radioactive tracer and incubated for 24 hrs under physiological conditions. This preparation is converted to simulate abomasal and intestinal fluids by the addition of enzymes, bile, and adjustment of the pH. The solubility of plutonium-238, -239, and americium-241 from rumen contents of cattle grazing on plutonium contaminated desert vegetation is determined in in-vitro bovine gastrointestinal fluids. An in-vitro study on -vitro solubility of 241Am has been published. Comparison of 238Pu and 239Pu has been completed and analytical work is in progress.

Keywords: AMERICIUM 241; PLUTONIUM 238; PLUTONIUM 239; SOLUBILITY; BODY FLUIDS; INTESTINES; STOMACH; CATTLE; SIMULATION; IN VITRO; SOLVENT PROPERTIES; RADIONUCLIDE KINETICS.

72345 Influence of Microbial Activity on the Solubility and Availability of Plutonium. Au, F.H. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627A-81. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$50,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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 green houses. 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. In the extraction of plutonium in sterile and nonsterile contaminated NTS soil, the results suggest that extractable plutonium may be largely influenced by the soil microbial activity and that this concentration is the fraction which is available for assimulation by other organisms.

Keywords: NEVADA TEST SITE; SOILS; CONTAMINATION; GREENHOUSES; BENCH-SCALE EXPERIMENTS; PLUTONIUM; SOLUBILITY; RADIONUCLIDE MIGRATION; ROOT ABSORPTION; CROPS; RADIONUCLIDE KINETICS; BIOLOGICAL ACCUMULATION; MICROORGANISMS.

72346 Absorption, Distribution, and Excretion of Actinide Elements by Dairy Cattle. Potter, G.D. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627A-82. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$158,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The purpose of this research is to provide input data for hazard assessment of areas contaminated by plutonium, uranium, and americium originating from nuclear testing activities, nuclear power plants, nuclear fuel reprocessing/fabrication facilities, and uranium extraction/fabrication activities. Since man consumes large quantities of dairy products and beef, evaluation of radiological hazards associated with actinide releases must include transport to man via the food chain from cattle which could ingest large quantitites of these actinides. Dairy cows and goats are maintained in metabolism stalls and actinide elements are administered by oral or intravenous routes. Blood, milk, urine, and fecal actinide concentrations are determined daily until the animals are sacrificed for determination of tissue nuclide burdens. The actinides administered are in specific chemical/physical forms which include the forms found in the environment. A new study on the feeding of debris from old nuclear test sites to goats has been initiated in order to determine which of the long-lived radionuclides from the debris will be observed in tissues. A report has been published on 241Am metabolism in dairy goats and cows. Preliminary data from 238/239Pu study indicated that the bioavailability of 239Pu is not much different from 238Pu, which was predicted from the differences in specific activity and non-biological solubility studies.

Keywords: NEVADA TEST SITE; RANGELANDS; CONTAMINATION; ACTINIDES; FOOD CHAINS; RADIONUCLIDE MIGRATION; AMERICIUM 241; PLUTONIUM 239; PLUTONIUM 238; INTRAVENOUS INJECTION; ORAL ADMINISTRATION; COWS; GOATS; METABOLISM; RADIONUCLIDE KINETICS; RADIATION MONITORING; BLOOD; MILK; URINE; FECES; TISSUES; RADIOACTIVITY.

72347 Grazing Studies on the Actinide Contaminated Ranges of the Nevada Test Site (NTS). Smith, D.D. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627A-83. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$60,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects.

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. Food habit analyses of ingesta from rumen-fistulated steers and sacrificed cattle grazing on actinide contaminated range revealed that shrub species made up the major portion of their diet during most seasons of the year. Grasses were preferred during the spring months. An apparent

relationship between actinide concentrations in the ingesta and Eurota 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 were significantly higher than those of blood and muscle and 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. The plutonium-239 concentrations in bones, lungs, and livers collected from wildlife with free access to and from the contaminated zones ranged from 1 to 10% of those found in cattle restricted to the area.
Keywords: NEVADA TEST SITE; RANGELANDS; CONTAMINATION; ACTINIDES; FOOD CHAINS; RADIONUCLIDE MIGRATION; SHRUBS; GRASS; DIET; ANIMAL FEEDS; CATTLE; PLUTONIUM 239; INGESTION; RADIATION MONITORING; BLOOD; LIVER; LUNGS; MUSCLES; SKELETON; RADIOACTIVITY; RADIONUCLIDE KINETICS; GONADS; MAN; ENVIRONMENTAL EXPOSURE PATHWAY; RADIOECOLOGICAL CONCENTRATION.

72348 Biological Transport of Cm and Np in Ruminants. Potter, G.D. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J627B-85. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$80,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

These investigations quantitate curium and neptunium transport in commercially significant ruminant species, e.g., dairy goats and cattle, which are directly in the human food chain. Since man consumes large quantities of dairy products, any evaluation of radiological hazards associated with an actinide-contaminated countryside should consider transport to milk. On-going studies determine the amount of ingested activity transported to milk and establish what portion of the activity is retained in various tissues following initial absorption. Additional objectives include (1) quantitating the in vitro solubility of these nuclides in artificial rumen fluids, and (2) establishing the biological availability of curium and neptunium once they have been incorporated into an edible animal product. Dairy goats and cows are maintained at the Nevada Test Site farm in metabolism stalls to facilitate the collection of blood, milk, urine, and feces after the animals have been dosed with either curium or neptunium. Tissue nuclide concentrations are determined following subsequent slaughters. Artificial rumen procedures are also used to study in vitro solubility of specific radionuclides. Metabolism studies have been completed in dairy animals using curium and neptunium and are currently being compared for final reports. Results for both nuclides appear to be somewhat similar.
Keywords: CURIUM ISOTOPES; NEPTUNIUM ISOTOPES; METABOLISM; GOATS; COWS; RADIONUCLIDE KINETICS; MILK; RADIOACTIVITY; FOOD CHAINS; CONTAMINATION; MAN; ENVIRONMENTAL EXPOSURE PATHWAY; RISK ASSESSMENT; BLOOD; URINE; FECES; TISSUES; RADIATION MONITORING; NEVADA TEST SITE.

72358 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:** J621A-57. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$106,000.
Related energy source: all(100).

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.
Keywords: STANDARDS; RADIATION MONITORING; BIOASSAY; DOSIMETRY; HOT LABS; QUALITY ASSURANCE; RADIOCHEMICAL ANALYSIS; RADIUM 228; DRINKING WATER; SOILS.

72366 Special Studies in the Atchafalaya Basin. Hern, S.C. (EPA, Office of Research and Development, Water and Land Quality Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J613B-18. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$8,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 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.
Keywords: AQUATIC ECOSYSTEMS; MANAGEMENT; WATER RESOURCES; WATER QUALITY; PESTICIDES; ORGANIC CHLORINE COMPOUNDS; AROMATICS; FISHES; METABOLISM; ECOLOGICAL CONCENTRATION.

72367 Test Commercially Available Sensors, Samplers, and Systems for Field Applications. Lambou, V.W. (EPA, Office of Research and Development, Water and Land Quality Branch, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J620A-26. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$45,000.
R and D categories: Characterization, measurement, and monitoring.

The objective is to identify presently available equipment and techniques for field monitoring applications. Commercially available laboratory equipment will be modified if necessary and its use in field monitoring applications will be 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.
Keywords: SAMPLERS; WATER POLLUTION MONITORS; ESTUARIES; AQUATIC ECOSYSTEMS; FRESH WATER; HYDROCARBONS; TECHNOLOGY ASSESSMENT.

72368 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:** J620A-60. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$1,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

72369 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:** J621A-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$35,000.
Related energy source: all(100).

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 developed or assisted in the development of such documents as: A Handbook for Analytical Quality Control in Radioanalytical Laboratories; Quality Control for Environmental Measurements Using Gamma-Ray Spectrometry; Least-Squares Resolution of Gamma-Ray Spectra; and Quality Assuran-- for Biological Research and Environmental Monitoring.
Keywords: DRINKING WATER; STANDARDS; QUALIT CONTROL; RADIOCHEMICAL ANALYSIS; MANUALS; HOT LABS; RECOMMENDATIONS.

72370 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: J621A-02. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$106,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects.

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 are nearing completion. Critical steps in the method have been identified.
Keywords: MEASURING METHODS; STANDARDS; QUALITY ASSURANCE; POLLUTION; RECOMMENDATIONS; WATER; RADIUM 228; RADIOCHEMICAL ANALYSIS; PERFORMANCE TESTING; RELIABILITY.

72371 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:** J621A-03. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$129,000.
Related energy source: all(100).

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 1100 samples of known activity levels were distributed to the 150 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. A laboratory performance evaluation study (blind sample) in support of the National Interim Primary Drinking Water Regulations was initiated.
Keywords: HOT LABS; PERFORMANCE TESTING; COMPARATIVE EVALUATIONS; RELIABILITY; MONITORING; ENVIRONMENT; POLLUTION; RADIOCHEMICAL ANALYSIS; DRINKING WATER; STANDARDS.

72372 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:** J621A-06. **Contract:** R804337-02. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$196,000.
R and D categories: Characterization, measurement, and monitoring.

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.

72373 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:** J621A-56. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$24,000.
Related energy source: all(100).

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. At the request of the EPA regions, on-site laboratory evaluations were conducted and reports of findings were prepared for approximately 20 laboratories. Seminars were also conducted in several regions at the request of the region. 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.

72374 Monitoring Changes in Ground Water Quality as a Result of Geothermal Development, Conversion and Waste Disposal. Kresse, F.C. (Harding Lawson Associates, 55 Mitchell Blvd., P.O. Box 3030, San Rafael, CA). **Project number:** J624B-01. **Contract:** 68-03-2668. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$79,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

At the present time, there is no recognized guideline for monitoring changes in ground water quality due to the escape of geothermal fluids as a result of extraction, conversion and waste disposal processes in the development of geothermal energy. Data on 11 selected western US KGRA's will be compiled. A compilation of environmental and regulatory restraints related to geothermal energy development will be made. Pollution control technology will be surveyed. A general ground water monitoring methodology that can be applied to any geothermal development will be prepared.
Keywords: GEOTHERMAL RESOURCES; RESOURCE DEVELOPMENT; GROUND WATER; WATER QUALITY; GEOTHERMAL FLUIDS; WASTE DISPOSAL; RECOMMENDATIONS; MONITORING; KGRA.

72375 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:** J624B-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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

72376 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:** J625C-62. **Contract:** R805759-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$13,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment.

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.

72377 Regional Visibility: The Colorado Plateau. Walther, E.G. (John Muir Inst. for Environmental Studies, Inc., 743 Wilson Street, Napa, CA, 94558). **Project number:** J625C-76. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The project proposes to measure (and collect from others) background visibility data necessary for the setting of visibility standards and the validation of operational models. The measurement program relies on a recently developed instrument, the multiwavelength contrast photometer. Calculations and measurements indicate that while multiwavelength contrast measurements in the blue portion of the visible spectrum are primarily sensitive to aerosol within the mixing layer, contrast measurements in the red portion of the spectrum are sensitive to aerosol above the mixing layer. The relationship between wavelength dependence on contrast measurements to vertical aerosol distributions is quite dependent on observation angle. Since contrast measurements are related to both tropospheric and stratospheric aerosol concentrations, the instrument is well suited to measure/monitor contrast changes due to spatial variations in aerosol concentrations that take place over hundreds of kilometers. Subject contrast is directly related to visibility and consequently the contrast telephotometer is also a direct measure of visibility as a function of spatially varying aerosol loads. Final output is in the form of a final report describing performance of photometer network system.
Keywords: COLORADO PLATEAU; VISIBILITY; AIR QUALITY; AEROSOLS; STANDARDS; MEASURING METHODS.

72378 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:** J625C-77. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$50,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 prefered 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.

72379 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:** J625C-78. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$125,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

A current monitoring problem related to energy development in the western states is the potential degradation of visibility due to the introduction of fine particulates into the atmosphere. Documentation of particulate burdens at present relies on in situ monitoring techniques with their associated difficulties in terms of expense per sample and limited coverage. Present downward-looking airborne Lidar systems overcome the sampling difficulties associated with in situ techniques but only produce relative results and thus in general only yield dimensions of the particular aerosol problem. 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. A most important application would be the documentation of particulate scattering over pristine areas of the west before and after energy development projects. An operational Raman downward-looking Lidar incorporating real time normalization of the Mie scattered return using the Raman N2 return will be assembled, tested, and reported. Raman normalized technique will be demonstrated in pristine areas in the vicinity of energy resource development and an historical data base will be established. Thus far, a Lidar system has been constructed for use as test frame in Raman N2 experiments, and software has been written to simulate Lidar returns for aid in system design.
Keywords: MONITORING; MEASURING METHODS; REMOTE SENSING; WESTERN REGION; PACIFIC NORTHWEST REGION; AIR POLLUTION; AEROSOLS; PARTICLES; AEROSOL MONITORING; ENVIRONMENTAL EFFECTS.

72380 Technical Support for Toxic Substances Program. Webb, V. (EPA, Office of Research and Development, Environmental Photographic Interpretation Center, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** J763A-01. **Supported by:** Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$20,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

Historical and current photographic coverage of areas in the vicinity of selected toxic substances manufacturing, processing, use or disposal sites are being used to assess changes and trends in demography, land use, and point and nonpoint pollution sources. Annotated map sheets and imagery showing the changes in population density, effluent source distribution, and industrial growth or decline will be included with individual project reports. This work is being performed as technical support. Additional annotated map sheets will be furnished as technical support showing the effect of label restrictions for selected pesticides. Several industrial areas have been surveyed and trend assessments conducted, the results of which have been furnished to the Office of Toxic Substances. In addition, proposed label restrictions have been applied to demonstration areas in Oklahoma, Arkansas, Louisiana, Alabama and Mississippi. These projects have demonstrated the extremely limited areas to which a pesticide or the test pesticide could be applied.
Keywords: TOXIC MATERIALS; RESEARCH PROGRAMS; TECHNOLOGY ASSESSMENT; RISK ASSESSMENT; PHOTOGRAPHY; MAPPING; IMAGE PROCESSING; CHEMICAL EFFLUENTS; HEALTH HAZARDS; BIOLOGICAL EFFECTS; PESTICIDES; OKLAHOMA; ARKANSAS; LOUISIANA; ALABAMA; MISSISSIPPI; POPULATION DENSITY; OCCUPATIONAL SAFETY; CARCINOGENS.

72506 Identification of Components of Energy-Related Wastes and Effluents. Ryan, J.F. (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: all(100). **R and D categories:** Integrated assessment.

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.
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.

72542 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.

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., sublight 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.**Keywords:** AQUATIC ECOSYSTEMS; PHOTOLYSIS; PHOTOSENSITIVITY; WATER POLLUTION; HYDROLYSIS; SEDIMENTS; MATHEMATICAL MODELS; PHOTOCHEMISTRY; ENVIRONMENTAL TRANSPORT.

72543 Combined Runoff, Hydraulic and Water Quality Models. **Project number:** K609A-410. **Contract:** R805471-01. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$3,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The purpose of this project is to combine the storm runoff model and the Explore-I hydraulic and water quality model in such a fashion that the allied FORTRAN program can be made to run on a single pass. Another objective is to restructure the combined program so that it can be run on the smaller computers usually available to the engineering firms doing impact studies; such machines should not exceed 64K eight-bit bytes of core and have no more than one tape and one disk plus printer as peripherals. The approach is as follows: (1) reduce the size of the core required for data storage; (2) reduce the number of programs that must be core resident at any one time; (3) calibrate the various parts of the combined program at specified check points; and (4) calibrate both the combined program and a sensitivity study of the same. The computer programs for the two models have been examined and found to be flexible enough to accomplish the necessary overlay work. An INTERDATA 7/16 computer has been chosen and the compiler and utility routines have been examined and found to be adequate. A final report will be published at the end of the project describing the results and giving guidance for the use of the linked model.
Keywords: RUNOFF; HYDROLOGY; WATER QUALITY; MATHEMATICAL MODELS; STORMS; COMPUTER CODES; WATER POLLUTION.

72544 Study on Energy Costs of Water Quality Improvement. Williamson, K.J. (Oregon State University, Department of Civil Engineering, 200 Covell Hall, Corvallis, OR, 97331). **Project number:** K609A-414. **Contract:** 68-03-2397. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$1,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The primary objective of this study is to test a methodology to estimate the economic and energy costs of implementing point source pollution control strategies on a river basin. A second major objective is to provide estimates of economic and energy cost incurred under the strategy adopted to improve water quality in the Willamette River, Oregon. The approach used in this study is as follows: (1) three unique strategies are to be formulated, analyzed, and compared; (2) cost and energy requirements of attaining at least three levels of water quality under each strategy will be evaluated; (3) the level of water quality will be determined by the biochemical oxygen demand and dissolved oxygen concentration; and (4) economic and energy costs associated with each strategy--water quality level combination will be estimated by the input-output analysis procedure. A final report will be submitted at the end of the project that summarizes the results of the project and includes guidance for use of the methodology.
Keywords: WATER QUALITY; ENERGY CONSUMPTION; WATER POLLUTION CONTROL; POINT POLLUTANT SOURCES; ECONOMICS; OREGON.

72545 High-Resolution Separation of Organics in Water. Bertsch, W. (University of Alabama, Department of Chemistry, Box 1937, University, AL, 35486). **Project number:** K614D-109. **Contract:** R804748-02. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$47,000.

Organics in water and sediment will be analyzed, and emphasis will be placed on the development of techniques to fingerprint oil spills in water and other bodies (marine life, sediments) which have been exposed to crude oil and petroleum products. A general method will be developed to distinguish between indigenous hydrocarbons and organics which have been introduced artificially. High resolution gas chromatography with glass capillary columns and multiple detectors will be used. At least three sets of characteristic patterns will be developed for each sample. These will include a general profile (FID) and chromatograms which are produced by a nitrogen sensitive AFID and a sulfur sensitive FPD. The chromatograms will be treated by pattern recognition techniques. Complete separation of critical areas will be accomplished by hearting-cutting techniques using a dual oven/two-dimensional GC with two capillary columns. A two-dimensional GC has been successfully tested. Selected components or groups of substances are switched from the first GC into the second instrument for further resolution. Switching is effected by Dean's switches with off-line solenoid valves. An electrical heating device is presently installed which will allow the temperature of the intermediate trap to be raised from -100 degrees C to 280 degrees C in 20 msec or less.**Keywords:** ORGANIC COMPOUNDS; SEPARATION PROCESSES; WATER POLLUTION CONTROL; REMOVAL; HYDROCARBONS; SEDIMENTS; WATER POLLUTION.

72546 Sorption Processes in Soils and Water. Karickhoff, S.W. (EPA, Office of Research and Development, Environmental Research Lab., College Station Road, Athens, GA, 30605). **Project number:** K617B-207. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$95,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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. 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.

72548 Input, Deposition, and Post Depositional Conversion of Arsenic. Anderson, M. (University of Wisconsin at Madison, Department of Civil Engineering, Madison, WI, 53706). **Project number:** K625B-210. **Contract:** R804881. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$1,000.
Related energy source: coal(50); geothermal(50). **R and D categories:** Physical and chemical processes and effects.

The input, deposition, and post depositional transport and conversion of arsenic is being evaluated in the lower section of the Menominee River at the entrance of Green Bay. Atmospheric mobilization and inputs of arsenic to the aquatic system are also being assessed. The objectives of the investigation are to: (1) obtain a total mass balance of arsenic by describing the net atmospheric depositional input, sedimentation, resuspensions rates, and convective transport of arsenic; and (2) elucidate the major controlling mechanisms for arsenic in this and other aqueous systems in general. An analytical method for the speciation of arsenicals in sediments at low concentrations has been developed. Mass balance studies have been completed for the ecosystems. Sorption isotherms for organoarsenicals in sediments and rates of chemical transformation have been obtained and are being used in a mathematical model describing the fate and transport of arsenicals.
Keywords: ARSENIC; DEPOSITION; ENVIRONMENTAL TRANSPORT; QUANTITY RATIO; RIVERS; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; SEDIMENTATION; PARTICLE RESUSPENSION.

72549 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.
R and D categories: Physical and chemical processes and effects.

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. The first phase experiments are in progress, as is the planning for the major portion of the study.
Keywords: TOXIC MATERIALS; AQUATIC ECOSYSTEMS; BIOLOGICAL MODELS.

72601 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-18. **Contract:** R804731-01. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

72604 Soil Filtration of Sewage Effluent of a Rural Area. Sabey, B.R. (Colorado State University, School of Agricultural Science, Department of Agronomy, Fort Collins, CO, 80523). **Project number:** L611C-51. **Contract:** R805401-02. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$40,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The work plan is presented in two parts. Part 1 consists of a continuation study of irrigation of mountain meadows with lagoon-stored municipal sewage effluent during summers. The summer phase was begun in 1976 with the prime objective of determining sewage loading rate, optimum frequency of loading and drying cycles, and soil treatment efficiency. Part 2 consists of a study to determine the feasibility of winter operation of a soil treatment infiltration system where wastewater is injected beneath ice capped ridge and furrow plots. The final output will be a report detailing the evaluation of the summer spray irrigation loading rate and dosing frequency and the optimum winter ridge and furrow flood irrigation technique. Results to date indicate rates of 7.5 cm/wk as feasible for both summer and winter operation.
Keywords: SOILS; FILTRATION; SEWAGE; CHEMICAL EFFLUENTS; MOUNTAINS; MUNICIPAL WASTES; WASTE MANAGEMENT; WASTE WATER; CROPS; PLANTS; GROUND WATER; CONTAMINATION; GROUND DISPOSAL.

72605 Dissemination of Information Concerning Animal Production Effects on Environmental Quality. Rowe, M.L. (East Central Oklahoma State University, School of Environmental Science, Ada, OK, 74820). **Project number:** L617D-28. **Contract:** R805151-02. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$97,000.
Related energy source: biomass(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The proposal outlines a project aimed at facilitating the dissemination of information pertaining to animal production's impact on environmental quality. The publications to be abstracted will be examined for the following topics: (1) the environmental impact of animal production activities on water, ground water, air, soil systems, health, and aesthetics; (2) feedlot, confinement pen, rangeland, and pasture land management, including animal waste management which includes the use of chemical fertilizers, manures, green manures, and sewage sludge in conjunction with animal production areas, the use of pesticides in conjunction with animal production areas or animal production-related areas, and pollution effects of crop residues, soil losses and sediments production from animal production areas to animal production-related areas; (3) legal, economic, and social constraints; and (4) research and development. The project staff will maintain a file copy of all articles which appear in the bibliography. Upon request to the project staff, users will be supplied a copy of individual articles at cost. This will be accomplished by searching the literature, abstracting pertinent publications, publishing water-related abstracts in Waters Resources Information Abstracts, and submitting a cumulative bibliography of abstracts to the Environmental Protection Agency for publication at the end of each budget period. This project has produced one volume of abstracts which is at the printer and a second volume is being prepared for printing.
Keywords: INFORMATION SYSTEMS; ANIMALS; PRODUCTION; ENVIRONMENTAL IMPACTS; AGRICULTURAL WASTES; ENVIRONMENT.

72610 Combined Industrial Wastes as Process Reactants for Mutual Detoxification. Lane, A.P. (Bio Ecology Systems Inc., 4100 E. Jefferson Avenue, Grand Prairie, TX, 75050). **Project number:** L610-55. **Contract:** 804685. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective of this program is to develop a practical process for the use of actual industrial waste chemicals as detoxification reagents for other toxic and hazardous industrial waste chemicals, specifically the utilization of waste hexavalent chromium to oxidize waste heavy metal cyanide solutions. After investigation of the utilization of hexavalent chromium solutions to oxidize heavy metal cyanide solutions is done in the laboratory and studied industrially, a final report detailing the studies will be produced. Limits in terms of excess cyanide that can be used in the reaction of the waste chromium have been established. Gelling and crystallization of the wastes pose a major problem. Copper concentrations of less than 500 mg/l should be employed in the reactions studied.
Keywords: INDUSTRIAL WASTES; WASTE PROCESSING; PROCESS CONTROL; PURIFICATION; CHROMIUM; CYANIDES; OXIDATION; CHEMICAL PROPERTIES.

72611 Pollution Profiles for Petrochemical Production: A Critical Analysis and Development of Waste Loads and Treatment Costs and Energy Requirements. Philoon, W. (University of Tulsa, School of Engineering and Physics, Department of Chemical Engineering, 600 S. College Avenue, Tulsa, OK, 74110). **Project number:** L610B-29. **Contract:** CI 75-0179. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100).

The University of Tulsa proposes to do a pollution profile on the petrochemicals industry. The purpose of this profile would be to establish which of the top 100 major petrochemical processes will, in the future, present the most difficult problems in pollution abatement. The results of this profile would not duplicate any work which is currently available. The University of Tulsa's approach would be as follows: (1) determine the 100 major processes, (2) compile production information for the processes for the last 20 years, (3) obtain flow sheets and materials balance for each, (4) determine the amount and character of the wastes from each process, (5) determine waste loading in total pounds, (6) estimate cost of treatment for each, (7) estimate the energy requirement for treatment, (8) examine housekeeping procedures, and (9) determine the most serious waste disposal problems.
Keywords: PETROCHEMICALS; PRODUCTION; ENVIRONMENTAL IMPACTS; PETROLEUM INDUSTRY; PETROCHEMICAL PLANTS; PROCESS CONTROL; INVENTORIES; CHEMICAL EFFLUENTS; FLOWSHEETS; WASTE MANAGEMENT; COST; ENERGY DEMAND; SYSTEMS ANALYSIS; SAFETY ENGINEERING; ECONOMICS; HEALTH HAZARDS; POLLUTION CONTROL.

72612 Identification of Refractory Organic Compounds from Treated Refinery Wastewaters. Harrison, W. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL, 60439). **Project number:** L610C-12. **Contract:** D5-0681. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100).

The output will be a report which identifies the refractory organic pollutants in treated petroleum refinery effluents entering receiving waters in the Calumet District of Illinois and Indiana. The products of this research will be used in evaluation, planning, formulation, and implementation of research treatment and control systems to effectively remove the refractory organic contaminants currently being discharged from petroleum refining wastewater treatment systems. The research work to be performed under this agreement will be complementary to research presently being

funded by the DOE at Argonne to study the dynamics, fate, and effects of organic pollutants in southwestern Lake Michigan. The work relates to gas chromatographic/mass spectrometric identification of the organic pollutants emanating from petroleum refinery activated sludge treatment systems which presently discharge effluents to Lake Michigan via the Calumet River and Indiana Harbor Canal. Composite samples of these effluents shall be collected and screened and the organics identified by GC/MS. Additionally, composited effluent samples ahll be further treated by activated carbon and the carbon treated effluents shall be screened for GC/MS identification of refractory organics.
Keywords: ORGANIC COMPOUNDS; WASTE WATER; WASTE PROCESSING; PETROLEUM REFINERIES; ENVIRONMENTAL IMPACTS; REMOVAL; PURIFICATION.

72613 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:** L610O-13. **Contract:** R805099. **Supported by:** Robert S. Kerr Environmental Research Lab.; Ada, OK (USA). **Funding:** EPA-$81,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment; Health effects.

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.

72614 American Petroleum Institute: Refinery Sour Water Stripper Studies. Gantz, R.G. (American Petroleum Institute, 2101 L Street NW, Washington, DC, 20037). **Project number:** L610C-14. **Contract:** R804364. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: oil and gas(100).

The project will produce the data base necessary to develop design equations for a refinery sour water stripping tower capable of achieving low bottoms concentrations of ammonia in the presence of ammonia fixation components. This will be accomplished by pulling together existing information, conducting bench-scale studies of operational variables on a spectrum of sour water sources, and identifying the ammonia fixation components. In addition, the cyanide compounds in sour water will be identified, and bench studies of cyanide removal will be conducted.
Keywords: PETROLEUM REFINERIES; ENVIRONMENTAL IMPACTS; CYANIDES; REMOVAL; DESIGN; POLLUTION CONTROL EQUIPMENT; WATER POLLUTION CONTROL.

72615 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-29. **Contract:** 12050GXF. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.

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.

72616 Muskegon County, Michigan, Wastewater Management System. Workman, H. (Muskegon County Dept. of Public Works, County Building, Muskegon, MI, 49440). **Project number:** L611C-06. **Contract:** R802457. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

This project will provide a demonstration of centralized regional treatment facilities for the management of combined municipal and industrial wastewater with nutrient recovery and reuse. A wastewater management system for Muskegon County, Michigan, handles flows totaling 32 MGD and is expandable to a capacity of 42 MGD. The system is comprised of a collection network with seven sub-regional access points, transmission pipeline to a rural 10,500-acre site, aerobic bio-oxidation in three 8-acre, 15 feet deep aerated lagoons, long-term storage in two 850-acre, 12 feet deep lagoons, sedimentation, chlorination, disinfection, a channel and pressurized pipe distribution network supplying 54, 850 to 1400 feet radius, center-pivot irrigation machines, approximately 5,405 acres of irrigable agricultural land, and a groundwater control and effluent collection system of perforated plastic drainage time and wells which discharge via channels to surface water of the Muskegon River and Black Creek, flowing to Lake Michigan through Muskegon Lake and Mona Lake. Initial acceptance of wastewater for treatment and storage by the system began in May 1973. The system became fully operational in 1974. An intensive research program initiated in 1972 included socio-economic and environmental impact studies, preconstruction engineering optimization studies, surface and groundwater quality monitoring and evaluation, and pre-irrigation farm management planning and crop selection studies. Wastewater treatment performance evaluations were initiated in 1973. Agricultural productivity studies begun in 1974 will evaluate resource recovery potentials of the system concept, under actual conditions of full-scale wastewater irrigated agricultural operations. All project data collections were completed in December 1978. Final reports are now in preparation.
Keywords: WASTE WATER; MANAGEMENT; MICHIGAN; MUNICIPAL WASTES; INDUSTRIAL WASTES; MATERIALS RECOVERY; RECYCLING; ENVIRONMENTAL IMPACTS; SOCIAL IMPACT; ECONOMIC IMPACT; WATER POLLUTION ABATEMENT.

72617 Wastewater Renovation by Sprinkler Irrigation at Tallahassee. Overman, A.R. (University of Florida, Department of Agricultural Engineering, Gainesville, FL, 32601). **Project number:** L611C-10. **Contract:** S800829-01. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

Several forage crops will be grown to determine suitability for receiving secondary effluent. Each crop will be grown at four irrigation rates: approximately 1, 2, 4, and 8 inches per week of effluent. Vegetation will be harvested at appropriate stages of growth and evaluated for yields, dry matter, nitrogen content, phosphorus, potassium, calcium, magnesium, and trace elements. Analysis will be run weekly on composite effluent samples for the same chemical elements. Response of the forest area to application of secondary effluent will also be evaluated through limited measurements of selected trees and through periodic photographs of selected spots in the forest area. The latter will give some idea of the shift in the forest ecology as a result of perturbation by the effluent. Extensive monitoring of the ground water in this area will be carried out. Plantings of species of trees are planned for screening of species suitable for this kind of environment. Measurements will be taken to determine flow patterns of the infiltrating water or chemical changes in the ground water, and of microbiological changes. Flow pattern will be determined by weekly readings of water table evaluations in a series of monitoring wells. Weekly samples will be collected from the various monitoring wells and will be analyzed for pH, chlorides, nitrates, ammonia, phosphates, calcium, magnesium, sodium, potassium, and trace elements. In addition, samples will be cultured for determination of fecal bacteria as an indication of ground water contamination.
Keywords: WASTE WATER; WASTE MANAGEMENT; IRRIGATION; ENVIRONMENTAL IMPACTS; PURIFICATION; FLORIDA; CHEMICAL EFFLUENTS; METABOLISM; ECOLOGICAL CONCENTRATION; BIOLOGICAL ACCUMULATION; NITROGEN; PHOSPHORUS; POTASSIUM; CALCIUM; MAGNESIUM; TRACE AMOUNTS; PLANTS; CHEMICAL COMPOSITION; GROUND WATER; CONTAMINATION; CROPS; AGRICULTURE; GROUND DISPOSAL.

72618 Sewage Disposal on Agricultural Soils: Chemical and Microbioloical Implications. Dronen, N.O. (Texas A and M University at College Station, Department of Biology, College Station, TX, 77843). **Project number:** L611C-19. **Contract:** R803281-01. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The research will involve measurement of the chemical and microbiological status of agricultural land that has undergone treatment with undisinfected municipal sewage waters for the past 15 years. Specifically, the quantities of P, N, As, Cd, Cr, Hg, Ni, Zn, Cu, and Pb in soils and drainage waters will be measured. The content of these elements in crops grown on the land will also be measured. Control areas not having received sewage waters will be sampled for comparative purposes. The objective of this portion of the study is to obtain the facts required in making recommendations on the management of agricultural lands receiving inorganic chemicals in sewage waters. The microbiological portion of the project will be designed to measure the population of pathogenic bacteria, viruses, and parasites in the soils and drainage waters. Soil biota will be examined to determine if they harbor more pathogenic organisms than similar organisms found on agricultural lands not receiving sewage waters. Metal columns filled with soil fom the sewage farm will be used in studying the adsorption and movement of salmonellae in soil. The results of the biological portion of the study should provide some basis for evaluating the public health effects of applying sewage waters to agricultural soils. It will also provide the information needed in managing such soils to minimize potential public health hazards.
Keywords: SEWAGE; GROUND DISPOSAL; SOILS; SOIL CHEMISTRY; MICROORGANISMS; ENVIRONMENTAL IMPACTS; IRRIGATION; PHOSPHORUS; NITROGEN; ARSENIC; CADMIUM; CHROMIUM; MERCURY; NICKEL; ZINC; COPPER; LEAD; ECOLOGICAL CONCENTRATION; CROPS; TRANSLOCATION; ENVIRONMENTAL TRANSPORT; HEALTH HAZARDS.

72619 Land Application of Waste Water Under High Altitude Conditions. Borrelli, J. (University of Wyoming, School of Agriculture, Department of Agricultural Engineering, P.O. Box 3435, University Station, Laramie, WY). **Project number:** L611C-20. **Contract:** R803571-02. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
R and D categories: Physical and chemical processes and effects.

Land application of effluent disposal is receiving strong emphasis as a pollution control method. The problem is to determine the interrelationships between effluent content, climate, soil properties, and growth of agronomic crops to provide efficient operation of effluent irrigation systems, especially under harsh environments. Specific objectives are to evaluate: (1) the effects of effluent nutrients on the soil, forage crops, and ground water; (2) production and quality of forage species; (3) the mechanical operation of the sprinkler system; (4) labor and electrical power requirements and crop production information required for an economic analysis; and (5) design and operation criteria. Changes will be recommended whenever necessary. To date nitrification has been found to occur below the ice pack in the field while ammonification occurs within the ice pack. Ammonia nitrogen is much more mobile in the ice pack than organic nitrogen. There is a distinct possibility that spring thaw may result in the contamination of ground water. The controlled environment experiments indicated that there could be a deficiency of nutrients in the effluent to adequately produce good quality forage. When the plants were subjected to a warmer environment, deficiencies of N and P were not as evident. Soil data showed that N was being depleted from the soil while P was accumulating. Collection of water, soil, and forage data at the field site will continue as initially proposed.
Keywords: GROUND DISPOSAL; WASTE WATER; SOIL CHEMISTRY; CLIMATES; IRRIGATION; ENVIRONMENTAL IMPACTS; CROPS; GROUND WATER; PRODUCTION; OPERATION; ELECTRIC POWER; CONSUMPTION RATES; MANPOWER; DESIGN; LEVELS.

72621 Evaluation of High-Rate Infiltration-Percolation Beds to Improve Water Quality. Smith, D.G. (Boulder City Government, P.O. Box 791, Boulder, CO, 80303). **Project number:** L611C-52. **Contract:** R803931-02. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$23,000.
R and D categories: Physical and chemical processes and effects.

This project involves the operation and monitoring of three infiltration-percolation basins of varying areas less than one acre. Secondary effluent from a municipal wastewater treatment plant is applied at loadings of 100 acre-feet/acre/year to 200 acre-feet/acre/year. The analysis of water quality and the various operational modes available and their effect on water quality is the main emphasis of the project. Additional studies in the supplemental funding for FY 79 are scheduled to evaluate primary treated sewage on existing infiltration basins. This wastewater will be applied at rates of 50 acre-feet/acre/year and 100 acre-feet/acre/year.
Keywords: WATER QUALITY; MUNICIPAL WASTES; WASTE WATER; PURIFICATION; WASTE MANAGEMENT; FILTRATION; SEWAGE; GROUND DISPOSAL; ENVIRONMENTAL IMPACTS.

72622 Large-Scale Lysimeter Infiltration-Percolation Test of Secondary Treated Municipal Sewage. Leach, L.E. (EPA, Office of Research and Development, Wastewater Management Branch, P.O. Box 1198, Ada, OK, 74820). **Project number:** L611C-53. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$20,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects.

The proposed research is designed to evaluate vertical changes in applied secondary wastewater moving through soil columns. Eight lysimeters, 8' deep and 6' in diameter, have been constructed and will be used to test the vertical changes in the quality of applied secondary treated municipal effluent. Two local soils will be used in four lysimeters each (Konawa sand and Chigley sandy loam). The test will be conducted by flooding the soil surfaces with secondary treated municipal wastewater and holding constant heads for several weeks, then drying for specific periods of time. After a drying cycle is completed, the columns will be reflooded and the cycle repeated a number of times. Infiltration-percolation rates will be determined for each flooding cycle, evaporation will be measured, and a water balance determined based on moisture content in the soil column, in-flow, evaporation, and cut-flow from the bottom of the columns. Vertical profiles of hydrogen ion concentration converted to soil moisture and mass density will be measured regularly to determine the change in volume of water in the soil versus depth and change in bulk density of the soil versus depth and time, respectively. The water quality analysis measured at various depths bimonthly includes total phosphate, orthophosphate, the nitrogen series, pH, sulfates, Cl, cod, and fecal coliforms.
Keywords: MUNICIPAL WASTES; SEWAGE; WATER QUALITY; PHOSPHATES; NITROGEN COMPOUNDS; PH VALUE; SULFATES; CARBON; ESCHERICHIA COLI; WATER TREATMENT; ORGANIC WASTES; EQUIPMENT; REMOVAL; MONITORING; PURIFICATION.

72623 Soil and Crop Management Systems for Treatment, Utilization, and Disposal of Municipal Waste Water and Sludges. Erickson, A.E. (Michigan State University, School of Agriculture, Department of Soil and Crop Science, Soil Science Building, East Lansing, MI, 48824). **Project number:** L611C-55. **Contract:** R805270-02. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$138,000.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The objectives are: (1) to develop intercropping management and wastewater management techniques which will optimize the stripping of nutrients from wastewater; and (2) to determine the feasibility of land application of sludge to land being used for a wastewater treatment system. A report evaluating intercropping of corn and forage crops for optimum nitrogen removal in percolating applied wastewater and for evaluation of feasibility of sludge and its loading rates on wastewater irrigated crops will be compiled. Preliminary results indicate that corn-rye system can reduce leaching losses of nitrogen to almost one-half and give equivalent corn yields.
Keywords: SOILS; CROPS; WASTE MANAGEMENT; MUNICIPAL WASTES; WASTE WATER; SLUDGES; WASTE PRODUCT UTILIZATION; WASTE DISPOSAL; MAIZE; RYE; NUTRIENTS; GROUND DISPOSAL; ENVIRONMENTAL IMPACTS; IRRIGATION; NITROGEN; LEACHING.

72624 Assessment of the Long Term Effects of Applying Domestic Wastewater to the Land. Koerner, E.L. (Benham, Blair and Affiliates, Inc., 6323 N. Grand Blvd., Oklahoma City, OK, 73118). **Project number:** L611C-56. **Contract:** 68-03-2363. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to collect quantitative data to assess the long-term effect of applying municipal effluent to the land on the properties of crops, soils, and groundwater. The approach which will be employed is the direct comparison of data collection on site to data collected at a control site having like management except for the application of the municipal effluent to the land. The work to be accomplished will include studies at irrigation sites in New Mexico and a Northern Plains state and high-rate infiltration studies in a North Central and Mid-Atlantic state. Current plans are to follow procedures and methodology to accomplish: (1) site selection; (2) sample collection, transport, and analysis; (3) data evaluation; and (4) report preparation. Site selection will include studying a number of alternative sites to determine which sites best meet the criteria established for each study site. Samples will be collected, transported, and analyzed over a twelve month period and in accordance with quality control procedures established to insure reliability of data. Data will be assessed progressively in relation to the time of data collection. The final report will be completed after all data has been collected and assessed. The four study sites were selected. The irrigation sites were at Roswell, New Mexico, and Dickinson, North Dakota. The infiltration sites were located at Milton, Wisconsin, and

Vineland, New Jersey. All data collection has been completed, and final reports are in preparation by the contractors.
Keywords: MUNICIPAL WASTES; WASTE WATER; GROUND DISPOSAL; ENVIRONMENTAL IMPACTS; RISK ASSESSMENT; IRRIGATION; NEW MEXICO; ROCKY MOUNTAIN REGION.

72625 Evaluation of Practices and Systems for Controlling the Loss of Sediments and Other Pollutants from Irrigated Lands. Fitzsimmons, D.W. (University of Idaho, School of Agriculture, Department of Agricultural Engineering, Moscow, ID, 83843). **Project number:** L617-03. **Contract:** R803524. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA. **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The primary objective of this project is to evaluate the effectiveness and economic impacts of alternatives for controlling the loss of sediment, nutrients and other pollutants from irrigated areas. Where possible, the effectiveness of alternatives will be demonstrated in conjunction with field evaluations. The specific objectives are to: (1) evaluate the effectiveness of settling ponds, pumpback systems, vegetated buffer strips, and other tailwater control and recovery systems in controlling the loss of sediment, nutrients and other pollutants from irrigated areas; (2) evaluate the effectiveness of alternative farm management practices, including water management practices and irrigation methods in reducing the loss of sediment and other pollutants from irrigated fields; (3) evaluate the cost effectiveness of the pollutant discharge control measures considered in Objectives 1 and 2 and their impact on net income; and (4) evaluate the aggregate (regional or area) effects of reducing the loss of sediment and other pollutants from irrigated areas. Practices and systems will be installed for controlling the loss of sediment and nutrients in irrigation runoff. Effectiveness of measures under study and costs of measures will be evaluated to arrive at cost-effectiveness relations.
Keywords: IRRIGATION; ENVIRONMENTAL EFFECTS; LAND POLLUTION ABATEMENT; WATER POLLUTION ABATEMENT; AGRICULTURE; CULTIVATION TECHNIQUES; ECONOMIC IMPACT; NUTRIENTS; RUNOFF.

72626 Reduction of Saline Pollution of the Groundwater Attributed to Dairy Operations. Ferguson, R.W. (Chino Basin Municipal Water District, 8555 Archibald Avenue, Cucamonga, CA, 91730). **Project number:** L617D-25. **Contract:** R804620. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

Evaluation of groundwater quality in the Chino Hydrologic Basin indicates degradation due to saline pollution leached from the wastes of dairy cows. The manure of these animals is known to contain some nutritional value. Technology exists by which this feed can be recaptured. If the quality of the food produced is comparable to more normal rations a viable means of waste disposal will be available. This project is designed to test and demonstrate the value of the feed produced from cow manure. Dairy cow manure will be collected from dairies in San Bernardino County and converted to feed products. This feed will be presented under test conditions to growing dairy heifers, beef cattle and chickens to determine its value in comparison to standard rations. Laboratory evaluations shall be conducted to determine the ability of the feed to support the growth of rumen microbes and to assay the amino acid content of the feed. Toxic metal deposits in the feces, tissues and organs of the animals fed in the program shall be evaluated. The various work projects outlined in the approach have been delegated to several campuses of the University of California and San Bernardino State College where experts in the required scientific fields are on staff. These people will perform the work and report their findings. Two test areas are complete and the others are well underway.
Keywords: GROUND WATER; SALINITY; AGRICULTURAL WASTES; WATER POLLUTION ABATEMENT; GROUND DISPOSAL; ENVIRONMENTAL IMPACTS; MANURES; COWS; WASTE DISPOSAL; WASTE PRODUCT UTILIZATION.

72627 Comparison of Four Dairy Manure Management Systems. Martin, R.O. (Agway, Inc., Research and Development, P.O. Box 1333, Syracuse, NY, 13201). **Project number:** L617D-33. **Contract:** R804349. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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 1978.
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.

72628 Relationship Between Mineralogy and Water Quality in Western Energy Recovery. Klocpper, D.L. (Colorado School of Mines, Research Institute, Energy Resources Division, P.O. Box 112, Golden, CO, 80401). **Project number:** L625B-03. **Contract:** R804162-01. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$264,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The Colorado School of Mines Research Institute, under grant from the Environmental Protection Agency, developed field and laboratory techniques which allow correlations to be made between ground-water chemistry and strata mineralogy. Applications of these techniques have been demonstrated in western coal strip mining and are being investigated in in-situ coal gasification. The purpose of the present study will be to demonstrate and extend the use of existing techniques to in situ recovery of hydrocarbon products from oil shale. This project will include an investigation of the hydrologic and mineralogic regimes. Data to be gathered include the number and type of aquifers, flow characteristics, and chemical composition. Cores of the oil shale section will be analyzed in the laboratory by x-ray fluorescence, x-ray diffraction, microscopy, and standard chemical methods. These data will provide baseline water and mineralogy data, prior to the burn. Additional water and core samples will be obtained after the in-situ burn is completed.
Keywords: OIL SHALE DEPOSITS; IN-SITU RETORTING; ENVIRONMENTAL EFFECTS; GROUND WATER; WATER POLLUTION; MINERALOGY; ROCK-FLUID INTERACTIONS; CHEMICAL ANALYSIS; X-RAY FLUORESCENCE ANALYSIS; X-RAY DIFFRACTION; MICROSCOPY; WATER CHEMISTRY; AQUIFERS.

72629 Resource Conservation and Utilization in Animal Waste Management. Loehr, R.C. (Cornell University at Ithaca, Department of Agricultural Engineering, 242 Carpenter Hall, Ithaca, NY, 14850). **Project number:** L770D-1-26. **Contract:** R806140-01. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$120,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this project is to identify and critically evaluate technically and economically feasible resource conservation and utilization (RCU) opportunities associated with currently used and under-utilized animal waste management alternatives. The project will critically analyze the many RCU possibilities associated with environmentally sound animal waste management practices using existing information and data, and evaluate in greater detail the better possibilities that emerge from the above analyses using pilot plant and full scale studies. The project will show how animal waste management approaches can integrate environmental protection and resource conservation opportunities. The project will place benefits, costs, and opportunities for RCU in practical perspective and by doing so increase the application of animal waste management practices.
Keywords: RESOURCE CONSERVATION; WASTE MANAGEMENT; DOMESTIC ANIMALS; AGRICULTURAL WASTES; WASTE PRODUCT UTILIZATION.

72630 Cost/Effective Livestock Management Systems to Control Pollution. White, R.K. (Ohio Agricultural Research and Development Center, Wooster, OH, 44691). **Project number:** L770D-2-10. **Contract:** R804548. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
R and D categories: Physical and chemical processes and effects; Integrated assessment.

The objective will be to prepare a manual on cost/effective management systems to control pollution from non-NPDES livestock production facilities, excluding animals on range. Livestock species to be considered are fed beef, cows/calves, dairy cattle, dry cows/heifers, fed hogs, hog breeding, sheep and poultry. This objective will be accomplished through a review of existing literature, consulting with leading scientists and extension personnel, regional reports by consultants and a two day workshop to formalize a manual.
Keywords: DOMESTIC ANIMALS; WASTE MANAGEMENT; PRODUCTION; AGRICULTURAL WASTES; COWS; SWINE; SHEEP; CHICKENS; DATA COMPILATION; MEETINGS; MANUALS; EDUCATION; WATER POLLUTION CONTROL; LAND POLLUTION CONTROL; ECONOMICS.

72631 Animal Waste Management Conference and Workshop. White, R.K. (Ohio Agricultural Research and Development Center, Department of Agricultural Engineering, Wooster, OH, 44691). **Project number:** L770D-2-18. **Contract:** R806025-01. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA-$35,000.
Related energy source: biomass(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

A Livestock Waste Management Seminar and Needs Assessment Workshop will be held during the week of May 22, 1978, in Columbus, Ohio. Three new publications will be presented and reviewed in depth at the seminar. They are: (1) Environmental Impact Resulting from Unconfined Animal Production, (2) Evaluation and Economic Analysis of Livestock Waste Management Systems (Non-NPDES), and (3) Animal Waste Utilization on Crop and Pasture Land. The Needs Workshop will assess current status and future research needs and the priorities for six areas of livestock production and waste management. The needs areas will include the topics of the three new publications as well as: (1) resource recovery from animal wastes (feed, fuel, etc.), (2) odor--cause and abatement, and (3) conservation of energy and nutrients in existing and new management systems. Needs assessment task groups (6 or 7 persons each) will prepare working papers for use at the seminar and workshop. A publication of the six needs assessments will be prepared.
Keywords: ANIMALS; AGRICULTURAL WASTES; WASTE MANAGEMENT; MEETINGS; PRODUCTION; ECONOMIC IMPACT; WASTE PRODUCT UTILIZATION; ODOR; POLLUTION ABATEMENT; MATERIALS RECOVERY.

72632 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-2-20. **Contract:** JB-5-534-7. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA). **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

72718 Assessment of the Effects of Bottom Disturbance on the Environment of a Clear Subarctic Stream. Morrow, J.E. (University of Alaska at Fairbanks, School of Environmental Science, Fairbanks, AK, 99701). **Project number:** M625A-004. **Contract:** R803945-03. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$28,000.
Related energy source: oil and gas(100).

This project has been modified to include a study to determine the effects of water-soluble fraction of crude oil on the condition and gut morphology of juvenile chum-salmon. The effect of sublethal exposure to the WSF of Prudhoe Bay crude oil on growth, condition, and total body fat in juvenile chum salmon will be tested. In addition, the morphology and structural integrity of the gut will be examined for potential abnormalities associated with the swallowing of oil-contaminated seawater. Scanning and transmission electron microscopy will be used for the gut comparisons.
Keywords: ALASKA; PRUDHOE BAY; OIL SPILLS; ENVIRONMENTAL EFFECTS; PETROLEUM; BIOLOGICAL EFFECTS; SALMON; GASTROINTESTINAL TRACT; PATHOLOGICAL CHANGES; ELECTRON MICROSCOPY; MORPHOLOGICAL CHANGES.

72722 Investigation of the Effects of Coal-Fired Power Plant Emissions on Tissue Structure of Selected Bird Species: Birds as Indicators. Kern, M.D. (College of Wooster, Graduate School, Department of Biology, Wooster, OH, 44691). **Project number:** M625A-021. **Contract:** R805370-02. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$27,000.
Related energy source: coal(100).

The objective of this project is the identification of grassland bird species which are sensitive to the emissions of coal-fired power plants and can be used to monitor and indicate air quality. A report that will help develop the capacity to predict the ecological impacts of coal-fired power plant emissions before damage occurs will be published.
Keywords: COAL; COMBUSTION PRODUCTS; FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; AIR POLLUTION; BIOLOGICAL EFFECTS; BIRDS; BIOLOGICAL INDICATORS; AIR QUALITY; MONITORING; PATHOLOGICAL CHANGES.

72723 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:** M625A-023. **Contract:** R805391-02. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$41,000.
Related energy source: coal(100).

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.

72726 Aerosol Characterization Research: Colstrip, Montana. Derr, V.E. (National Oceanic and Atmospheric Administration, Atmospheric Spectroscopy Branch, Boulder, CO, 80302). **Project number:** M625A-054. **Contract:** D8-X0292. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$30,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The project involves the measurement of the concentration of particulates categorized by size, shape, and chemical constitution. Two radiation measurements will be made: (1) the rate at which solar energy reaches the earth as a function of wavelength, and (2) the net heat loss of the earth, measured by infrared radiometry by measuring upward and downward radiation and by employing aircraft and ground-based instruments.
Keywords: MONTANA; AIR POLLUTION; AEROSOLS; PARTICLES; MONITORING; PARTICLE SIZE; CHEMICAL COMPOSITION; EARTH ATMOSPHERE; SOLAR FLUX; HEAT LOSSES.

72728 Characterizing the Air Quality in the Colstrip, Montana, Area. Ambrose, T.W. (Department of Energy, Richland Operations Office, P.O. Box 550, Richland, WA, 99352). **Project number:** M625A-057. **Contract:** D8-X0185. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$89,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

DOE will operate and maintain a research survey station for the Environmental Protection Agency at Colstrip, Montana, providing approximately one man-year of effort. DOE will maintain a scientist at Colstrip who will operate research equipment, as required by EPA, for the measurement of a wide spectrum of airborne pollutants. It is understood that these pollutants include the measurements of most of the conventional air pollutants which are monitored by the EPA and will require daily calibrations of much of the scientific equipment used for these measurements. It will also require the transfer of data from the various analyzers to an on-board computer for subsequent analysis and transmittal.
Keywords: AIR QUALITY; MONTANA; AIR POLLUTION; COAL MINING; ENVIRONMENTAL IMPACTS.

72729 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:** M625A-088. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$237,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

72770 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:** M608A-065. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$541,000.
R and D categories: Physical and chemical processes and effects.

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.

72771 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:** M608A-073. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$309,000.
R and D categories: Physical and chemical processes and effects.

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.

72772 Fate and Effects of Growth Promoting and Inhibiting Material Within Aquatic Ecosystems. Baumgartner, D.J. (EPA, Office of Research and Development, Environmental Research Lab., Marine and Freshwater Ecology Branch, 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M608A-202. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$580,000.
R and D categories: Physical and chemical processes and effects.

The objective is to determine the transport, effects, transformation, and fate of growth-promoting and inhibiting materials in freshwater ecosystems. The specific approach will include the study of physical, chemical and biological cycling processes affecting the distribution, biological and chemical availability, and ecological effects of both growth-promoting and inhibiting materials in freshwater ecosystems. Results of these studies will be tested full-scale in aquatic situations where anticipated alterations in materials inputs may affect water quality, as in lakes to which curtailment of nutrient loading for control of excess productivity is planned or water which is expected to be impacted by energy resource development.
Keywords: AQUATIC ORGANISMS; NUTRIENTS; ENVIRONMENTAL TRANSPORT; MONITORING; QUANTITATIVE CHEMICAL ANALYSIS; REMOVAL; POLLUTION CONTROL; ENVIRONMENTAL IMPACTS; CHEMICAL EFFLUENTS; METEOROLOGY; CLIMATES; TERRESTRIAL ECOSYSTEMS; GROWTH; STIMULATION; INHIBITION.

72773 Environmental Assessment Interface. Tichenor, B.A. (EPA, Office of Research and Development, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M623D-099. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$10,000.
R and D categories: Integrated assessment.

The objective is to provide OEMI Environmental Assessment Program with necessary consultation, data, and research information in the development, use and interpretation of decision criteria, impact factors, and bioassay. It will be determined whether system/process is environmentally acceptable or whether further or more economical control of waste streams is necessary.
Keywords: ENVIRONMENT; DECISION MAKING; DATA ACQUISITION; ENVIRONMENTAL IMPACTS; BIOASSAY; WASTE MANAGEMENT; POLLUTION CONTROL; ECONOMIC IMPACT; SOCIO-ECONOMIC FACTORS; POLLUTION; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; SOLID WASTES.

72774 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:** M625A-212. **Contract:** R805610-01. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$65,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

72775 Assessment of the Acid Precipitation Monitoring Needs in Northeastern United States. Jones, K. (Council on Environmental Quality, 722 Jackson Place NW, Washington, DC, 20006). **Project number:** M625A-234. **Contract:** D8-F0119. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$8,000.

The objective of the agreement is to provide an assessment of the acid precipitation monitoring needs in the Northeastern United States. CEQ will provide a written evaluation of existing monitoring programs in the Northeast. This information will be used in planning an EPA acid rain program that will conform with and augment existing monitoring programs and networks.**Keywords:** ACID RAIN; MONITORING; AIR QUALITY; WATER QUALITY; NORTH ATLANTIC REGION; MID-ATLANTIC REGION; CENTRAL REGION.

72776 Analysis of Maple Creek Model Implementation Program Project Area. Hoover, H. (Agricultural Research Service, Natural Resource Econ. Division, 100 Central Mall N., Lincoln, NE, 68508). **Project number:** M625A-236. **Contract:** D8-F0329. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$10,000.

The objectives of this project are: (1) to identify reasons why landowners and operators do not adopt soil conservation systems and land needing conservation treatment; (2) to identify the types of incentives that will induce landowners and operators to adopt conservation systems on land needing conservation treatment; and (3) to analyze and appraise prospective program and program costs for achieving voluntary participation in soil erosion and sediment control programs consistent with objectives of the Clean Water Act.**Keywords:** WATERSHEDS; IMPLEMENTATION; SOIL CONSERVATION; LAND RECLAMATION; FINANCIAL INCENTIVES; OWNERSHIP; ECONOMIC IMPACT; LAND POLLUTION ABATEMENT; SOILS; EROSION; SEDIMENTATION; CONTROL; WATER POLLUTION ABATEMENT.

72777 Evaluate Current Standards for Petroleum Discharges Relative to Impacts or Effects on Planktonic/Benthic/Intertidal Organisms on West Coast. Swartz, R. (EPA, Office of Research and Development, Environmental Research Lab., 200 SW 35th Street, Corvallis, OR, 97330). **Project number:** M625A-237. **Supported by:** Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab. **Funding:** EPA-$15,000.
R and D categories: Physical and chemical processes and effects.

The objectives are to: (1) develop existing and modified versions of assays for response indications of lethal and sub-lethal stress effects; (2) develop fluorometric, electrophoretic, or other analytical procedures which will permit the evaluation of cells of algae, benthos, macrophytes or other marine organisms for short-term or sub-lethal stress from components of refinery and petrochemical effluents; (3) determine lethal and sub-lethal stress effects of hexane-extractable and non-hexane-extractable portions of petroleum processing waste discharges using test procedures developed; and (4)

determine chemical components of process waste streams and test to determine which ones are harmful or not harmful to the marine environment. Test procedures will be published to indicate subacute effects of petroleum processing wastewater streams and other components on primary producers and detrital organisms. This will assist in providing guidance for granting permit for discharge to ocean outfalls.
Keywords: STANDARDS; WATER POLLUTION ABATEMENT; PLANKTON; BENTHOS; AQUATIC ORGANISMS; PETROLEUM; BIOLOGICAL EFFECTS; OIL SPILLS.

72902 Toxic Effects on the Aquatic Biota from Coal and Oil Shale Development. Thurston, R.V. (Colorado State University, Natural Resource Ecology Lab., Fort Collins, CO, 80523). **Project number:** N644A-080. **Contract:** R803950-03. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$108,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 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: TOXICITY; AQUATIC ECOSYSTEMS; COAL INDUSTRY; OIL SHALE INDUSTRY; ENVIRONMENTAL IMPACTS; CHEMICAL EFFLUENTS.

72943 Renewal of Water Temperature Studies at the Environmental Protection Agency Monticello Field Station. Stefan, H. (University of Minnesota, Department of Civil and Mineral Engineering, Mississippi River and 3rd, Minneapolis, MN, 55414). **Project number:** N608A-084. **Contract:** R804736-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$18,000.
Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The main objective of the studies is to provide information on the water temperature regimes encountered in eight experimental field channels in which biological experiments are conducted. Heated water is discharged through these channels at low flow velocities. Field measurements of water temperatures and mathematical models are used to achieve the objective. Field data are 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 loss. Correlation with weather parameters will be provided. Soil temperature conditions are also surveyed.
Keywords: SURFACE WATERS; THERMAL POLLUTION; AMBIENT TEMPERATURE; TEMPERATURE MEASUREMENT; TEMPERATURE GRADIENTS; DAILY VARIATIONS; MATHEMATICAL MODELS; STATISTICS; HEAT LOSSES; METEOROLOGY; CORRELATIONS; SOILS; ENVIRONMENTAL EFFECTS.

72955 Limnological Investigations of Water Quality and Fish Larvae in Lake Erie. Herdendorf, C.E. (Ohio State University, Center for Lake Erie Area Research, 484 W. 12th Avenue, Room 112, Columbus, OH). **Project number:** N608A-006. **Contract:** R804612-03. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$114,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The Ohio State University Center for Lake Erie Area Research (CLEAR) proposed to continue investigations of Lake Erie water quality and fish larvae. The water quality studies will emphasize the importance of sediment-water interactions and their influence on water quality and biological communities in Lake Erie. Larval fish investigations will be concentrated in areas of highest densities in an attempt to more precisely define the present and potential impact of electric power generation on these populations. Efforts to model the mortality to key fish species will be continued. The general objectives of the proposed work include: (1) determining oxygen demand and nutrient regeneration in the sediment/water interface zone; (2) determining hypolimnion flux and respiration rates; (3) investigating sediment-water-biomass interactions of toxic metals; (4) monitoring toxic metals in sediments at dredge disposal sites serving Ashtabula Harbor; (5) studying the effects of common Lake Erie benthic macro-invertebrates on sediments and the overlying water column; (6) investigating zooplankton abundance in the sediment/water interface zone; (7) estimating fish larvae populations in Western Lake Erie and assessing the impact of intake entrainment on these populations; (8) providing logistical and analytical support for other research groups conducting EPA sponsored research on Lake Erie; (9) supporting continued development and verification of EPA water quality, sediment dynamics and fish larvae mortality models for Lake Erie; and (10) preparing technical reports of the findings for each phase of the project. The main object is to follow changes in the water quality as a result of nutrient removal to the western basin. The number of fish larvae in western Lake Erie will be determined in support of the determination on the impact of power plants in western Lake Erie.
Keywords: WATER QUALITY; FISHES; LARVAE; LAKE ERIE; POPULATION DYNAMICS; MORTALITY.

72956 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:** N608A-096. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$114,000.
Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective of the project is to describe the effects of waste heat on the physical/chemical/biological dynamics of outdoor, experimental stream ecosystems. Monthly to quarterly samplings in these channels (1,700 feet long) document changes in zooplankton, periphyton, phytoplankton, macroinvertebrates (benthic and pelogic) communities and introduced fish populations. Responses measured in these communities are standing crop, diversity, and species lists of lower forms as well as distribution, growth, mortality, behavior, standing crop, and production rate of fish and emergence of aquatic insects. Water temperature is monitored continuously by thermograph. Weekly grab samples are taken at sunup and mid-afternoon to measure diel changes in dissolved oxygen, total gas pressure, dissolved nitrogen, pH, and alkalinity. Progress in FY78 has centered on development of data management techniques.
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.

72957 Sensitivity of Embryos and Larvae of Four Species of Trout to Reduced Oxygen Concentration. Spoor, W.A. (EPA, Office of Research and Development, Environmental Research Lab., 6201 Congdon Blvd., Duluth, MN, 55804). **Project number:** N608A-097. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$25,000.
R and D categories: Integrated assessment; Health effects.

The objective is to compare the sensitivity to oxygen deficiency of successive embryonic and larval stages of brook, lake, brown and rainbow trout. Specimens will be exposed to reduced oxygen concentrations for one (1 to 48 hr) period during some stage of development and behavior and survival will be observed. Sensitivity increases slowly before and rapidly after hatch. Lake trout are more sensitive than brook, brown or rainbow trout. Behavior is more important end-point than mere survival.
Keywords: OXYGEN; BIOLOGICAL FUNCTIONS; DYNAMIC FUNCTION STUDIES; QUANTITY RATIO; WATER QUALITY; EMBRYOS; LARVAE; TROUT; BEHAVIOR; PHYSIOLOGY.

72958 Study of Oxygen Production, Loss, Exchange, and Transport Rates in the MERS Field Channels. Stefan, H. (University of Minnesota at Minneapolis, Mississippi River and 3rd, Minneapolis, MN, 55414). **Project number:** N608A-103. **Contract:** R805678-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$33,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The investigators propose to evaluate existing methods or develop new methods for measurement of photosynthesis and community respiration in EPA's Monticello Ecological Research Station (MERS) experimental channels. Their primary obectives are to make a more detailed study of the oxygen transport and production mechanism and their interactions in the outdoor stream channels to evaluate assumptions used in production/respiration measurements in flowing streams. Their procedures will include empirical measure-

ments of reaeration coefficients and wind effects, channel morphology, longitudinal dispersion coefficients, diel oxygen concentrations measurement, community photosynthesis respiration and BOD, benthic respiration rate and temperature effects on saturation concentration of dissolved oxygen. Empirical models will be developed to evaluate assumptions of existing methods and to provide a working procedure for use by EPA to measure community response to environmental stress in flowing stream channels. An empirical model is developed for measurement of dissolved oxygen fate in experimental ecosystem studies of the Monticello Ecological Research Station. Coefficients will be empirically measured on site for use by MERS. The technology is readily transferable to all large scale ecosystems for monitoring large scale ecosystems.
Keywords: OXYGEN; PHOTOCHEMISTRY; ENVIRONMENTAL TRANSPORT; PHOTOSYNTHESIS; STREAMS; WATER QUALITY; QUANTITY RATIO; BIOCHEMICAL OXYGEN DEMAND; BIOLOGICAL MODELS; BIOLOGICAL STRESS; ENVIRONMENTAL IMPACTS; ECOSYSTEMS; MATHEMATICAL MODELS.

72959 Feasibility Study of pH Effects on the Experimental Ecosystem of MERS. Hermanutz, R.O. (EPA, Office of Research and Development, Monticello Ecological Research Lab., Box 500, Monticello, MN, 55362). **Project number:** N608A-113. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$102,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective is to test the feasibility of dosing the experimental channels with toxic substances. Specific plans for FY 78 are to (1) procure, construct, and implement the use of necessary equipment to dose one channel with sulfuric acid over a linear distance of 900 feet at 100 to 400 gpm; (2) install and monitor suitable pumps and pH controllers; (3) design and test prototype shading devices for the experimental channels to reduce weed growth; (4) determine pH gradients achievable in the experimental channels at a given flow rate; (5) test various pH meters, probes and recorders for reliability and durability; (6) make application for waste discharge permit and make necessary arrangements for monitoring and compliance with state and federal permit requirements; (7) devise methodology necessary to measure survival, growth, and reproduction of fathead minnows, white sucker, and bluegills; and (8) test various designs of fish cages, mirgration traps, and spawning substrates. Food habits of fathead minnows will be assessed to determine relative importance of macroinvertebrates. A brief survey of macroinvertebrate distribution will be assessed to facilitate development of the definitive work plan on pH effects on aquatic communities. No report is anticipated from this work but will provide input to work plans.
Keywords: PH VALUE; FEASIBILITY STUDIES; TOXIC MATERIALS; WASTE MANAGEMENT; AQUATIC ECOSYSTEMS; ENVIRONMENTAL IMPACTS; BIOLOGICAL EFFECTS; FISHES; INVERTEBRATES; VERTEBRATES; BIOLOGICAL STRESS.

72960 Identification of Mechanisms, Rates of Change and Recycling Processes for Pollutants. Glass, G.E. (EPA, Office of Research and Development, Environmental Research Lab., Duluth, MN, 55804). **Project number:** N608A-114. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$102,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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 mechanisms, rates of change, recycling processes and chemical-biological activity for pollutants. These include, as follows: (1) the determination of factors influencing the presence of lead, asbestos and halocarbons in drinking water (municipalities using western Lake Superior are currently being studied); (2) the identification of biotic and abiotic methylation processes of metals and metalloids in contaminated environmental ecosystems (mercury in northern Minnesota is currently under study); (3) the measurement of exchange rates and transport processes across the sediment-water and water-air interfaces using dissolved components, amphibole minerals and diatoms as residual components (laboratory and field studies using western Lake Superior as a study site are in progress); (4) the development of chemical speciation models for identifying the biologically and chemically reactive components in environmentally polluted ecosystems and laboratory bioassay systems (current effort is in conjunction with the generalization of water quality criteria and Great Lakes pollutant susceptibility using chemical models); and (5) the determination of major sources and effects of environmental pollutants (current effort is in conjunction with studies concerning the impacts of coal-fired generating stations on the environment).
Keywords: MINERAL CYCLING; ENVIRONMENTAL TRANSPORT; CHEMICAL REACTIONS; LEAD; ASBESTOS; ORGANIC HALOGEN COMPOUNDS; DRINKING WATER; LAKE SUPERIOR; MERCURY; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; MINNESOTA; BIOASSAY; COAL; FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; COAL INDUSTRY; ECOLOGICAL CONCENTRATION; BIOCHEMISTRY.

72961 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:** N628A-117. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$114,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment.

Detailed trace analysis of organic chemicals in fish has related quantities of hazardous chemicals such as mirex, kepone, DDT, and PCB's greatly exceeding FDA tolerances. To further characterize the occurrence of residue-forming chemicals in fish tissue, fish samples from at least five areas in the US will be studied using newly developed gel permeation chromatographic and mass spectroscopic techniques. Explicit identification and estimates of concentrations are the expected output.
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.

72962 Activity and Mortality of an Experimental White Sucker Population During Thermal Stress. Kleiner, C.F. (EPA, Office of Research and Development, Monticello Ecological Research, Box 500, Monticello, MN, 55362). **Project number:** N608A-127. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$98,000.
Related energy source: coal(33); oil and gas(33); nuclear fuels(general)(34). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this study is to intensively monitor the physical/chemical environment and activity of a fish population prior to and during a planned fish kill in the field. The principal goal is to field test various monitoring devices. The approach is to monitor water temperature and dissolved oxygen in one experimental channel continuously by ADP technology. Adult white sucker movement and activity will be automatically tracked by radio telemetry techniques and chart recorder during testing phase of a research grant to the University of Minnesota. Fish implanted with radio transmitters will be tracked for a 3 to 4 week period to establish a normal pattern of activity and distribution within one experimental channel. Then waste heat will be gradually added to the channel to raise the temperature above the upper lethal temperature over a two week period. The thermal history of this mobile fish population will be accurately recorded from position locations of fish and fixed water quality monitoring stations. Movement, diel activity, and mortality of the fish population will be described in relation to acclimatization temperature and compared to laboratory results of lethal temperature for field validation.
Keywords: WASTE HEAT; AQUATIC ECOSYSTEMS; THERMAL POLLUTION; BIOLOGICAL EFFECTS; FISHES; POPULATION DYNAMICS; MORTALITY; TEMPERATURE EFFECTS; THERMAL STRESSES; TELEMETRY; TEMPERATURE MEASUREMENT.

72963 Critical Review and Evaluation of Research on the Impact of Energy-Related Wastes on the Aquatic Environment. Chappell, W.R. (University of Colorado at Boulder, Department of Physics, 1200 University Avenue, Boulder, CO, 80302). **Project number:** N625A-083. **Contract:** R805921-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$50,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The purpose of the 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; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; WATER POLLUTION.

72964 Chemical and Biological Characterization of Oil Shale Processing and Coal Conversion Effluents. Skogerboe, R.K. (Colorado State University, School of Natural Sciences, Department of Chemistry, Fort Collins, CO, 80523). **Project number:** N625A-087. **Contract:** R806051-01. **Supported by:** Environmental Protection

Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$158,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Integrated assessment.

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 INDUSTRY; COAL INDUSTRY; ENVIRONMENTAL IMPACTS; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; TOXICITY; OIL SANDS; SURFACE WATERS; AQUATIC ORGANISMS.

72965 Coal Fired Steam Plants: Human and Environmental Exposure to Air and Water Pollutants. Chesters, G. (University of Wisconsin at Madison, Water Resources Center, Agriculture Hall, Madison, WI, 53706). **Project number:** N625A-088. **Contract:** R806137-01. **Supported by:** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. **Funding:** EPA-$275,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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 supported by the Environmental Protection Agency, entitled The Impact of Coal-Fired Power Plants on the Environment. Part of the work has also been funded by the Wisconsin Power and Light Company. The study was undertaken at Columbia Power Generating 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. The project is divided into four major sections, including: (1) effects of coal-fired generating stations on air quality; (2) effects of coal-fired generating stations on water quality; (3) wetland effects on aquatic ecology around the Columbia Generating Station; and (4) data integration, assessment, and transferability. 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; ENVIRONMENT; TERRESTRIAL ECOSYSTEMS; AIR POLLUTION; WATER POLLUTION; ENVIRONMENTAL IMPACTS; AIR QUALITY; WATER QUALITY; MATHEMATICAL MODELS; AQUATIC ECOSYSTEMS; DATA ACQUISITION; DATA ANALYSIS; TECHNOLOGY TRANSFER; INFORMATION; HUMAN POPULATIONS; BIOLOGICAL MODELS; FLUE GAS; FLY ASH.

73005 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:** Characterization, measurement, and monitoring; Integrated assessment.

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.

73006 Effects of Thermal Addition on Marine Fouling Community Dynamics. Miller, D.C. (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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The project objectivc 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.
Keywords: THERMAL POLLUTION; WATER POLLUTION; BIOLOGICAL EFFECTS; BIOLOGICAL FOULING; CERAMICS; GROWTH; REPRODUCTION; HABITAT; POPULATION DYNAMICS; BIOLOGICAL STRESS; AQUATIC ECOSYSTEMS; WASTE HEAT; THERMAL EFFLUENTS.

73007 Behavioral and Physiological Indices of Pollutant Stress in Zooplankton and Invertebrate Larvae. Miller, D.C. (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(34); oil and gas(33); nuclear fuels(general)(33). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

73008 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 require-

ments) 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.

73027 Coastal Environmental Assessment Station. Phelps, D.K. (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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73028 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73029 Environmental Effects and Acceptability of Effluents from Rum Distilleries. Canoy, M.J. (College of the Virgin Islands, Charlotte Amalie, St. Thomas, VI, 00801). **Project number:** P608C-34. **Contract:** R806110-01. **Supported by:** Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab. **Funding:** EPA-$120,000.

The objectives are: (1) to characterize the receiving waters and biotic communities; (2) to evaluate the effect of rum plant effluent on the environment; (3) to test the environmental acceptability of rum plant effluent; and (4) to survey the literature of the field and review treatment and/or use technologies. Intensive field work will be carried out in the area of a rum effluent plume south of St. Croix, USVI, to determine hydrology, marine ecology, and in-situ effects of the discharge. These will be carried out in conjunction with laboratory tests in bioassay and bioconversion of the wastes and extensive literature and technology reviews.**Keywords:** PLANTS; ENVIRONMENTAL EFFECTS; HYDROLOGY; AQUATIC ECOSYSTEMS; WATER POLLUTION; FOOD INDUSTRY.

73030 Petroleum Hydrocarbon Analysis of Marine Systems. Rogerson, P. (EPA, Office of Research and Development, 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-$128,000.
Related energy source: oil and gas(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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: PETROLEUM; HYDROCARBONS; AQUATIC ECOSYSTEMS; ECOLOGICAL CONCENTRATION; BIOLOGICAL MODELS; MONITORING; BASELINE ECOLOGY.

73031 Effects of Thermal Additions on the Dynamics of Fouling Communities at Beaufort, NC. Kirbysmith, W.W. (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 shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated 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.

73032 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.
R and D categories: Health effects.

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.
Keywords: ANIMAL CELLS; BIOASSAY; GENETIC EFFECTS; TOXIC MATERIALS; INFORMATION SYSTEMS; MUTAGENS; DNA; BIOLOGICAL REPAIR; SISTER CHROMATID EXCHANGES.

73106 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-1-01. **Contract:** R804527-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$60,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73108 ADP Technical Support Services. McCutchen, R. (General Services Administration, P.O. Box 1900, Huntsville, AL, 35807). **Project number:** Q625A-1-02. **Contract:** D7-01000. **Supported by:** Environmental Protection Agency, Johns Island, SC (USA). Bears Bluff Field Station. **Funding:** EPA-$100,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The purpose of this IAG is to provide ADP technical services in support of the Environmental Research Laboratory, Gulf Breeze, research program. This includes work in support of the Bears Bluff Field Station and support of the modelling program on the fate, persistence and effects of toxic materials on coastal waters, statistical services in the laboratory, and data base management of the toxicology program.
Keywords: ENVIRONMENT; RESEARCH PROGRAMS; TOXICITY; DATA BASE MANAGEMENT; POLLUTION; ENVIRONMENTAL TRANSPORT; ELEMENTS; TOXIC MATERIALS.

73113 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-1-04. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$199,000.

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 onsite 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.

73117 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-1-06. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73124 Determine Toxicity to Marine Organisms of Petrochemicals/Energy Related Organic Solvents Derived from Off-Shore Activities and Ocean Dumping. Richards, N. (EPA, Office of Research and Development, Gulf Breeze Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q625A-1-11. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$173,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

Offshore petroleum extraction may affect marine organisms and ecosystems in the Gulf of Mexico and other areas undergoing intensified petroleum exploitation, extraction, and transportation activities. The research objective is to assess the affects of these emissions on marine organisms and communities. Toxicity tests on single species and communities will be continued on selected components of drilling muds. Work will be initiated on whole drilling muds and other pollutants emitted from extraction activities such as cutting and man-mobilized petroleum hydrocarbons. Mutagenic, carcinogenic and teratogenic components of shale oil will be characterized. Toxicity tests will be conducted on shale-oil derived marine diesel fuel.
Keywords: TOXICITY; AQUATIC ORGANISMS; OFFSHORE OPERATIONS; WASTE DISPOSAL; PETROCHEMICALS; TOLERANCE; HYDROCARBONS; ECOLOGICAL CONCENTRATION; AQUATIC ECOSYSTEMS; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; ENVIRONMENTAL IMPACTS.

73138 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-17. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$25,000.
R and D categories: Physical and chemical processes and effects.

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.

73139 Cycling of Xenobiotics Through Estuarine and Marine Sediments. Dasaro, C.N. (University of West Florida, Department of Biology, Pensacola, FL, 32504). **Project number:** Q625F-1-09. **Contract:** R804458-02. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$110,000.
R and D categories: Physical and chemical processes and effects.

This research will examine a mechanism of cycling various xenobiotics in and through estuarine and marine sediments. A lugworm, Arenicola cristata (Polychaeta: Arenicolidae), will be 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.

73140 Environmental Assessment of Complex Industrial Wastes. Walsh, G. (EPA, Office of Research and Development, Gulf Breeze Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q625G-01. **Supported by:** Environmental

Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$100,000.
R and D categories: Integrated assessment; Health effects.

The objectives of this project are (1) to estimate the potential impact of liquid industrial wastes on estuarine biota, and (2) to develop biological and chemical methods for analysis of waste. Bioassays are conducted on waste with the diatom Skeletonema costatum, the mysid Mysidopsis bahia, the grass shrimp Palaemontes pugio, and the sheepshead minnow Cyprinodon variegatus. Responses measured are inhibition or stimulation of diatom growth and death of animals. Toxic wastes are fractionated and toxic fractions identified by bioassay. Gas chromatography, mass spectroscopy, and plasma analysis are used to identify possible toxic substances. Current plans are to build a data base from analysis of many industries and to identify plants that require installation of waste treatment systems. Ultimately, a standard method for waste analysis that incorporates biological and chemical methods will be published.
Keywords: INDUSTRIAL WASTES; AQUEOUS SOLUTIONS; BIOASSAY; AQUATIC ECOSYSTEMS; CHEMICAL EFFLUENTS; CHEMICAL ANALYSIS; TOXICITY; PESTICIDES; WASTE WATER; WATER POLLUTION; STANDARDS; FISHES; SHRIMP; DIATOMS; AQUATIC ORGANISMS; BIOLOGICAL MODELS.

73141 Determine the Species Level Effects of Selected Pesticides and Other Organic Compounds on Marine and Estuarine Organisms. Lowe, J.I. (EPA, Office of Research and Development, Gulf Breeze Environmental Research Lab., Sabine Island, Gulf Breeze, FL, 32561). **Project number:** Q714A-2-1. **Supported by:** Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab. **Funding:** EPA-$972,000.
R and D categories: Integrated assessment; Health effects.

The objectives of this project are to: (1) expose selected marine and estuarine organisms to pesticide-heavy metal combinations; (2) determine toxicological and physiological effects; (3) determine rates of pollutant accumulation; (4) determine rate of response of organisms to individual pollutants; (5) expose marine and estuarine planktonic organisms to selected pesticides; (6) determine toxic concentrations in relation to variations in salinity and temperature; (7) determine bioaccumulation of pesticides; (8) determine effects of pesticides on growth characteristics; (9) expose selected marine and estuarine algae and protozoa species to varying concentrations of toxic organics, such as pesticides and heavy metal combinations; (10) determine effects of population dynamics by measuring toxicity growth and productivity; (11) compare effects of pollutants in combinations with effects of single individual compounds; and (12) determine, for marine and estuarine organisms commonly utilized in laboratory investigations, the range of environmental parameters optimal for health and survival under unstressed conditions. Environmental parameters to be investigated include temperature, dissolved oxygen, salinity, etc.
Keywords: PESTICIDES; ORGANIC COMPOUNDS; AQUATIC ECOSYSTEMS; AQUATIC ORGANISMS; ZOOPLANKTON; TOXICITY; PHYSIOLOGY; METABOLISM; ALGAE; PHYTOPLANKTON; BIOLOGICAL ACCUMULATION; BIOLOGICAL EFFECTS; BIOLOGICAL MODELS; USA.

73142 Effects of Drilling Mud on Marine Organisms. Glassen, R.C. (Florida State University, Department of Geology, 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** Q775F-03. **Contract:** R806130-01. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73143 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:** Q787-08. **Contract:** R805364-02. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73144 Effects of Drilling Fluids and Oil in Corals Occupying Hard-Bank Communities. Bright, T.J. (Texas A and M University, Department of Oceanography, College Station, TX, 77843). **Project number:** Q787-09. **Contract:** R805441-02. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73145 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:** Q787-10. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

73200 Continuous Source Monitoring Systems Handbook. Jahnke, J.A. (Northrop Services, Inc., P.O. Box 12313, Research Triangle Park, NC, 27709). **Project number:** S622C-05. **Contract:** 68-03-2561. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Research and Development. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment.

The manual provides the environmental engineer in industry or government with a background in continuous monitoring instrumentation. The manual covers continuous monitoring requirements established by the Federal government, details of available instrumentation, and methods of using monitor data. The handbook will be distributed as a part of the Environmental Protection Agency'S ERIC Program.
Keywords: MANUALS; MONITORING; ENVIRONMENT; AIR POLLUTION; WATER POLLUTION; LAND POLLUTION.

73330 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:** J625C-65. **Contract:** 68-03-2449. **Supported by:** Environmen-

tal Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab. **Funding:** EPA-$350,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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. Three intermediate reports are in draft form and should be printed during calendar year 1978. These relate to identifying and prioritizing pollutants.
Keywords: COAL MINING; SURFACE MINING; OIL SHALE INDUSTRY; GROUND WATER; WATER QUALITY; ENVIRONMENTAL IMPACTS; MONITORING; OIL SHALES; IN-SITU PROCESSING; WATER POLLUTION.

74002 Study of Ultraviolet-B Effects on Nucleic Acid Models. Rein, R. (Roswell Park Memorial Institute, 666 Elm Street, Buffalo, NY, 14203). **Project number:** X751A-001. **Contract:** R806078-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$43,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The immediate objective of the proposed work is a better understanding of the uv-B molecular absorption process and the ensuent photochemical steps leading to molecular damage in typical biological situations. The effects of environment, sensitizers, and chromophore interactions on the properties of the excited states of the bases and on pyrimidine dimerization will be studied by theoretical methods. Action spectra and quantum yield will be obtained for the 290 to 320 nm range for dimerization and other photoproducts in selected model systems. There is a paradox between the fact that the initial uv-B damage appears in nucleic acid and protein components although the isolated components absorb only in the uv-B range. Our main objective is to resolve this paradox by establishing the nature of uv-B absorbance and the excitation pathway leading to the initial photodamage in DNA. This information will also be used to extrapolate existing photobiological data from the far ultraviolet, thus quantifying effects of solar radiation in the uv-B range.
Keywords: FAR ULTRAVIOLET RADIATION; IRRADIATION; NUCLEIC ACIDS; BIOLOGICAL RADIATION EFFECTS; DIMERS; RADIOINDUCTION; PYRIMIDINES; PHOTOCHEMICAL REACTIONS; BIOCHEMICAL REACTION KINETICS; BIOPHYSICS; MATHEMATICAL MODELS.

74003 In Vivo Analysis of UV-B Induced Photooxidations. Krinsky, N.I. (Tufts University, 136 Harrison Avenue, Boston, MA, 02111). **Project number:** X751A-002. **Contract:** R806066-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Health and Ecological Effects. **Funding:** EPA.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.
Keywords: ULTRAVIOLET RADIATION; IN VIVO; BIOASSAY; BIOLOGICAL EFFECTS; PHOTOCHEMICAL OXIDANTS.

75902 Technology Assessment of Western Energy Resource Development. White, I.L. (University of Oklahoma at Norman, Department of Political Science, 660 Parrington Oval, Room 101, Norman, OK). **Project number:** V624C-01. **Contract:** 68-01-1916. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$315,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

This is a technology assessment of large scale energy development in 8 western states: North and South Dakota, Montana, Wyoming, Colorado, Utah, New Mexico, and Arizona. Six energy resources--coal, oil shales, geothermal, uranium, oil and natural gas--are investigated, and the entire fuel cycle from extraction to transportation of a fuel (or transmission of electricity) is considered. The objective of the study is to determine the impacts of energy development on the physical environment and on society, to identify major issues associated with these impacts, and to analyze policy alternatives for resolving the most critical issues. Final output of the study is a series of reports describing the results of the impact assessment and policy analysis, a research adequacy report recommending changes in current western energy R and D, and a series of briefings on key results of the study will be produced. The key result of the study to date is the demonstration that alternatie technology choices, design approaches, and siting decisions play as critical role as the overall level of development in determining the physical and societal outcomes of energy development in the west. The final reports illustrate the kinds of choices open to policy-makers to control these factors in order to minimize the adverse impacts of development.
Keywords: TECHNOLOGY ASSESSMENT; ENERGY SOURCE DEVELOPMENT; ROCKY MOUNTAIN REGION; WESTERN REGION; COAL INDUSTRY; OIL SHALE INDUSTRY; GEOTHERMAL ENERGY; NUCLEAR ENERGY; URANIUM; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; ENVIRONMENTAL IMPACTS.

75903 Review of Innovative Technology Waiver Applications. Becker, D. (Acruex Corp., Aerotherm Group, 1901 N. Fort Meyer Drive, Rosslyn, VA, 22209). **Project number:** V623A-04. **Contract:** 68-02-2611. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to evaluate requests for waivers from the requirement of the Clean Air Act as amended in 1977 as an innovative technology under Sections 111 and 113 of the act. The following will be reviewed in the effort to determine applicability of waiver provision of the act: description of innovative technology, proposed test plan, applicability of technology, benefits, determinations of why waiver is required, status of technology, expected emissions and health, and welfare and safety risk. Acruex has prepared application forms to be filled out by requesting industry and has provided data for evaluation. They have also reviewed and evaluated two requests for waivers.
Keywords: CLEAN AIR ACT; TECHNOLOGY ASSESSMENT; IMPLEMENTATION; AIR POLLUTION CONTROL; ENVIRONMENTAL IMPACTS; RISK ASSESSMENT; AIR POLLUTION.

75904 Environmental Site Models. Bourgeois, S.V. (Lockheed Missiles and Space Co., Inc., 4800 Bradford Drive, Huntsville, AL, 35807). **Project number:** V624C-10. **Contract:** 68-02-2614. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$30,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The purpose of this project is to vividly depict the air, water and solid waste discharges of industrial facilities and the interaction of these multimedia streams with the surrounding environment. A solid model of the land use and facilities of different technologies is built to scale for a typical energy use/production. The model is placed on display for various technical/public meetings. A flyer explaining the model is generated with each model for distribution to the public. A series is planned which will include, among others, coal gasification, coal liquefaction, and fluidized-bed combustion facilities. Different energy technologies will be readily envisioned. Model 1, Physical Coal Cleaning, was completed in June, 1978, and Model 2, Coal Gasification, was started in August, 1978.
Keywords: INDUSTRY; AIR POLLUTION; WATER POLLUTION; SOLID WASTES; CHEMICAL EFFLUENTS; MATHEMATICAL MODELS; LAND USE; ENVIRONMENTAL IMPACTS.

75905 Limited Integrated Assessment of Air Pollution from Transportation of Petroleum by Vessels. Niemann, B. (Teknekron, Inc., 2118 Milvia Street, Berkeley, CA, 94704). **Project number:** V624C-13. **Contract:** 68-01-4715. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$73,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

The objective is to assess the options for controlling air pollution from vessels transporting crude oil and petroleum products. This research project consists of four interrelated tasks. Task 1 includes: (1) scoping down the problem from an unwieldy assessment of all operations of all tankers to an assessment of the particular problems on interest to EPA, and (2) identifying issues and specific EPA policy instruments aimed at their alleviation. Major emission sources during loading and unloading of volatile hydrocarbon liquids, and the importance of vessel characteristics such as cargo design, cruise history, pollution control and safety equipment will be evaluated. Data bases for vessel types, characteristics of ports, control technology and costs, ambient air quality and source emissions will be established. Task 2 consists of identifying control measures suitable for reducing the air pollution associated with petroleum transport by vessels, clarifying the conditions where these measures are applicable, specifying their interrelationships with safety and water pollution control, and evaluating their effects. Task 3 includes identifying those policy instruments and strategies that have the greatest potential for reducing air pollution associated with the operations of vessels carrying petroleum. Task 4 consists of estimating the impacts of alternative national strategies and measures for controlling air pollution from vessels engaged in the transport

and transfer of petroleum; postulating scenarios for future demand and supply patterns for petroleum products and for the technologies available for pollution and control; and evaluating the impact of each scenario in terms of releases of air pollutants, impact of these releases on ambient air quality, costs of control strategies and measures, spill risk, explosion risk, and other relevant and identifiable socioeconomic phenomena.
Keywords: AIR POLLUTION; MARITIME TRANSPORT; PETROLEUM; ENVIRONMENTAL IMPACTS; HYDROCARBONS; ECOLOGICAL CONCENTRATION; TANKER SHIPS.

75906 Texas Lignite Development Environmental Assessment and Research Plan. White, D. (State Energy Advisory Council, 7703 N. Lamar Blvd., Austin, TX, 78752). **Project number:** V624C-14. **Contract:** R806359-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$160,000.
R and D categories: Integrated assessment.

The objective of this project is to assess the probable impacts of expected future development of Texas lignite resources. This multi-disciplinary, policy-oriented study will consider possible lignite extraction and utilization options through the year 2000. The research team will attempt to identify and characterize the major environmental, socio-economic, public health and institutional impacts which could result from this process and the policy issues created or aggravated by these impacts. Alternative solutions to policy problems will be outlined with probable consequences of each. The major final product of this project will be a final report presenting the results of the research effort in a format which will be understandable and useful to current decision-makers. Work to date has included a preliminary Phase I report, and a review panel meeting to evaluate this report and assist in planning the remainder of the study and the completion of a work plan for the remainder of the project.
Keywords: TEXAS; LIGNITE; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; PLANNING; ENERGY POLICY; GOVERNMENT POLICIES; SOCIO-ECONOMIC FACTORS; DECISION MAKING; COAL MINING.

75907 Study to Support the Development of New Source Performance Standards for Control of SO2, NOx, and Particulates from Combustion Boilers. Cukor, P. (Teknekron, Inc., 2118 Milvia Street, Berkeley, CA, 94704). **Project number:** V624C-16. **Contract:** 68-01-3970. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$631,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

This is a study of the projected effects of several alternate revisions to the new source performance standards (NSPS) for emissions from coal-fired utility power boilers. The revision is assumed to apply to all coal-fired units after 1982. The revised standards which are considered are: (1) mandatory 90 percent SO2 removal with an upper limit on emissions of 1.2 lb SO2 per million Btu; (2) mandatory 80 percent SO2 removal with the same upper limit; and (3) no mandatory percentage removal with an upper limit of 0.6 lb SO2 per million Btu. In addition, effects of revising the NSPS for particulate emissions from the current value of 0.1 lb per million Btu down to 0.03 lb are quantified as are effects in reducing the NOx emissions to 0.6 lb per million Btu. Projections of the structure of the electric utility industry both with and without the NSPS revisions are given out to the year 2000. Effects of alternative standards on air emissions, solid waste production, water consumption, energy requirements and economic and financial factors, including projections of pollution control costs and changes in electricity prices, are evaluated within this study.
Keywords: SULFUR DIOXIDE; NITROGEN OXIDES; PARTICLES; AEROSOLS; BOILERS; STANDARDS; POLLUTION REGULATIONS; AIR POLLUTION ABATEMENT; FOSSIL-FUEL POWER PLANTS.

75908 Development and Evaluation of an Integrated Approach to the Optimization of Nuclear Power Plant Radiological Surveillance Programs. Belvin, E.A. (TVA, Radiological Hygiene Branch, Muscle Shoals, AL, 35660). **Project number:** V624C-18. **Contract:** D8-E721-DI. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives of the project are: (1) to produce an analytical quality control document which can be used by radiological laboratories for quality control monitoring of procedures, counting equipment, and data handling; (2) to develop a program of interlaboratory studies, standards, and analytical and counting procedures to use as standard methods in multiple laboratories; (3) to provide guidelines for gamma counting and data reduction techniques; and (4) to develop portions of a cost-effective environmental radiological surveillance program through the use of statistical methodologies, parametric studies and improved sampling procedures.
Keywords: NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; ENVIRONMENT; RADIATION MONITORING; QUALITY ASSURANCE; COUNTING TECHNIQUES; DATA PROCESSING.

75909 Develop Economic Projection Modeling Capability Necessary to Derive Modular Energy and Environmental Planning Models at a Multicounty Level. Hinote, H. (TVA, Division of Navigation Development, Valley Fidelity Bank Building, Suite 700, Knoxville, TN). **Project number:** V624C-55. **Contract:** D8-E721-DU. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$74,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment.

As a part of its ongoing economic research program, TVA is in the process of developing a regional economic model of the TVA region and its principal subregions. Long-term objectives in the development of the model include: (1) provision of an annual and consistent set of long-run economic and demographic projections which reflect the national business cycle; (2) assessment of regional sensitivity to national economic parameters such as growth or decline in specific industries; (3) assessment of the impact in small areas (multicounty) of a major construction project, e.g., a large nuclear energy-generating plant; and (4) provision of a macroeconomic data base at a multicounty level for land-use planning and site assessment.
Keywords: TENNESSEE VALLEY AUTHORITY; FORECASTING; ECONOMIC DEVELOPMENT; TENNESSEE; ALABAMA; KENTUCKY; EMPLOYMENT; HUMAN POPULATIONS; INCOME; MATHEMATICAL MODELS; SOCIO-ECONOMIC FACTORS; ECONOMIC GROWTH; NUCLEAR POWER PLANTS; ENVIRONMENTAL IMPACTS; INDUSTRIAL PLANTS.

75910 Environmental Residuals Output Model for Operation and Expansion of an Electric Power System. Evans, B.D. (TVA, 401 Chestnut Street, Room 268, Chattanooga, TN). **Project number:** V624C-56. **Contract:** D8-E721-DV. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.

Work has been completed on the Environmental Residual Output Model and its documentation.**Keywords:** ELECTRIC POWER; ENVIRONMENTAL IMPACTS; MATHEMATICAL MODELS; WATER POLLUTION; CHEMICAL EFFLUENTS; OPERATION; MODIFICATIONS; AIR QUALITY; WATER QUALITY; TERRESTRIAL ECOSYSTEMS; SOUTHEAST REGION.

75911 Academy Forum on the Development of Ocean Resources. White, R.R. (National Academy of Sciences, 2101 Constitution Avenue, Washington, DC, 20037). **Project number:** V625A-01. **Contract:** R806115-01. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$25,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

Science and technology have opened the oceans as a source of abundant materials, energy, and food. Ocean engineering technology and procedures, however, are becoming more costly and increasingly complex as these activities extend into harsher and more remote regions, and concerns mount for the protection of the environment, the conservation of resources, and the safety of human life. These concerns have resulted in conflicting and restrictive regulatory policies as well as counterproductive delays for all concerned. In an effort to find new ways of communication among the various groups interested in the broad topic of development of ocean resources, it is proposed that they be brought together in an academy forum in regional workshops and eventually in plenary sessions in Washington, DC, at which time the discussion can be shared with representatives of government, industry, and public interest groups. The objectives of this academy forum include: to seek new ways for constructive participation of scientists, sea technologists, and citizens to formulate programs for the beneficial utilization of oceans while protecting the government, to determine the long- and short-term issues emerging from the further development of ocean resources, and to place these issues in some order of priority.
Keywords: OCEANOGRAPHY; RESOURCE CONSERVATION; ENERGY CONSERVATION; FOOD; PRODUCTION; AQUATIC ECOSYSTEMS; MATHEMATICAL MODELS; SEAS.

75912 Environmental Assessment of Northern Puget Sound and the Strait of Juan de Fuca. Harris, H.S. (Department of Commerce, National Oceanic and Atmospheric Administration, Rockville, MD, 20852). **Project number:** V625A-34. **Contract:** D5-E693-EN. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$850,000.

Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objectives are to: (1) characterize the major marine biological populations subject to impact by pollution resulting from petroleum transportation and refining; (2) determine the existing distribution and concentration of pollutants within the ecosystem which are associated with refinery effluent and petroleum; (3) characterize the principal processes and major pathways by which petroleum moves through the marine ecosystem; and (4) provide decision makers with ecological data and information on the effects of oil-related activities upon the ecosystem. The results will include: (1) descriptions of existing environmental conditions; (2) determinations of the present occurrence and variability of petroleum related pollutants; (3) a state-of-the-art oil spill trajectory model for Northern Puget Sound and Strait of Juan de Fuca; and (4) estimates of biologic effects and recovery following an oil spill. The project is in its third of five years. A description of the possible movement of floating material (e.g., petroleum) in the Strait of Juan de Fuca has resulted from a synthesis of physical oceanographic and meteorological data. The sorptive characteristics of suspended sediments relative to selected petroleum constituents have been determined. The types of petroleum (and derivatives) that potentially could reach the waters of Puget Sound during transport, transfer, and refining have been identified. A study has shown that microbial degradation of crude oil will not take place in the absence of nutrients. An operating oil spill trajectory model (using tidal current predictions and regional winds) has been developed and made available to the Bureau of Land Management and Northern Tier Pipeline Co. for their use in developing an EIS for the siting of oil transfer facilities and pipeline in the Strait of Juan de Fuca and Puget Sound. Studies are continuing on the distribution and abundance of biologic marine resources and habitats in this region (studies include marine birds and mammals, plankton, fishes, and tidal and shallow subtidal invertebrates).

Keywords: ENVIRONMENTAL IMPACTS; PETROLEUM INDUSTRY; OCEANOGRAPHY; HYDROCARBONS; ENVIRONMENTAL TRANSPORT; PETROLEUM REFINERIES; MARITIME TRANSPORT; PETROLEUM; BASELINE ECOLOGY; ECOLOGICAL CONCENTRATION; PUGET SOUND; BIODEGRADATION; MICROORGANISMS.

75913 Environmental Assessment of an Active Oil Field in the Northwestern Gulf of Mexico. Caillouet, C.W. (Department of Commerce, National Oceanic and Atmospheric Administration, Rockville, MD, 20852). **Project number:** V625A-35. **Contract:** Contract D5-E693-EO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$600,000.

Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

A detailed multi-year environmental assessment of the Buccaneer oil and gas field was initiated in April 1976. The Buccaneer field is approximately 32 miles south-southeast of Galveston, Texas, is relatively isolated from other oil and gas fields, and has been in production for 17 years. The objectives of the study are: (1) to identify and document the extent and types of biological, chemical and physical alterations in a marine ecosystem that are associated with the development of and production of discharges from an oil field; and (2) to determine the specific pollutants, their quality, and effects on the various components of the marine ecosystem. The project will use historical and new data to describe and quantify the biological, chemical, and physical characteristics and the temporal variations of these characteristics in the environments of an active field. In this third year of research, an intensive investigation of environmental and ecosystem variables within the oil and gas field is being conducted, with a view toward comparison between production platforms from which production brines and other effluents are released and satellite platforms (well jackets) with no effluents. Academic institutions participating in the research include University of Houston and Texas A and M University. Private firms include Energy Resources Co., Inc.; LGL, Limited-U.S., Inc.; NALCO Environmental Sciences; Southwest Research Institute; Science Applications, Inc.; and Environmental Research and Technology, Inc.

Keywords: PETROLEUM; OIL WELLS; GULF OF MEXICO; ENVIRONMENTAL IMPACTS; OIL FIELDS; TEXAS.

75914 Field and Filtered/Unfiltered Field Exposure Chamber Studies of the Effects of Coal-Fired Power Plant Emissions on Crop and Forest Species. Noggle, J.C. (TVA, Division of Environmental Planning, Air Quality Research Station, Muscle Shoals, AL, 35660). **Project number:** V625A-40. **Contract:** D8-E721-D0. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$150,000.

Related energy source: coal(100).

These studies are designed to characterize under field conditions the relationship between pollutant dose and effects on foliar appearance, growth, and yield of selected crop and forest species (including soybeans, wheat, cotton, and Virginia pine). A field study has been conducted during two growing seasons in the vicinity of a coal-fired power plant. Control crops were grown utilizing an air-exclusion system that operated when ambient SO2 concentrations exceeded 0.1 ppM. In the 1978 growing season, an experimental design utilizing air exclusion systems to exclude SO2, SO2 plus ozone, and ozone was developed which will be used to determine whether SO2-ozone synergisms occur in the field. Foliar appearance, growth, and yield of crops exposed to ambient air pollutants were compared with the control crops. Intermittent exposure of soybean for 127 hours to SO2 concentrations, which were in excess of 0.1 ppM, but less than those required to cause foliar injury, did not result in yield reductions. The yield of soybeans exhibiting chlorosis on 6.4 percent of the leaf area was significantly lower than control plants. Yield reductions have not been observed in the absence of visual symptoms of injury. A milestone report to EPA discussing the selection and characterization of experimental plots and testing of the air-exclusion system is available.

Keywords: COAL; FOSSIL-FUEL POWER PLANTS; FLUE GAS; CROPS; FORESTS; ENVIRONMENTAL IMPACTS; PRODUCTIVITY; AIR POLLUTION; SULFUR DIOXIDE; OZONE; SOYBEANS; SYNERGISM; METABOLISM.

75915 Effects of Emissions from Coal-Fired Power Plants on Soybeans and Other Crops of Economic Importance to Southeast US. Noggle, J.C. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625A-42. **Contract:** D8-E721-D0. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$45,000.

Related energy source: coal(100).

The objective is to determine the relationship between dose of atmospheric emissions from coal-fired power plants and effects on growth and/or yield of agricultural crops. Soybeans, cotton, and wheat are exposed to SO2, NO2, and O3, alone and in combinations, at acute and chronic levels in controlled exposure chambers. Responses measured included visible injury, growth, and yield. With fluctuating SO2 concentrations, as normally occurs during field exposure, expressing dosage as time-average concentration is not adequate in predicting visual effects of SO2 on vegetation. Soybeans were exposed to SO2 with the concentration changing as follows: (1) increased linearly from 0.0 to 4.5 ppM in one hour; (2) increased linearly from 0.0 to a peak of 4.5 ppM in 30 minutes then decreased linearly to 0.0 in 30 minutes; and (3) decreased linearly from 4.5 ppM to 0.0 in one hour. Each of these treatments has one-hour average concentration of 2.25 ppM and three-hour average of 0.75 ppM. Soybeans exposed to these treatments developed significantly more visual effects (chlorosis, bronzing, and necrosis) than soybeans exposed to a constant SO2 concentration of 0.75 ppM for three hours. Soybeans exposed to treatments 1 and 2 developed more necrosis than those exposed to treatment 3. Wheat exposed to 1.5 ppM SO2 for three hours developed 3 percent leaf injury without resulting in a grain reduction. A milestone report to EPA describing the design, construction, and testing of an exposure chamber will be available in January, 1979.

Keywords: FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; CHEMICAL EFFLUENTS; FLUE GAS; FLY ASH; BIOLOGICAL EFFECTS; SOYBEANS; CROPS; ECONOMIC IMPACT; AIR POLLUTION; SULFUR DIOXIDE; COTTON; WHEAT; NITROGEN DIOXIDE; OZONE; SYNERGISM; DOSE-RESPONSE RELATIONSHIPS.

75916 Transfer, Fate, and Effects of SOx, NOx, and Acid Precipitation on a Terrestrial Ecosystem Representative of the Tennessee Valley Region. Kelly, J.M. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625A-43. **Contract:** D8-E721-DO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$184,000.

R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this study is to use the watershed approach to characterize and quantify the transfer, fate, and effects of SOx, NOx, and acid precipitation on forested ecosystems. Field studies include the development of sulfur and nitrogen budgets, including measurements of gaseous, particulate, and liquid atmospheric input. Final output will provide insight into the holistic response of forest ecosystems to anthropogenic perturbations, as well as insights into the processes and transfers that control system response. These types of information can be utilized in the development of emission standards and in the economic evaluation of emission control costs. Two forested watershed study areas have been developed and equipped with an advanced instrument package to monitor both element inputs and losses from the system. Data collection is proceeding at both study sites, and a milestone report covering the objectives, facilities, and ecological characteristics of the study areas has been written and should be available by July 1979.

Keywords: TRANSLOCATION; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL EFFECTS; SULFUR OXIDES; NITROGEN OXIDES; ACID RAIN; ENVIRONMENTAL IMPACTS; SOUTHEAST REGION; TENNESSEE VALLEY AUTHORITY; WATERSHEDS; AEROSOLS; GASEOUS WASTES; BIOLOGICAL MODELS; BASELINE ECOLOGY; WATER QUALITY; TERRESTRIAL ECOSYSTEMS; POWER PLANTS.

75917 Beneficial Effects of SO2 Emissions from Coal-Fired Power Plants on Crop and Forest Species. Noggle, J.C. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625A-44. **Contract:** D8-E721-DO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$44,000.
R and D categories: Physical and chemical processes and effects.

This study involves the evaluation of economic benefits of sulfur deposition from the atmosphere on crop and forest species. The source of sulfur accumulated by vegetation is positioned between the soil and the atmosphere. The potential for atmospheric sulfur to meet the supplemented sulfur needs for maximum crop production is evaluated. This evaluation requires information on the sulfur requirements of crops, sulfur supplying capacity of soils, and the amount of sulfur transferred from the atmosphere to the agroecosystem. A technique for measuring the accumulation of sulfur from the atmosphere by field-grown plants has been developed. Cotton plants accumulated a significant amount of sulfur from the atmosphere and produced significantly more biomass when grown in a low-sulfur soil 4 km from coal-fired power plants compared with that grown at a location remote to industrial sources of sulfur. Fescue, which has a lower sulfur requirement than cotton, accumulated a lesser amount at the same locations. The S-supplying capacity of selected soils was evaluated by measuring the rate of S accumulation by fescue grown in a greenhouse with charcoal filtered air. The rate of S mineralization in top soil, with less than 1 percent organic matter collected at five sites, was about 1 mg S per kilogram soil during a 27-week growth period.
Keywords: SULFUR DIOXIDE; FLUE GAS; FOSSIL-FUEL POWER PLANTS; CROPS; FORESTS; ENVIRONMENTAL IMPACTS; ENVIRONMENTAL EFFECTS; NUTRIENTS; COAL; SULFUR; PRODUCTIVITY; PLANT GROWTH; SOIL CHEMISTRY; COTTON; AIR POLLUTION; METABOLISM; UPTAKE; PLANTS.

75918 *Fate and Effects of Atmospheric Emissions from Cooling* Systems on Terrestrial Habitats. Noggle, J.C. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625A-46. **Contract:** D8-E721-DP. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$10,000.

This investigation is aimed at identifying and characterizing the effects of atmospheric releases from mechanical draft cooling towers on soils and crops. Four vegetation study plots were established 1 to 9 km in the prevailing downwind direction from the mechanical draft cooling towers at Browns Ferry Nuclear Plant. Measurements included wet and dry deposition of Na, Cr, Zn, Cl, and SO4; their accumulation in and effects on soil and vegetation; and impacts of moisture on growth and/or yield of selected crops and timber species and incidence of disease. Depositions of these chemicals at 1 and 9 km from the cooling towers were not significantly different. There were no visual symptoms attributable to tower drift on the vegetation at 1 km from the cooling tower. This study was discontinued after two years, and a final report will be available in July 1979.**Keywords:** ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL IMPACTS; COOLING TOWERS; COOLING SYSTEMS; TERRESTRIAL ECOSYSTEMS; HABITAT; SOILS; CROPS; NUCLEAR POWER PLANTS; CHEMICAL EFFLUENTS; SODIUM; CHROMIUM; ZINC; CHLORINE; SULFATES; DEPOSITION; BIOLOGICAL MODELS.

75919 Ecological Recovery After Reclamation of Toxic Spoils Left by Coal Surface Mining. Zarger, T.G. (TVA, Division of Forestry, Fisheries and Wildlife, Norris, TN, 37828). **Project number:** V625A- 47. **Contract:** D8-E721-DQ. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$67,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objective is to determine the rate of recovery of a damaged ecosystem in response to intensive remedial treatment of a problem surfae mine. The project involves a problem watershed in which 162 ha (400 acres) of forested land were disturbed by coal surface mining in the early 1970's. Unsuccessful reclamation efforts resulted in adverse environmental impacts within a 28 sq km (10.8 sq mi) watershed that includes a city water supply reservoir. Project objectives are being accomplished by applying intensive remedial land treatments and evaluating their effectiveness by measuring the degree of recovery of the affected terrestrial and aquatic ecosystems. Environmental data collected during the period of mining and early reclamation effort provide initial baseline. Monitoring (soil, vegetation, and receiving stream ecology) is being conducted through treatment and will be continued thereafter on a more limited basis as long as significant recovery is noted. A paper, Effects of Remedial Reclamation Treatments on Terrestrial and Aquatic Ecosystems, was prepared for publication. Also, the baseline assessment of environmental conditions prior to application of intensive remedial treatments was submitted for EPA/TVA review in July, 1978. An internal milestone report will be prepared in June, 1979. Treatments are complete and 20 ha (50 acres) have been retreated with a heavier liming rate. Treatments have resulted in significant increases in perentages of herbaceous ground cover and number of woody stems per ha. The most evident improvement in water quality is stream pH. Aquatic invertebrates increased in numbers of individuals and taxa.
Keywords: COAL MINING; SURFACE MINING; SPOIL BANKS; REVEGETATION; LAND RECLAMATION; WATER QUALITY; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; MONITORING.

75920 Thermal Effects on Aquatic Insects. Tennessen, K.J. (TVA, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625A-49. **Contract:** D8-E721-DR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$77,000. **Related energy source:** coal(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The objective of this task is to provide data on the effects of thermal plume entrainment on aquatic insects. Thermal tolerance of selected species (i.e., Hexagena bilineata and Coelotanypus sp.) and the effect of acclimation temperature on tolerance are being determined in the laboratory. Field studies have been directed at comparing the growth and emergence time of H. bileneata in thermal plume and ambient temperature areas near several steam-electric generating plants. The concern is that aquatic insect populations upstream and downstream of steam-electric stations may be depleted if the insects cannot tolerate thermal plume entrainment. In laboratory tests on H. bilineata and Coelotanypus sp. immatures, low percentages of mortality resulted at thermal shocks as high as 20 degrees C for 6 hr durations (acclimation temperature of 15 degrees C). Results from a series of acclimation temperature tests (3 acclimation temperatures: 5, 15, and 25 degrees C) show that tolerance of H. bilineata nymphs increases with increasing acclimation temperature, but that the magnitude of the temperature change (delta T) that can be tolerated decreases. The highest 6-hr LT50 (41.2 degrees C) was obtained at an acclimation temperature of 25 degrees C.
Keywords: THERMAL POWER PLANTS; THERMAL EFFLUENTS; SURFACE WATERS; THERMAL POLLUTION; BIOLOGICAL EFFECTS; INSECTS; GROWTH; METAMORPHOSIS; TEMPERATURE EFFECTS; MEDIUM TEMPERATURE; BIOLOGICAL ADAPTATION; THERMAL STRESSES; TEMPERATURE DISTRIBUTION; AQUATIC ORGANISMS.

75921 Biochemical Methodology, Aquatic Thermal Impacts. Murray, S.A. (TVA, Division of Environmental Planning, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625A-50. **Contract:** D8-E721-DR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$46,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objectives of this research are to develop and implant hematological methodologies for fish, define baseline hematological parameters under field and laboratory conditions, and quantify and isolate thermal stress effects on hematology of fish under field and laboratory conditions. Final outputs will appear as TVA internal reports and EPA milestone reports. The methodologies we have developed are documented in TVA internal report I-WQ-77-3. Results from studies on loading density, predator density, and between sexes are apparent in the blood of some fish. Preliminary laboratory and field studies indicate that levels of hematocrit, hemoglobin and erythrocytic sedimentation rates as well as morphological measures of erythrocytes and distribution of cell types are consistently good indicators of stress.
Keywords: BIOCHEMISTRY; AQUATIC ECOSYSTEMS; TEMPERATURE EFFECTS; BIOLOGICAL STRESS; BIOLOGICAL MODELS; MEASURING METHODS; THERMAL POLLUTION; HEMATOLOGY; FISHES; BIOLOGICAL INDICATORS; BIOASSAY.

75922 Biomonitoring, Mollusks, and Others. Isom, B.G. (TVA, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625A-51. **Contract:** D8-E721-DR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$63,000.

Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this task is to quantify the role of bioaccumulation in cycling of trace elements (selected metals and radionuclides) released to aquatic ecosystems by energy technologies (coal combustion and nuclear steam-electric stations). Laboratory methods have been developed for processing mussel tissues prior to analysis of heavy metals. A method for dry weight and ash weight determinations for solid tissues has been developed. A procedure for treating extrapallial fluid samples for analysis of heavy metals was developed.
Keywords: FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; AQUATIC ECOSYSTEMS; MINERAL CYCLING; RADIONUCLIDE MIGRATION; TRACE AMOUNTS; METALS; RADIOISOTOPES; ECOLOGICAL CONCENTRATION; RADIOECOLOGICAL CONCENTRATION; BIOLOGICAL ACCUMULATION; MOLLUSCS; RADIONUCLIDE KINETICS.

75923 Evaluate Water Intake, Zooplankton Entrainment. Urban, R.D. (TVA, Division of Environmental Planning, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625A-52. **Contract:** D8-E721-DR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$64,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective of this research project is to determine if intake design is a feasible means of mitigating effects to zooplankton by minimizing the quantity entrained. The Tennessee Valley Authority has several different types of intake designs at existing power plants. Studies at these intakes should show what differences exist, if any, in the quantity of zooplankton entrained at each intake design. High replicate sample variability has hindered evaluations. However, preliminary interpretations indicate that none of the intake designs studied minimize the quantity of zooplankton entrained. That is, the numbers per unit volume in the intake were similar to those in the source body, regardless of the intake design.
Keywords: ZOOPLANKTON; ENTRAINMENT; INTAKE STRUCTURES; DESIGN; POWER PLANTS; COOLING.

75924 Production of Arthropod Pests and Vectors in Coal Strip Mine Pools. Pickard, E. (TVA, Division of Environmental Planning, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625A-54. **Contract:** D8-E721-DT. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of this study is to determine the species of aquatic anthropod pests, mainly mosquitoes, that are breeding in abandoned cool stripmine ponds, their population densities, and whether these breeding sites will serve as feci for annoyance to surrounding human populations. Monthly field surveys are being conducted to qualify and quantify arthropod species composition according to pond age classification. The study was originally planned for five years and data obtained from surveys of nine selected ponds should depict successional changes in aquatic insect and plant species composition over a period of 15 successive years. Mosquito larvae of four genera including eight species have been collected from the study ponds. Anopheles punctipennis and Culex erraticus were the most prevalent species in ponds formed five or more years ago. Anopheles quadrimaculatus, the malaria vector, was found in significant numbers in ponds five years of age and older. A total of 98 species of insects have been collected by aquatic dip net and Ekman dredge sampling in the nine study ponds. There was a paucity of insects of public health importance in the benthic samples with only a few larval specimens of palpomyia and chrysops. A total of 58 plant species have been detected in the study ponds. There appears to be no significant difference in the pH of the water among the study ponds.
Keywords: COAL MINING; SURFACE MINING; PONDS; WATER POLLUTION; HUMAN POPULATIONS; AQUATIC ORGANISMS; POPULATION DYNAMICS; HEALTH HAZARDS; INSECTS; PLANTS; RISK ASSESSMENT; ENVIRONMENTAL IMPACTS; PH VALUE; ACID MINE DRAINAGE; BIOLOGICAL EFFECTS.

75925 Methodology, Development and Application for Determining Instream Flow Needs. Stalnaker, C. (Fish and Wildlife Service, 10th and Constitution Avenue, Room 378, Washington, DC). **Project number:** V625A-78. **Contract:** D8-E685-FE. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$250,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment.

The objective is to develop improved methodologies for determining the instream flow requirements of fish, wildlife, recreation and aesthetics. The approach utilized will be to develop, test and evaluate methodologies through an intergovernmental multidisciplinary team; and to rely heavily on existing data and refinements to existing methods, primarily engineering and biological. Particular attention is given to priority needs in arid western states where energy impacts on water resources are anticipated.
Keywords: AQUATIC ORGANISMS; WATER REQUIREMENTS; RECREATIONAL AREAS; AESTHETICS; FISHES; WILD ANIMALS; BIRDS; ARID LANDS; MATHEMATICAL MODELS; ECOSYSTEMS; FLOW RATE; STREAMS.

75926 Determine Water Quantity Needs of Fish in Western States Affected by Energy Development. Doerksen, H. (Fish and Wildlife Service, 10th and Constitution Avenue, Room 378, Washington, DC). **Project number:** V625A-79. **Contract:** D8-E685-BQ. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$303,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The objectives are to: establish instream flow requirements necessary to maintain the viability of species present in high priority western states streams; develop and document methods, techniques and strategies for determining and securing water quantity needs; and test and evaluate methods, techniques and strategies. Priority streams will be identified and field studies will begin. Reports will be published as information is available. Reports include documentation of methods, flow requirements and evaluations.
Keywords: FISHES; WATER REQUIREMENTS; SPECIES DIVERSITY; GENETIC VARIABILITY; MEASURING METHODS; WATER QUALITY; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; PHYSIOLOGY; STREAMS.

75927 Ecological Methods for Rapidly Assessing Coal Impacts to Wildlife. Stewart, R.E. (Fish and Wildlife Service, Office of Biological Services, 10th and Constitution Avenue, Room 378, Washington, DC). **Project number:** V625A-80. **Contract:** D8-E685-BN. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$550,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

These investigations identify, demonstrate, and implement a rapid, cost effective, reliable method of inventorying and characterizing wildlife habitat. Wildlife habitat is being mapped using modern photographic and satellite techniques for western coal areas with high development potential. Emphasis is being given to standardizing base line studies, habitat requirements of wildlife species for food, cover, breeding, and other critical factors, and to the relationship of these factors to terrestrial ecosystems, other surface resources and events. Emphasis is also given to a determination of how various coal related activities, particularly processing and population growth, impact wildlife and the magnitude of that impact. Results will consist of maps, computer systems, interim and final reports of field and laboratory work and an interagency workshop. Studies are being conducted on western ecological test areas where coal development is or will be taking place.
Keywords: COAL INDUSTRY; WILD ANIMALS; ENVIRONMENTAL IMPACTS; BASELINE ECOLOGY; HABITAT; FISHES; POPULATION DYNAMICS; INFORMATION SYSTEMS.

75928 Major Coastal Ecosystem Characterization and Methodology Emphasis on Fish and Wildlife as Related to Oil and Gas Development. Tait, H. (Fish and Wildlife Service, Office of Biological Services, 10th and Constitution Avenue, Room 378, Washington, DC). **Project number:** V625A-81. **Contract:** D8-E685-AW. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$600,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are to develop multi-year plan for ecological characterization of coastal areas, and prepare standardized methodologies and specifications for conducting ecological characterizations. Priorities for ranking candidate characterization areas, a programmatic plan for completing additional characterization studies, and a report for the regionalization of coastal ecosystem will be developed. Current plans are to characterize four selected coastal ecosystems (S.W. Louisiana, Georgia/South Carolina, Maine, and N.W. Pacific Coast) using above methodologies and to evaluate factors with predictive potential.
Keywords: COASTAL REGIONS; FISHES; WILD ANIMALS; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; AQUATIC ECOSYSTEMS; BIOLOGICAL MODELS.

75929 Ecological and Physiological/Toxicological Effects of Oil on Birds. Stickel, L.F. (Department of the Interior, Fish and Wildlife Service, 10th and Constitution Avenue, Room 378, Washington,

DC). **Project number:** V625A-82. **Contract:** D8-E685-AV. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$300,000. **Related energy source:** oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives are to evaluate the effects on birds of exposure to petroleum and/or components by dietary intake or by exposure of eggs. Effects measured include physiological functions, reproductive performance, survival and tissue accumulation.

Keywords: PETROLEUM; BIOLOGICAL EFFECTS; BIRDS; METABOLISM; PHYSIOLOGY; TOXICITY; DIET; EGGS; CHRONIC EXPOSURE; REPRODUCTION; SURVIVAL CURVES; TISSUE DISTRIBUTION; BIOLOGICAL ACCUMULATION; HYDROCARBONS.

75930 Metals in Marine Organisms. Fowler, B.A. (National Institite of Environmental Health Sciences, Environmental Toxicology Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625A-87. **Contract:** D8-E772-CV. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$80,000.

R and D categories: Health effects.

The objective of this study is to determine the physiological, biochemical, and ultrastructural effects of arsenic, cadmium, and copper in marine shellfish and to compare these effects to those found in mammals. This year, further studies will be conducted to assist in understanding the subcellular mechanisms of metal uptake and toxicity in marine species. Metal-contaminated marine shellfish will also be fed to mammals to determine metal availability and to indirectly estimate human risk potential. The increased release of heavy metals into the environment (drilling muds, etc.) as a result of increased energy R and D, the capability of marine invertebrate species to bio-accumulate many of these metals, and the mammalian toxicity of these elements are all relative to our energy research strategy.

Keywords: METALS; UPTAKE; AQUATIC ORGANISMS; CADMIUM; COPPER; ARSENIC; TOXICITY; INVERTEBRATES.

75931 Hydrocarbons in Marine Species. Bend, J.R. (National Institute of Environmental Health Sciences, Laboratory of Pharmacology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625A-88. **Contract:** D8-E772-CV. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$70,000.

R and D categories: Health effects.

This study is determining the in-vitro and in-situ metabolism of hydrocarbons with particular emphasis on the PAH benzo(a)pyrene. The importance of environmental temperature and the effect of preexposure to hydrocarbons or other classes of environmental pollutants on various biotransformation steps is also being assessed. Particular emphasis is being placed on potentially toxic (carcinogenic, mutagenic cytotoxic) forms of the compound that might be stored in tissues of aquatic animals prior to consumption by humans. In-depth studies are also in progress to assess enzyme induction in marine vertebrate species as an index of the presence of toxic compounds such as the PAH, dioxins, PCBs, and PBBs.

Keywords: HYDROCARBONS; METABOLISM; BENZOPYRENE; TOXICITY; FOOD CHAINS; TISSUE DISTRIBUTION; FISHES; MAN; HEALTH HAZARDS; TEMPERATURE EFFECTS.

75932 Carcinogenic Effects on Marine Species. Bend, J.R. (National Institute of Environmental Health Sciences, Laboratory of Pharmacology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625A-89. **Contract:** D8-E772-CV. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$29,000.

R and D categories: Health effects.

The purpose of this project is to compare the incidence of tumors, including but not restricted to epidermal papillomas, in exposure and control groups of English sole in response to continuous exposure to water containing benzo(a)pyrene. Should this disease be caused either directly or indirectly by PAH such as benzo(a)pyrene, then once the etiology is thoroughly characterized it could potentially be used as an indicator for PAH pollution in marine environments.

Keywords: CARCINOGENESIS; TUMOR CELLS; NEOPLASMS; BENZOPYRENE; WATER POLLUTION; WASHINGTON; BIOLOGICAL EFFECTS; TOXICITY; ETIOLOGY; BIOLOGICAL INDICATORS; MONITORING.

75933 Coal Ash Contaminants in Southeastern Aquatic Ecosystems. Gibbons, J.W. (University of Georiga, Savannah River Ecology Lab., Aiken, SC, 29801). **Project number:** V625A-90. **Contract:** D8-E681-CO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$120,000.

Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

Work to date has sought to determine the impact of ashes from coal combustion in raising heavy metal concentrations in ecosystem components in several aquatic environments of the Savannah River Plant, SC. The goal is to develop a predictive capability in assessing the threat of heavy metals derived from coal ashes to aquatic ecosystems of the southueastern USA, where coal utilization is expected to increase greatly. Our approach is to determine: (1) inputs of heavy metals from coal ash to local aquatic systems; (2) factors affecting and potentially limiting these inputs; (3) concentrations of heavy metals in ecosystem components of aquatic habitats receiving inputs from coal ash; (4) biological availability and potential toxicity of heavy metals in coal ash to potentially impacted biota; and (5) chemical factors in southeastern aquatic habitats potentially limiting or accentuating heavy metal toxicity and biological availability. Semi-annual reports of progress toward these goals are scheduled for January 1979 and July 1979.

Keywords: COAL INDUSTRY; FLY ASH; CHEMICAL COMPOSITION; AQUATIC ECOSYSTEMS; SAVANNAH RIVER PLANT; METALS; WATER POLLUTION; ENVIRONMENTAL IMPACTS; TOXICITY; ECOLOGICAL CONCENTRATION; FOSSIL-FUEL POWER PLANTS.

75934 Water Chlorination, Effects on Aquatic Species. Murray, S.A. (TVA, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625A-91. **Contract:** D8-E721-DR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$47,000.

Related energy source: biomass(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives of this research are to develop and implement methodologies using aquatic species at various trophic levels (producers, consumers, and decomposers) to identify and quantify chlorination impacts. The results will be verified under controlled conditions. The information will be used to predict impacts at new sites. The approach will be to select a power plant site and use the plant as a source of chlorine. Flow-through systems will be used to determine biological effects. Types of responses considered will include photosynthetic rates, periphyton community structure, fish hematology, histopathology, and cough response, tropism behavior in unicellular organisms, regeneration rates in amphibians, to name a few.

Keywords: WATER; CHLORINATION; CHLORINE; BIOLOGICAL EFFECTS; AQUATIC ORGANISMS; ENVIRONMENTAL IMPACTS.

75935 Atmospheric Interaction Studies (Field and Chamber). Meagher, J.F. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625B-38. **Contract:** D8-E721-DL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$179,000.

Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objective of this project is to determine the chemical reactions of plume constituents from coal-fired power plants. Emphasis is placed on studying the rate of oxidation of SO2; NO-NOx chemistry is also under investigation. The goal is to predict the concentrations of major constituents at various locations downwind. Highly instrumented aircraft measure the concentrations of the constituents at several altitudes at each of a number of downwind distances. Pertinent meteorological parameters are measured from the aircraft and on the ground. These data will be utilized to develop a plume chemistry model that will detail the plausible mechanisms and kinetics of chemical reactions occurring in the plume and the meteorological influences on these reactions. Field experiments were conducted in May and June 1978 at TVA's Colbert and Paradise steam plants. The purpose of this study is to investigate the effects of boiler type on the conversion of SO2 to sulfate (less than 2% per hour in the plume close to the plants). After approximately 2 hours of drift time, the conversion rate increases to 4 to 5% per hour. Samples were collected at distances ranging from 7 to 60 km downwind at Paradise. Preliminary results show that the conversion rate is very slow, about 1% per hour, and does not change significantly over the distances samples. Initial characterization of the photochemical reaction chamber has begun. Measurements are being made to determine light intensity, temperature, and concentration gradients and to compare the relative oxidation rate of SO2 in this chamber to others presently in use. A report has been prepared on the design of the photochemical reaction chamber. Tentative plans are to move the chamber to the Colbert Steam Plant in January with initial introduction of stack gas into the chamber in March.

Keywords: FOSSIL-FUEL POWER PLANTS; PLUMES; SULFUR DIOXIDE; NITROGEN OXIDES; OXIDATION; AIR POLLUTION; CHEMICAL REACTIONS.

75936 Long-Range Atmospheric Transport of Coal-Fired Power Plant Emissions in the Tennessee Valley Region. Crawford, T.L. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625B-39. **Contract:** D8-E721-DL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$85,000.
R and D categories: Physical and chemical processes and effects.

The sulfur dioxide/sulfate issue requires development of a scientific data base to delineate regional effects of coal-fired power plant emissions and characterization and quantification of the mechanisms of long-range transport of emissions. A long-range transport model describing the conservation balance of SO2/sulfate complex is being developed and applied to a mesoscale region (1000 km) centered over the Tennessee Valley watershed. Among factors being considered are advection by wind field, air parcel trajectories, diffusion by atmospheric turbulence, source/sink mechanisms, and chemical transformations. A regional SO2 emissions inventory has been acquired and maintained by continual updating. Field studies were conducted in spring 1976 and summer 1977. An additional field study will be conducted during the fall 1979. Data are being analyzed and a regional atmospheric transport model is being developed. Some findings have been reported in internal reports and professional journals. A major milestone report is due in April 1978 and a final report in September 1980.
Keywords: ENVIRONMENTAL TRANSPORT; FOSSIL-FUEL POWER PLANTS; FLUE GAS; EARTH ATMOSPHERE; AIR POLLUTION; SOUTHEAST REGION; SULFUR DIOXIDE; COAL; SULFATES; INVENTORIES; MATHEMATICAL MODELS.

75937 Evaluation and Improvement of Models Used for Radiological Impact Assessment of Gaseous Releases from Nuclear Power Plants. Belvin, E.A. (TVA, Radiological Hygiene Branch, 401 Chestnut Street, Room 268, Chattanooga, TN). **Project number:** V625B-41. **Contract:** D8-E721-DM. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$44,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

Data will be obtained that is usable in the evaluation and refinement of analytical models used for radiological impact assessment of nuclear power operations. Emphasis will be placed on the collection of data related to models used to predict radiation doses from radioactive materials confined within the plant, and radioactive materials in the gaseous effluent plume. Pressurized ionization chambers will be used. Meteorological data analysis procedures will be developed that help refine intermediate and long-range transport models. The procedures are to be applicable to impact analysis for both nuclear and coal-fired power plants. Results suggest collection of additional, radionuclide-specific data is necessary for model refinement.
Keywords: NUCLEAR POWER PLANTS; RISK ASSESSMENT; RADIOACTIVE EFFLUENTS; FOSSIL-FUEL POWER PLANTS; RADIATION DOSES; METEOROLOGY; MATHEMATICAL MODELS; RADIONUCLIDE MIGRATION; AIR POLLUTION; RADIATION MONITORING.

75938 Fate and Effects of Petroleum Hydrocarbons and Selected Toxic Metals in Selected Marine Ecosystems and Organisms. Wolfe, D.A. (National Oceanic and Atmospheric Administration, Environmental Research Labs., Boulder, CO, 80302). **Project number:** V625B-42. **Contract:** D6-E693-EM. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$425,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The overall approach of this project is to study experimentally selected processes controlling the distribution, transport, and effects (both physiological and ecological) of petroleum hydrocarbons and selected toxic metals in subarctic coastal marine ecosystems to facilitate the assessment of the impacts of petroleum releases in this ecosystem type. Project includes four interdependent tasks with the following objectives: (1) establish a national NOAA analytical facility at the NMFS Northwest and Alaska Fisheries Center with capability for petroleum hydrocarbons and toxic metals in the marine environment for purposes of standardizing analytical techniques, providing intercalibration services, and conducting routine analyses on a contract basis; (2) conduct major symposium fate and effects of petroleum hydrocarbons in marine ecosystems and organisms in Seattle in November 1976; (3) select, on a priority basis, and conduct specific laboratory experiments on fate and effects of metals and hydrocarbons; and (4) design experimental ecosystem research to determine changes at the ecosystem level and test our ability to predict ecological and biological impacts of petroleum in subarctic ecosystems. A report on design and feasibility of field experiments is currently available.
Keywords: PETROLEUM INDUSTRY; HYDROCARBONS; TOXICITY; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; AQUATIC ORGANISMS; BIOLOGICAL EFFECTS; METALS; BIOLOGICAL MODELS; BIRDS; FISHES; CRUSTACEANS; ESTUARIES; BEHAVIOR; SYNERGISM.

75939 Data Management and Archival Services for Interagency Energy Related Marine and Meteorologic Programs. Hughes, K.H. (Department of Commerce, Environmental Data and Information, Rockville, MD, 20852). **Project number:** V625B-59. **Contract:** D5-E693-FA. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.
R and D categories: Integrated assessment; Health effects.

Project objectives include: (1) development of a data management system; (2) development of a taxonomic code; and (3) operation of a data management system.
Keywords: TAXONOMY; DATA ACQUISITION SYSTEMS; STANDARDIZED TERMINOLOGY; SEAS; AQUATIC ECOSYSTEMS; METEOROLOGY; OCEANOGRAPHY.

75940 Strip Mine Drainage Water Quality with Emphasis on Toxic Substances. Ruane, R.J. (TVA, 401 Chestnut Street, Room 268, Chattanooga, TN). **Project number:** V625B-60. **Contract:** D5-E721-DS. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$166,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objectives of this project are to: (1) identify the occurrence and significance of trace metals in a strip mined area; (2) calibrate existing regionalized hydrologic models using data from surface mined watersheds with several types of reclamation; (3) develop or extend nonpoint source water quality models so that the natural-area environmental loadings of imporant water quality constituents can be predicted; (4) relate the transport of significant trace metals and other important water quality constituents to the hydrology of small strip mined watersheds; (5) develop relationships between the chemical composition of strip mine overburden and the downstream transport of important constituents over and above the natural-area environmental levels; and (6) relate the transport of important constituents to the structure and function of biological communities. The goal of this project is to demonstrate the methodologies for predicting the impact on downstream biotic communities, based upon the characteristics of the site to be mined. Sampled programs are continuing on six area-mined (Jamestown, Tennessee) and six contour-mined (New River Basin, Tennessee) sites. Storm event sampling has been underway at eight of these sites during the past years. Two years of monthly biological and fishereis data have been collected at the Jamestown sites. Core drills have been performed for overburden analysis at three locations in the contour-mined sites and four locations in the area-mined sites. A daily streamflow and storm hydrograph model has been calibrated for project use, and an algorithm for suspended sediment production and transport has been modified and is being tested. A sedimentation basin model is also being evaluated.
Keywords: TRACE AMOUNTS; METALS; MINE DRAINING; WATER QUALITY; OVERBURDEN; CHEMICAL COMPOSITION; HYDROLOGY; SURFACE MINING; TOXIC MATERIALS; TENNESSEE.

75941 Morphological Deformities in Procladius from Coal Strip Mine Ponds. Tennessen, K.J. (TVA, Water Quality and Ecology Branch, Muscle Shoals, AL, 35660). **Project number:** V625B-61. **Contract:** D5-E721-DS. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The purpose of this study is to investigate the factors causing morphological abnormalities in larvae of Djalmabatista pulcher (Diptera: chironomidae) inhabiting coal strip mine ponds in Alabama. Differences in the incidence of abnormalities between strip mine ponds and the control lakes will be correlated with larval density and water quality data. Suspected factors will be tested with laboratory bioassays. A semiannual report was written in July 1978, outlining the overall objectives of the project and preliminary results. An EPA milestone report is due in January 1979, and will contain field survey results and recommendations for further bioassay work. Thus far water quality data has been collected trimonthly from January to October 1978. Greatest differences in the values of calcium and magnesium cations, sulfate anions, calcium-magnesium hardness, conductivity, and dissolved solids were observed between each pond and control for each sampling period. Preliminary analysis of monthly chironomid sampling indicates that lingual deformities (deformities of larval mouth parts) have an approximate incidence rate of 1% in the control lake.

Keywords: COAL; SURFACE MINING; PONDS; WATER POLLUTION; ACID MINE DRAINAGE; WATER QUALITY; BIOLOGICAL EFFECTS; FLIES; CALCIUM; MANGANESE; SULFATES; ENVIRONMENTAL IMPACTS; LAKES.

75942 Atmospheric Interactions in Scrubber Plumes. Meagher, J.F. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625B-62. **Contract:** D8-E721-DL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objective of this study is to determine the impact of a limestone wet scrubber on the production of potentially toxic substances downwind of a power plant. The overall goal of the program is to look at isolated scrubber plumes and scrubber plumes which have mixed with the plume from unscrubbed units to determine what impact the retrofit of these control devices will have on pollutant production downwind. Instrumented aircraft are used to measure ambient air and plume constituent concentrations at various distances downwind from the power plant. Pertinent meteorological parameters are measured with instruments on the aircraft and at a ground station. These data will be used to calculate rates of sulfate and other secondary pollutant formations. These rates will be compared with those found for conventional unscrubbed power plants. A study was conducted at TVA's Widow Creek Steam Plant during August 1978. The TVA sampling helicopter (Bell UH-1B) was equipped with continuous monitors for SO2, NO, NOx, SO4, O3, aerosol size distribution, condensation nuclei, light scattering, altitude, temperature, dew point, and position (VOR-DME). Filter samples were collected and are being analyzed by SEM and by ion chromatography. Excess ozone production was observed in the power plant plume on one of the 10 sampling days. This is believed to be the result of the incursion of polluted air, containing reactive hydrocarbons, from the Chattanooga area.
Keywords: LIMESTONE; SCRUBBERS; AIR POLLUTION CONTROL; TOXICITY; PLUMES; POWER PLANTS; POLLUTION CONTROL; SULFUR DIOXIDE; NITROGEN OXIDES; SULFATES; OZONE; AEROSOLS; PARTICLE SIZE; CONDENSATION NUCLEI; TEMPERATURE EFFECTS; DEW POINT; ATMOSPHERIC CHEMISTRY; ENVIRONMENTAL IMPACTS.

75943 TVA Support to EPA for Sulfur Transformation and Transport in the Environment (State). Meagher, J.F. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625B-63. **Contract:** D8-E721-DL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$140,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objectives of this program were to provide the necessary meteorological support for the field personnel working the state study, to provide an instrumented aircraft suitable for obtaining air samples for SF6 analysis, to provide field and coordination support at Cumberland Steam Plant for several other agencies involved in the study, and to measure several constituents in the flue gas. Four PIBAL stations, one dual and three mobile, provided data on wind speed and direction profiles whenever an experiment was in progress. Wind speed, wind direction, temperature, and dew point profiles were provided by radiosondes released at a nearby steam plant. A detailed up-to-date weather forecast was provided daily. Summaries of the meteorological conditions for each study day are being prepared. A Dehavilland U6A, single engine airplane was equipped to measure SO2, altitude, and temperature. After installation of a system designed by NOAA, that collected air samples for SF6 analysis, this aircraft was used to locate the Cumberland plume and study its dispersion characteristics. One secretary and seven drivers were provided for the support of other groups involved in the state study. The activities of all the agencies working at the plant site were coordinated, and plant operational data were provided. Coal samples were analyzed for percentage sulfur, ash content, and Btu content. Tests of the flue gas were conducted to measure the following constituents: particle size distribution, O2, CO, CO2, and SO2.
Keywords: SULFUR; ATMOSPHERIC CHEMISTRY; ENVIRONMENTAL TRANSPORT; EARTH ATMOSPHERE; METEOROLOGY; MATHEMATICAL MODELS; COAL; FLUE GAS; FOSSIL-FUEL POWER PLANTS; PARTICLE SIZE; OXYGEN; CARBON MONOXIDE; CARBON DIOXIDE; SULFUR DIOXIDE; AIR POLLUTION; CHEMICAL COMPOSITION.

75944 Ocean Oil Spill Concentration and Trajectory Forecast. Barrientos, C.S. (Department of Commerce, Techniques Development Lab., Silver Spring, MD, 20910). **Project number:** V625C-10. **Contract:** D5-E693-DY. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this program is to develop an oil spill trajectory model and to implement the model in the National Weather Service, NOAA. The model will be used as an operational mode during oil spill episodes. It will also be used with climatological data for coastal impact determination and assessment. The final output will be forecasts of fates and trajectories of spilled oil in the ocean. In actual oil spill episodes, the output will be used by the on-scene-coordinator to plan the operations to combat oil spill damage. The operations include cleaning and recovering the oil and protecting the environment. In impact determination and assessment, the ouput will be used to calculate probabilities and severities of damage to the environment. A large portion of the program is on meteorological modelings to get the proper atmospheric forcings for the oceanic models. We are developing in-house and thru contracts regional atmospheric models to specify and predict surface wind stress at smaller space and time scales. We have completed the oil spill trajectory program that will be the core of the operational model. It includes evaporation, spreading, diffusion, and advection routines that can easily be modified and improved. The program is designed to use the forecasts produced by the numerical weather prediction models. It will be put into operation in April 1979.
Keywords: OIL SPILLS; TRAJECTORIES; FORECASTING; SEAS; DIFFUSION; WATER POLLUTION.

75945 Marine Measurement Quality Assurance. Basileo, M.A. (Department of Commerce, Test and Evaluation Lab., Rockville, MD, 20852). **Project number:** V625C-12. **Contract:** D8-E693-EA. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$160,000.
Related energy source: oil and gas(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of the project is to characterize the performance of new measurement techniques and sensors in freshwater and seawater in order to define the quality of marine data collected throughout EPA energy-related environmental measurement activities. The approach is to (1) compare the results of energy-related environmental measurements performed at various locations by separate laboratories on basic marine chemical parameters; (2) investigate the performance and reliability of automated chemical analyses and electrode sensor measurements of chemical parameters important in the energy-related monitoring of natural marine waters; (3) sensor measurements to accepted laboratory methods and standards; and (4) develop improved measurements and calibration techniques to overcome limitations uncovered in the investigations. The final output will be technical reports on the performance and characteristics of chemical electrode sensors and on the accuracy and precision of automated analysis techniques in freshwater and seawater. Tests on the electrode sensors and automated analyses have been initiated but not yet completed. Results to date indicate relatively long response times for the electrode sensors, and some minor interference and drift problems with the automated analysis techniques in seawater samples.
Keywords: WATER QUALITY; SEAWATER; GROUND WATER; MEASURING METHODS; QUALITATIVE CHEMICAL ANALYSIS; QUANTITATIVE CHEMICAL ANALYSIS; AUTOMATION.

75946 Develop a Data Base Classification System for Determining the Rehabilitation Potentials of Surface Mined Lands. Joyce, A.T. (National Aeronautics and Space Administration, Earth Resources Lab., 1010 Gause Boulevard, Slidell, LA, 70458). **Project number:** V625C-17. **Contract:** D5-E771-EL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objective is to develop a procedure which utilizes both Landsat and ancillary data in such a manner that a classification of various rehabilitation potentials can be made. Ancillary data relates to soil type, slope, aspect, rainfall, elevation, or other data not directly associated with the Landsat data, but nonetheless considered as being of significant importance to overall effectiveness of the rehabilitation classification procedure devised. The technical approach is to derive land cover information from Landsat computer implemented techniques. All information will be integrated into a data base file specifically constructed for the 1 degree by 1 degree Campbell Co., WY, study area. All parameters will then be utilized to estimate the rehabilitation potential for sites within the study area.
Keywords: SURFACE MINING; LAND RECLAMATION; INCLINATION; SOILS; CLASSIFICATION; COAL MINING; WYOMING; INFORMATION SYSTEMS.

75947 Environmental Effects of Pollutants from Energy Production. Pueschel, R.F. (National Oceanic and Atmospheric Administration, Atmospheric Chemistry Program Area, Boulder, CO, 80302). **Project number:** V625C-31. **Contract:** D5-E693-EG. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$215,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The obectives are to develop criteria by which to assess the impact of pollutants from power generation on the solar and terrestrial radiative fluxes, and to determine their capability for altering amount and distribution of precipitation through changes in the numbers of cloud and ice nuclei. The approach is to measure in-situ by aircraft (1) number and size distributions of primary (flyash) and secondary (gas-to-particle converted) aerosols; (2) gases that lead to particle formation; (3) infrared terrestrial radiation; (4) electric fields and conductivities of the atmosphere; (5) aerosol light scattering coefficients. Additional aerosol samples will be collected for delineating the parameters that determine cloud nucleating and radiative effects, viz., particle sizes, shapes and elemental compositions. The cloud and ice nucleating portion of the aerosol will be independently determined. Similar measurements and sample collections will be conducted at selected surface locations. Visibilities will be measured photochemically and by light scattering coefficient. Measured aerosol size distributions will be used as input into radiative transfer models.
Keywords: ENERGY CONVERSION; SOLAR FLUX; FLY ASH; AEROSOLS; PARTICLES; INFRARED SPECTRA; ELECTRIC FIELDS; EARTH ATMOSPHERE; CLOUDS; PARTICLE SIZE; POWER PLANTS; COAL; COMBUSTION; AIR POLLUTION; ENVIRONMENTAL IMPACTS.

75948 Isolation and Identification of Water-Borne Pollutants Associated with the Power Industry. Howe, L.H. (TVA, Laboratory Branch, 401 Chestnut Street, Room 268, Chattanooga, TN). **Project number:** V625C-36. **Contract:** D5-E721-DH. **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:** Integrated assessment; Health effects.

Laboratory studies will be made to improve analytical procedures and provide acceptable alternate analytical methods for several pollutants from energy-critical areas in the Ohio and Tennessee River valleys. Specific tasks for which improved methods are being developed are: digestion techniques for suspended and dissolved metals; chromium(III and VI) by voltametry; and procedures for identifying and quantifying extractable organic pollutants in sediments by gas chromatography and mass spectrometry.
Keywords: WATER POLLUTION; MONITORING; ELECTRIC POWER INDUSTRY; ENVIRONMENTAL IMPACTS; QUANTITATIVE CHEMICAL ANALYSIS; ORGANIC COMPOUNDS; METALS; SEDIMENTS; SEPARATION PROCESSES; CHROMIUM; GAS CHROMATOGRAPHY; MASS SPECTROSCOPY; CADMIUM; ZINC; LEAD; COPPER; VOLTAMETRY.

75949 Remote Sensing of SO2 Effects on Vegetation. Sapp, C.D. (TVA, Division of Environmental Planning, Air Quality Research Section, Muscle Shoals, AL, 35660). **Project number:** V625C-45. **Contract:** D8-E721-DJ. **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:** Physical and chemical processes and effects.

This research activity involves testing, refinement, and development of remote sensing instrumentation and techniques for monitoring the visible, previsual, and extravisual effects of SO2 emissions from fossil-fueled electric generating stations on terrestrial vegetation. NASA and EPA National Environmental Research Center are collaborating with TVA in the project. Low and high altitude color, color infrared, multi-spectral scanning, and ground-truth data are being obtained for effects on soybeans and mixed southern pine--decidous hardwood timber stands in the vicinities of the Shawnee, Widows Creek, Johnsonville, and Colbert steam plants for both manual and automated interpretations. Spectral reflectance data are being acquired in the field and laboratory to calibrate the aerial sensors.
Keywords: SULFUR DIOXIDE; REMOTE SENSING; PLANTS; ENVIRONMENTAL EFFECTS; METABOLISM; FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; PINES.

75950 Radiological Pollutant Quality Assurance. Hutchinson, R. (Department of Commerce, Nuclear Radiation Division, 14th Street Bet. Constitution Avenue, Washington, DC, 20234). **Project number:** V625C-64. **Contract:** D7-E684-CN. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$81,000.
Related energy source: coal(50); nuclear fuels(general)(50).

The objectives are to develop certain environmental radioactivity standards according to a contract with EPA, and to develop traceability of radioactivity measurements to the EPA--LV Laboratory.
Keywords: RADIOACTIVITY; STANDARDS; SOILS; URANIUM; PLUTONIUM 241; FLY ASH; QUALITY ASSURANCE.

75951 Energy Related Water Pollutant Standard Reference Materials (SRMS). Lafleur, P.D. (National Bureau of Standards, Analytical Chemistry Division, 14th and Constitution Avenue, Washington, DC, 20234). **Project number:** V625C-65. **Contract:** D7-E684-CN. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$325,000.
Related energy source: coal(25); oil and gas(25); oil shales and tar sands(25); nuclear fuels(general)(25). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are to conduct and issue reports on workshops on standards and methods for water quality associated with new energy production; issue SRM's for elemental analysis of runoff water from energy production; and issue SRM's for organic analysis associated with coal and oil shale processing. The methods used are to establish SRM and measurement method priorities of workshops and interaction with EPA labs to permit evaluation of energy/environment tradeoffs; develop SRM's for trace elements in water, sea water, sediments; develop SRM's for anion concentration, ion exchange concentration techniques; develop coated glass bead column for trace organic standards, methods for coal conversion analysis and SRM's for oil, shale oil, and coal liquids.
Keywords: STANDARDS; WATER QUALITY; COAL INDUSTRY; OIL SHALE INDUSTRY; ENERGY CONVERSION; COAL; ENVIRONMENTAL EFFECTS; MONITORING; WATER POLLUTION.

75952 Energy Related Air Pollution Standard Reference Materials: Instrumentation and Methods. Taylor, J. (National Bureau of Standards, Analytical Chemistry Div., 14th and Constitution Avenue, Washington, DC, 20234). **Project number:** V625C-66. **Contract:** D7-E684-CL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$444,000.

The objectives are to: develop gas SRM's for stationary source and ambient energy/environment analysis; develop particulate measurement techniques and standards for energy/environmental analysis; and develop methods and standards for coal conversion and oil shale processes. SRM and measurement method priorities will be established by workshops and interactions with EPA laboratories to permit evaluation of energy/environment tradeoffs. The project will also develop SRM's for NO2 in air, O2 in N2H2S, XRF and urban air particulates; develop gas, particulate and trace organic measurement methods; and develop coal conversion, coal, fly ash and oil shale methods and standards to evaluate environmental effects of new energy development.**Keywords:** AIR POLLUTION MONITORS; STANDARDS; COAL GASIFICATION; COAL LIQUEFACTION; SHALE OIL; PRODUCTION; NITROGEN DIOXIDE; AIR; OXYGEN; FLY ASH; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; AIR POLLUTION; MONITORING.

75953 LIDAR Techniques for Measuring Particulate Pollutants from Energy Production and Their Transport and Dispersion Processes. Derr, V.E. (National Oceanic and Atmospheric Administration, Environmental Research Labs., Boulder, CO, 80302). **Project number:** V625C-70. **Contract:** D8-E693-EB. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$175,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The project involves two tasks. The first is to develop economical LIDAR measurement techniques (optical backscatter intensity) for remote tracing and analyzing of pollutants arising from extraction and power production. The second task is to develop and test a Doppler LIDAR (remote velocity sensor) for high resolution measurements of atmospheric wind and turbulence aspects of pollutant transport. We are developing techniques and equipment for pollutant identification and transport processes by modifying NOAA LIDAR hardware. Modification is based on scattering theory tested in a field environment. Analysis of the field tests leads to further technique refinement for characterizing aerosols and measuring their transport. Final output will be an evaluation of the effectiveness of LIDAR in characterizing the aerosol content and determining wind fields. The NOAA LIDAR has been modified for dual wavelength operation and used to map wind fields and stack emission velocity. For well-filtered stacks, the signal-to-noise ratio will be improved if visible Doppler is used. Study of this potential is underway.

Keywords: PARTICLES; AEROSOLS; AIR POLLUTION; ATMOSPHERIC CHEMISTRY; DIFFUSION; ENVIRONMENTAL TRANSPORT; REMOTE SENSING; EQUIPMENT; DESIGN; AEROSOL MONITORING; OPTICAL PROPERTIES; CHEMICAL ANALYSIS; DOPPLER EFFECT; ENERGY; ENVIRONMENTAL IMPACTS; WIND; FLUE GAS; MATHEMATICAL MODELS.

75954 HF Radar for Mapping Circulation in Straits of Juan de Fuca. Barrick, D. (National Oceanic and Atmospheric Administration, Engineering Research Lab., Boulder, CO, 80302). **Project number:** V625C-71. **Contract:** D8-E693-GK. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$80,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to: develop and assess application of WPL's radar system in characterizing circulation in eastern area of Juan de Fuca Straits, with measurements and analyses to be accomplished in conjunction with NOAA/PMEL's environmental assessment project and NOAA/Puget Sound MESA experiment in the same area; and interpret circulation in eastern Juan de Fuca Straits by intercomparing radar surface-current data with various measurements made by the other principal investigations in these joint experiments.
Keywords: WASHINGTON; COASTAL REGIONS; RADAR; PUGET SOUND; COASTAL WATERS; WATER CURRENTS; BASELINE ECOLOGY; ENVIRONMENTAL TRANSPORT.

75955 High Altitude Monitoring Environmental Effects of Geothermal Energy, Coal Strip Mining, and Oil Shale Activities. Knutson, M.A. (National Aeronautics and Space Administration, Airborne Missions and Appl. Division, Moffett Field, CA, 94035). **Project number:** V625C-72. **Contract:** D7-E771-ELB. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$125,000.
Related energy source: coal(33); oil shales and tar sands(33); geothermal(34). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this effort is to evaluate the application of high altitude and low altitude photographic and multispectral remote sensing to the determination of the potential and actual environmental effects of geothermal, coal strip mining and oil shale energy resource development. The effort utilizes existing sensors onboard the NASA U-2 aircraft based at Ames Research Center and existing photographic cameras and multispectral scanner onboard a low altitude aircraft. Results to date indicate that high altitude color infrared photography can be used to provide an accurate environmental information base for energy resource development over areas as large as the entire Northern Great Plains. Low altitude multispectral imagery over geothermal sites has shown that vegetative and thermal baseline data can be obtained for future change detection.
Keywords: GEOTHERMAL ENERGY; COAL INDUSTRY; SURFACE MINING; OIL SHALE INDUSTRY; ENVIRONMENTAL EFFECTS; ENERGY SOURCE DEVELOPMENT; AERIAL MONITORING; REMOTE SENSING; PLANTS; THERMODYNAMIC PROPERTIES; INFRARED SPECTRA; PHOTOGRAPHY; COMPARATIVE EVALUATIONS; ALTITUDE.

75956 Energy-Related Air Pollutant Analysis Instrumentation. McKenzie, R. (National Bureau of Standards, Analytical Chemistry Div., 14th and Constitution Avenue, Washington, DC, 20234). **Project number:** V625D-59. **Contract:** D7-E684-CL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$67,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to develop a continuous automatic total particulate and aerosol-sulfur measurement instrument capable of measuring ambient concentrations in real time, and to develop techniques whereby this instrumentation can be used to obtain information about the chemical form of particulate and aerosol sulfur (i.e., as sulfates, sulfuric acid, etc.). A feasibility study of possible techniques will be made and a technique will be selected for development. Instrumentation will be built and operating parameters will be characterized to optimize the technique. A final instrument configuration will be selected and a prototype instrument will be constructed and characterized. Various techniques for using the instrument for identification of particulated sulfur compounds will be developed and evaluated.
Keywords: AIR POLLUTION MONITORS; DESIGN; AEROSOLS; SULFUR; SULFATES; SULFURIC ACID; FEASIBILITY STUDIES; MONITORING; AIR POLLUTION; ON-LINE MEASUREMENT SYSTEMS.

75957 Energy Related Water Pollutant Analyses Instrumentation. Durst, R. (National Bureau of Standards, Analytical Chemistry Division, 14th and Constitution Avenue, Washington, DC, 20234). **Project number:** V625D-61. **Contract:** D7-E684-CK. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$209,000.
Related energy source: coal(50); oil shales and tar sands(50).

The objectives are to issue comprehensive report on needs of instrumentation for water energy/environment analysis; to develop organic analysis techniques for measurement of effluents from coal processing, petroleum and oil shale operations; and to develop measurement methods for species identification of coal processing effluents. The approaches to be used include: establishing instrumentation priorities by workshops and interaction with EPA laboratories to permit evaluation of energy environment tradeoffs; developing marker compounds, LC-MS and special detections for organic analysis; and developing LC-electrochemical detectors, plasma speciation techniques, and special analysis methods such as cars and OGE.
Keywords: WATER POLLUTION; CHEMICAL ANALYSIS; ENERGY; ENVIRONMENT; CHEMICAL EFFLUENTS; COAL INDUSTRY; MEASURING METHODS; PETROLEUM INDUSTRY; OIL SHALE INDUSTRY; BIOLOGICAL INDICATORS; WATER POLLUTION MONITORS; TECHNOLOGY ASSESSMENT; HYDROCARBONS; MONITORING.

75958 Energy-Related Remote and In-Situ Sensing Instrument Development. Browell, E.V. (National Aeronautics and Space Administration, Office of Aeronautics and Space, Hampton, VA, 23665). **Project number:** V625D-68. **Contract:** D6-E771-EU. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this project are to advance and improve instrument techniques for measuring environmental parameters associated with the generation of electrical energy and other pollution sources. To meet these objectives, the following tasks will be conducted: Task 1, Raman LIDAR--evaluate Raman LIDAR for remote measurement of SO2 concentration at power plant stack exit; Task 2, Plume Dispersion Studies--apply aerosol scattering LIDAR techniques to the study of plume dispersion under various atmospheric conditions; Task 3, IR Dial--develop and apply the tunable infrared 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; 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 power plant stack exit and within the stack plume.
Keywords: REMOTE SENSING; OPTICAL RADAR; ENVIRONMENTAL EFFECTS; SULFUR DIOXIDE; THERMAL POWER PLANTS; OZONE; AEROSOLS; ECOLOGICAL CONCENTRATION; IN-SITU PROCESSING.

75959 Monitoring Methods Development. Baron, P. (HEW, Public Health Service, Division of Physical Sciences, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625D-69. **Contract:** D8-E773-DE. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$477,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The EPA, through an interagency agreement with NIOSH, has provided funds to conduct occupational health research and development related to the country's efforts to become self sufficient in energy. This project has been established to provide personal dosimeters or portable, direct-reading instruments to measure worker exposure to health hazards in energy production processes. The investigations in this area include: (1) development and evaluation of a field-usable, microwave spectrometric analyzer for multigas analysis; (2) development of a pocket-sized gas chromatograph for multi-gas analysis; (3) development of a personal sampler fiber counter for evaluating exposure to fibrous aerosol; (4) evaluation of a direct-reading, portable fibrous aerosol developed in FY-77, through laboratory and field testing; (5) evaluation of batteries used in sampling pumps; (6) development of personal uv-vis radiation exposure monitors; (7) evaluation of personal passive monitors for organic vapors; and (8) development of portable XRE analyzer.
Keywords: HEALTH HAZARDS; ENERGY FACILITIES; GAS CHROMATOGRAPHY; GAS ANALYSIS; AEROSOLS; FIBERS; AIR POLLUTION MONITORS; SAMPLING; DOSEMETERS; OCCUPATIONAL DISEASES; MICROWAVE SPECTRA; SPECTROSCOPY; PRIMARY BATTERIES; ORGANIC COMPOUNDS; VAPORS; X-RAY FLUORESCENCE ANALYZERS; DESIGN; TESTING.

75960 Industrial Hygiene Study of Coal Liquefaction Processes. Pallay, B. (HEW, Public Health Service, Division of Respiratory Disease, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-100. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$306,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

This project is a contract to perform an in-depth research industrial hygiene characterization of worker environments in four coal liquefaction facilities. The study will address coal liquefaction products, processes, and material containment methods and worker exposures. The product document will provide a basis for design of industrial hygiene surveillance during commercial plant operations. The identification of liquefaction process health hazards in the developmental phase of the technology will provide necessary information for health protection design considerations. The following objectives have been accomplished to date: (1) an RFC was prepared and submitted to contracts office; (2) the RFP was issued; (3) technical and business proposals were evaluated; (4) contract was awarded and losing bidders were debriefed; (5) two site visits were made to the contractor's facilities; (6) two walk-through surveys at liquefaction plants were completed; and (7) the new NIOSH project office was briefed and took charge of the project.
Keywords: COAL LIQUEFACTION PLANTS; WORKING CONDITIONS; PERSONNEL; HEALTH HAZARDS.

75961 Mortality Study of Workers Exposed to Fibrous Glass. Bayliss, D. (HEW, Public Health Service, Division of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-101. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
R and D categories: Health effects.

Much controversy has arisen over the possible carcinogenicity of fibers of small diameter. One group of scientists believes that the carcinogenicity of such fibers relate not to its physiochemical properties but more to the morphology of the particle. Several studies that have been accomplished recently have provided evidence that tends to support both positions. A historic follow-up study of workers at an Ohio fiberglass plant failed to demonstrate any excess of cancer over expected when followed for over thirty years. In the historic follow-up study most members of the cohort under study were never exposed or minimally exposed to small diameter fibers with certain exceptions. However, during the 1940's, a process existed that produced small diameter fibers at this plant. While this pilot plant operation existed, approximately 450 employees were exposed to small diameter fibers for varying lengths of time. It is proposed that to assess whether this group of employees suffers from unusual cancer mortality, a matched control group can be selected from the non-exposed segment of the same population, matched according to date of birth and beginning date of employment, and cancer mortality of the exposed be compared to that of the non-exposed controls. (The population consists entirely of white males.) It is proposed that two controls be selected for each exposed employee. After the selection of the controls, follow-up will be accomplished on the approximately 450 exposed and their approximately 900 non-exposed controls. Mortality due to lung cancer in the exposed will be contrasted with that of the non-exposed after analysis is complete. Relative risk of lung cancer will be examined at various periods from initial exposure and contrasted to the non-exposed controls.
Keywords: FIBERGLASS; PERSONNEL; MORTALITY; TOXICITY; HEALTH HAZARDS; PARTICLES; AEROSOLS; MORPHOLOGY; LUNGS; NEOPLASMS; EPIDEMIOLOGY; MALES; OCCUPATIONAL DISEASES.

75962 Insulating Materials: Long-Term Inhalation Effects. Moorman, W. (HEW, Public Health Service, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-102. **Contract:** D8-E772-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
R and D categories: Health effects.

Chronic biologic effects following long-term inhalation of fibrous glass used in insulating trades will be studied via the contractual route. The specific objectives include: (1) the evaluation of carcinogenic risk; (2) the evaluation of the fibrogenic potential; and (3) the character of pulmonary responses, both physiological and pathological (including deposition patterns). The results from this effort will be useful in evaluating the validity of the NIOSH proposed standard.
Keywords: THERMAL INSULATION; INHALATION; HEALTH HAZARDS; OCCUPATIONAL DISEASES; MINERAL WOOL; TOXICITY; ENERGY CONSERVATION; FIBERGLASS; CARCINOGENS; PHYSIOLOGY; PATHOLOGICAL CHANGES; AEROSOLS; RATS; MONKEYS; LUNGS; DYNAMIC FUNCTION STUDIES; BIOLOGICAL EFFECTS; CHRONIC EXPOSURE.

75963 Morbidity and Industrial Hygiene Study: Workers Exposure to Sulfur and Nitrogen Oxides. Gamble, J. (Public Health Service, Division of Respiratory Disease, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-103. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$30,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.

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 personal sampling for the compounds under investigation. Measurement of worker response includes 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.
Keywords: SULFUR OXIDES; NITROGEN OXIDES; ACUTE EXPOSURE; CHRONIC EXPOSURE; DOSE-RESPONSE RELATIONSHIPS; HEALTH HAZARDS; PATHOLOGICAL CHANGES; RESPIRATORY SYSTEM; MINES; DIESEL ENGINES; LEAD-ACID BATTERIES; MANUFACTURING; SULFURIC ACID; PERSONNEL DOSIMETRY; OCCUPATIONAL DISEASES.

75964 Mortality and Industrial Hygiene Study of Workers Exposed to Sulfuric Acid. Beaumont, J. (HEW, Public Health Service, Div. of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-104. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
R and D categories: Health effects.

The EPA Chess Report (1970--1971) studied seven U.S. cities for community exposure to air contaminants. One community had a primary exposure to sulfur oxides and particulates. The findings of the Chess Report strongly suggest that occupational exposures to sulfur pollutants need further study in terms of exposure levels and morbidity and mortality. The proceedings of the computer-based conference on Human Response to Sulfur Pollutants, at Brookhaven Laboratory suggested that sulfates and sulfuric acid could have a possible carcinogenic and/or co-carcinogenic effect. The purpose of this project is to conduct a retrospective cohort mortality study of a population occupationally exposed to sulfuric acid mist. Pulp facilities, sulfuric acid plants, and copper sulfate processes have been eliminated as suitable cohorts. Several battery plants have been visited to determine their suitability for inclusion in a cohort mortality study. A contract has been awarded to Enviro Control, Inc., to locate a cohort and conduct a retrospective mortality study. Industrial hygiene assessment of the study plants will be conducted by NIOSH.
Keywords: MORTALITY; SULFURIC ACID; OCCUPATIONAL DISEASES; CHRONIC EXPOSURE; PARTICLES; AEROSOLS; HEALTH HAZARDS; PERSONNEL; INHALATION; TOXICITY; COPPER SULFATES; PAPER INDUSTRY; INDUSTRIAL PLANTS; INDUSTRIAL MEDICINE; CHEMICAL INDUSTRY.

75965 Recirculation of Exhaust Air. Amendola, A. (HEW, Public Health Service, Div. of Physical Sciences, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-105. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$74,000.
R and D categories: Health effects.

Facing the prospect of increasing cost and decreasing availability of energy, industry is turning to various means of energy conservation. One such means of energy conservation is the recirculation of exhaust air. The recirculation of exhaust air, however, creates a potential for worker health problems unless adequate control measures or procedures are practiced. This project will address the design and operation of safe recirculation systems. The specific tasks in this project entail the testing of air cleaner/monitor combinations suitable for recirculation applications in an industrial application (contract pilot study) and through laboratory studies. Previously developed recirculation system design criteria will be validated and improved through actual case study applications. NIOSH guidelines will be developed utilizing the results of all the previous efforts in the area of exhaust air recirculation.

Keywords: ENERGY CONSERVATION; AIR; EXHAUST RECIRCULATION SYSTEMS; DESIGN; OPERATION; AIR POLLUTION MONITORS; PERFORMANCE TESTING.

75966 Respirator Research for Coal Operations. Todd, W. (HEW, Public Health Service, Division of Physical Sciences, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-106. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$80,000.
Related energy source: coal(100). **R and D categories:** Health effects.

Little study has been made of health hazards associated with surface mining operations. The TWA of coal and other respirable dusts have been lowered; this increases the probability that some surface workers are exposed to potentially harmful levels of these materials. The results of Contract 78-0085, Evaluate Effectiveness of Respirators in Underground Coal Mining Operations, will be evaluated to determine the need for additional precautions against exposure to hazardous respirable dusts in surface operations and the need for enlightening workers of the hazards they encounter. Another contract is to be let for the evaluation of the effectiveness of respirators against coal mine dust and chemical vapor hazards in a representative number of underground mining operations. A NIOSH generated experimental design strategy will be employed in the conduct of the in-house laboratory and field evaluation. The results of the research will be consolidated, printed and distributed. A seminar will be held and the transactions published in a final report form.
Keywords: DUSTS; RESPIRATORS; SURFACE MINING; COAL MINING; HEALTH HAZARDS; EVALUATION; COAL MINERS.

75967 Industrial Hygiene Study of Petroleum Production. Cox, C. (HEW, Public Health Service, Division of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-107. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$272,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

Petroleum refineries in the U.S. process crude oil into approximately 3 x 10 to the 6th power cubic meters/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 cubic meters/day with the average refinery processing 6,900 cubic meters/day. Over 3,000 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. The purpose of the project is 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.
Keywords: PETROLEUM REFINERIES; HEALTH HAZARDS; PERSONNEL; WORKING CONDITIONS; TOXIC MATERIALS.

75968 Industrial Hygiene Study of Insulation Material Workers. Herrick, R. (HEW, Public Health Service, Div. of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-108. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$427,000.
R and D categories: Health effects.

Members of the insulation trade have long been noted to experience excess mortality due to malignant and non-malignant respiratory diseases. Although much of this observed disease has been attributed to asbestos fiber exposures, the hazards associated with many of the other insulation materials used are unknown. Some of the commonly used insulation materials include: (1) aluminum silicate (ceramic) fibers, (2) asbestos fibers, (3) bentonite clay, (4) calcium carbonate, (5) cork, (6) fibrous glass, (7) gypsum, (8) hair felt, (9) impregnated paper, (10) magnesium carbonate, (11) polystyrene, (12) polyurethane foams, (13) portland cement, (14) slagwool and rockwool fibers, and (15) vermiculite (expanded). The purpose of the proposed research is to determine, by literature research, quantities of the various insulation materials used in the U.S., the number of workers potentially exposed to each material, and historic exposure levels. Current exposure levels of employees to two insulation materials will be determined through industrial hygiene surveys. A contract will be awarded to accomplish this project.
Keywords: INDUSTRIAL MEDICINE; PERSONNEL; THERMAL INSULATION; MORTALITY; RESPIRATORY SYSTEM DISEASES; ASBESTOS; TOXICITY; ENERGY CONSERVATION; ALUMINIUM SILICATES; FIBERS; CALCIUM CARBONATES; CLAYS; MINERAL INDUSTRY; FIBERGLASS; OCCUPATIONAL DISEASES; MAGNESIUM CARBONATES; CHRONIC EXPOSURE; INHALATION; PLASTICS INDUSTRY; CORK; BENTONITE; GYPSUM; CEMENTS; MINERAL WOOL; VERMICULITE; PLASTIC FOAMS; POLYURETHANES; POLYSTYRENE; HEALTH HAZARDS; IMPREGNATION; NEOPLASMS.

75969 Diesel Exhaust/Coal Dust Animal Exposure Studies. Lewis, T. (Public Health Service, Division of Biomedical and Behavioral, 4676 Columbia Pathway, Cincinnati, OH, 45266). **Project number:** V625F-109. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$467,000.
Related energy source: coal(100). **R and D categories:** Health effects.

The objectives are 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; and investigate pulmonary damage, immune potential and mutagenic potential of combined exposure to coal dust and diesel exhaust and each agent alone in comparison to control populations. Exposure design features include zero, 2 mg/cu m and 10 mg/cu m bituminous coal dust and either 2 or 3 levels of diesel exhaust from one engine type or one level of diesel exhaust from 2 or 3 different types of diesel engines in a 3 x 4 design matrix. Characterization of components of the diesel exhaust in the absence or presence of coal dust prior to introduction of animals will be essential. Exposure will be for 6 hours/day for 5 days/week for 24 months. An inbred rat strain will be one animal subject with the possible inclusion of cynomologous monkeys (10 to 12) as the second species of animal subjects. Subgroups of 20 rats will be sampled after 6, 12, 18, and 24 months exposure; an additional subgroup (minimum of 20 rats) will cease exposure after 24 months and will be followed as a survival subgroup. This study will emphasize pulmonary function and pathology, tumor incidence and time to tumor and immune and mutagenic potentials following such exposures. Lung collagen will be measured biochemically. The retained dust level will also be measured. Mutagenic potential will be evaluated by using sister chromatid exchange and host-mediated assays.
Keywords: DIESEL ENGINES; EXHAUST GASES; COAL INDUSTRY; AEROSOLS; PARTICLES; BIOLOGICAL EFFECTS; METABOLISM; NEOPLASMS; EPIDEMIOLOGY; BITUMINOUS COAL; DUSTS; MONKEYS; RATS; INHALATION; LUNGS; SULFUR OXIDES; NITROGEN OXIDES; HYDROCARBONS; ORGANIC COMPOUNDS; AIR POLLUTION; DIESEL FUELS.

75970 Uranium Miner and Mill Studies. Archer, V. (HEW, Public Health Service, Division of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-110. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$363,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

During the period 1950 to 1975, NIOSH collected data on about 20,000 uranium miners and mill workers. Further study and analysis of this data is expected to improve the exposure-response curve for lung cancer, to provide data on pulmonary disability and hair root changes, to determine if an altered sex ratio of offspring for uranium miners exists, and to determine if there is an excess of leukemia, cancer of the brain, pancreas, or bone in uranium miners. Using data from Swedish and other mining groups, a dose-response curve has been constructed extending to quite low levels. This curve suggests that alpha radiation at very low dose rates induces 5 to 10 times as much cancer as equal amounts of radiation at higher dose rates. If this phenomena is correct, then there are definite implications for setting lower standards, especially for radon daughters in uranium mining and plutonium in the nuclear power industry. Because of importance of the implications, verification or rejection of the present composite exposure-response curve is highly desirable. A retrospective mortality study on a new cohort of approximately 3,000 uranium miners having less than 12 WLM/year exposure and two control groups, will be conducted to test this hypothesis.
Keywords: NUCLEAR INDUSTRY; PERSONNEL; RADIATION HAZARDS; RISK ASSESSMENT; LUNGS; BRAIN; SKELETON; PANCREAS; BIOLOGICAL RADIATION EFFECTS; NEOPLASMS; LEUKEMIA; RADIOINDUCTION; DOSE-RESPONSE RELATIONSHIPS; RADON; DAUGHTER PRODUCTS; LOW DOSE IRRADIATION.

75971 Developmental Toxicity Indicators. Dixon, R.L. (National Institute of Environmental Health Sciences, Lab. of Environmental Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-23. **Contract:** D5-E772-CR. **Supported by:**

Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$70,000.
R and D categories: Health effects.

The objective of the project is to assess the postnatal toxic effects of gestational chemical exposure using energy-related compounds, such as trace metals and polycyclic aromatic hydrocarbons, as well as other environmental chemicals. In this investigation, emphasis will be placed on physiological and biochemical functions associated with various organs. Tissues of gestationally exposed rodent offspring systems (or functions) which will be studied include the following: bone marrow and blood; motor and sensory function of the nervous system (including pain, taste, olefaction, audition, and vision); behavior and memory; cadiovascular responses; respiration, renal function and body fluid balance; digestive system; metabolism (energy exchange); endocrinology; reproduction; immunologic capacity; and pathologic lesions. Tests of overall homeostasis, physical endurance, and adaption to stress are also planned.
Keywords: TOXICITY; BIOLOGICAL INDICATORS; RATS; EMBRYOS; PATHOLOGICAL CHANGES; METALS; POLYCYCLIC AROMATIC HYDROCARBONS; PHYSIOLOGY; BEHAVIOR; BIOLOGICAL STRESS; CENTRAL NERVOUS SYSTEM; BIOLOGICAL FUNCTIONS.

75972 Trace Element Deposition in Ambient Aerosol Inhalation. Winchester, J.W. (Florida State University, Department of Oceanography, 205 Wildwood Drive, Tallahassee, FL, 32306). **Project number:** V625F-35. **Contract:** D5-E772-CQ. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$61,000.
R and D categories: Health effects.

The air pollutants most detrimental to normal pulmonary function are aerosols of small particle size. Such aerosols are produced in large quantities by fossil-fuel-fired steam plants used for generation of electricity. No systems are presently available to remove the one micron and submicron-sized particles from the smoke stack effluents. Small sized aerosols of various chemical composition are likely to be one of the major chronic problems associated with a fossil-fuel-based energy industry. The study of particle retention and changes in particle size during breathing is basic to our understanding of aerosol toxicity. These studies are being conducted with human volunteers. Changes in particle size of exhaled air are measured by means of cascade impactors. The effect of temperature and humidity on particle size are being determined. Also tested are the effects of total volume and breathing frequency. Techniques utilizing proton induced x-ray emission for detection of sulfur and lead-containing particles are being tested. These investigations are of great importance in advancing physicochemical techniques needed for future toxicological studies of various types of fossil fuel related aerosols.
Keywords: TRACE AMOUNTS; AEROSOLS; PARTICLES; INHALATION; FOSSIL-FUEL POWER PLANTS; FLUE GAS; HEALTH HAZARDS; TOXICITY; MAN; CASCADE IMPACTORS; SULFUR; LEAD.

75973 Regional Deposition of Inhaled Particles in Man. Lippmann, M. (New York University, School of Medicine, 550 1st Avenue, New York, NY, 10016). **Project number:** V625F-36. **Contract:** D5-E772-CQ. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$80,000.
R and D categories: Health effects.

The most severe threat from a fossil fuel based energy industry stems from the polydispersed aerosols generated by fossil fuel fired electricity generating plants. The toxicity of these aerosols depends on their chemical composition, and equally important, on their physical size and shape characteristics. Studies on the deposition of aerosols of various sizes in the human respiratory tract are, therefore, of fundamental importance in determining the mechanism of toxicity of fossil fuel related aerosols. The studies are primarily based on human respiratory tract models using constant and cyclic respiratory flows. Aerosols with gamma-labelled particles are introduced into hollow human bronchial casts. Regional deposition of various aerosols and different conditions of air flow are studied with collinated scintillation detectors. Locations within the airways with highest exposure to aerosols of different sizes will be identified. The results are providing the basis for an airway surface dosimetry related to human bronchial cancer and will also be of great value for predicitng toxicity of various types of toxic sulfate aerosols, based on particle size and respiratory activity.
Keywords: PARTICLES; AEROSOLS; INHALATION; TOXICITY; RESPIRATORY SYSTEM; FOSSIL-FUEL POWER PLANTS; FLUE GAS; FLY ASH; METABOLISM; SULFATES; PARTICLE SIZE; MAN; BIOLOGICAL MODELS; OCCUPATIONAL DISEASES; CARCINOGENS.

75974 Environmental Mutagen Information Center. Malling, H.V. (National Institute of Environmental Health Sciences, Laboratory of Biochemical Genetics, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-42. **Contract:** D5-E772-CS. **Supported by:** Environmental Protection Agency, Washington DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA $31,000.
Related energy source: coal(33); oil and gas(33); oil shales and tar sands(34). **R and D categories:** Health effects.

Through the Environmental Mutagen Information Center, the objectives are to collect and tabulate data on energy-related pollutants, and to develop review on new techniques and widely studied pollutants.
Keywords: MUTAGENS; ENVIRONMENTAL IMPACTS; ENERGY; CHEMICAL EFFLUENTS; TOXICITY; POLLUTION; ENVIRONMENT; TOXIC MATERIALS; HAZARDOUS MATERIALS; INFORMATION SYSTEMS; INFORMATION CENTERS; DATA COMPILATION.

75975 Mammalian Chromosome Assay. Hsu, T.C. (M.D. Anderson Hospital and Tumor Institute, P.O. Box 20036, Houston, TX, 77025). **Project number:** V625F-44. **Contract:** D5-E772-CS. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$124,000.
Related energy source: coal(33); oil and gas(33); oil shales and tar sands(34). **R and D categories:** Health effects.

There is an urgent need for devising and standardizing procedures for monitoring the effects of environmental mutagens resulting from energy related activities 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 equals 6), two species of the deer mice (differing drastically in the amount of constitutive heterochromatin and repetitive DNA content), the laboratory mouse, and several other species.
Keywords: MUTAGENS; MONITORING; BIOLOGICAL INDICATORS; GENETIC EFFECTS; MAMMALS; BIOASSAY; CHROMOSOMAL ABERRATIONS.

75976 Multistage Carcinogenesis Models. Hoel, D.G. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-46. **Contract:** D5-E772-CT. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$150,000.
R and D categories: Health effects.

The objective is to develop improved statistical techniques for using data from animal carcinogenicity tests conducted at high dose levels to estimate long-term risk from chemical carcinogens at very low (environmentally) dose levels. In attempting to improve the statistical procedures available for addressing the question of low-dose cancer extrapolation, special attention will be given to various issues related to the selection of the most appropriate experimental design and to the adjustment for competing risks or causes of death. All of the statistical development will be set in the framework of the multistage models for carcinogenesis.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; CHRONIC EXPOSURE; STATISTICAL MODELS; DOSE-RESPONSE RELATIONSHIPS; ANIMALS; CHEMICAL EFFLUENTS.

75977 NOx Effects of Membranes. Chignell, C.F. (National Institute of Environmental Health Sciences, Lab. of Environmental Biophysics, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-51. **Contract:** D5-772-CU. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$20,000.
R and D categories: Health effects.

Many of the biochemical changes found in the lung following exposure of NO2 are thought to result from lipid peroxidation. Possible target structures include cell membranes, lung surfactant and the lamellar bodies found in Type II cells. In our studies, the effect of in-vitro NO2 exposure on the molecular structures of membranes (alveolar macrophages, erythrocyte ghosts and model systems including liposomes and lecithin multilayers) and lung surfactant (including lamellar bodies) will be examined. Molecular changes induced by NO2 will be detected with the aid of specific membrane probes (fluorescent and spin labels). The parameters which will be studied include membrane fluidity, membrane order

and protein-lipid interactions. These studies should provide a molecular basis for understanding how NO2-induced lipid peroxidation alters the structural integrity of cell membranes and the properties of lung surfactant.
Keywords: NITROGEN OXIDES; TOXICITY; CELL MEMBRANES; PHYSIOLOGY; PATHOLOGICAL CHANGES; METABOLISM; BIOLOGICAL MODELS; ANIMAL CELLS.

75978 Effects of Energy-Related Pollutants on Behavior. Mitchell, C.L. (National Institute of Environmental Health Sciences, Behavioral and Neurology Toxicology Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-55. **Contract:** D5-E772-CR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$200,000.
R and D categories: Health effects.

There is considerable concern about the possibilities for subtle neurobehavioral changes resulting from low-level chronic exposure to energy-related pollutants. Unfortunately, there is only limited agreement as to the sensitivity and utility of many commonly used neurobehavioral tests in animals for the extrapolation of risks to humans. Therefore, the current work seeks to provide a strategy aimed at resolving this important problem. Test validation will be accomplished by evaluating known neurotoxins in a battery of tests chosen to assess in animal models a wide-range of effects based on reported human toxicosis symptomatology. Phenomena to be measured are ongoing home cage motor activity, food consumption, water consumption (and the diurnal cycling of these), neurological/physiological indices (reflexes, autonomic signs, equilibrium/gait, balance, tremor reactivity, and muscular strength), and aspects of cognitive and associative behavior involving both endogenous and exogenous (sensory control of responding). An integrated time scheme covering 90 days of chemical treatment and 30 days of post-dosing recovery will be used.
Keywords: BEHAVIOR; NEUROLOGY; CHRONIC EXPOSURE; PHYSIOLOGY; HUMAN POPULATIONS; HEALTH HAZARDS; RISK ASSESSMENT; BIOLOGICAL EFFECTS; ANIMALS; CENTRAL NERVOUS SYSTEM; CHEMICAL EFFLUENTS; AIR POLLUTION; WATER POLLUTION.

75979 Effects of Prenatal Exposure to Foreign Chemicals on Genital Tract Function. Lucier, G. (National Institute of Environmental Health Sciences, Environmental Toxicology Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-56. **Contract:** D5-E772-CR. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$150,000.
R and D categories: Health effects.

This project seeks to determine the effects of energy-related pollutants on human beings by conducting biological dose-effect studies on non-human experimental research models. The effects of exposure of pregnant animals to energy-related pollutants on male and female reproductive tracts and behavioral functions in F-1 offspring are being studied. Forced-breeding and serial mating techniques are used to evaluate fertility. Endocrinologic and histopathologic parameters are being studied in reproductively abnormal animals. Screening procedures are being performed on contract and further mechanistic studies are being conducted in intramural laboratories.
Keywords: REPRODUCTION; BEHAVIOR; MALE GENITALS; FEMALE GENITALS; HUMAN POPULATIONS; HYDROCARBONS; BENZOPYRENE; TOXICITY; HEALTH HAZARDS; DOSE-RESPONSE RELATIONSHIPS; EMBRYOS; TERATOGENESIS; RATS; BIOLOGICAL EFFECTS; MICE; HAMSTERS; GUINEA PIGS; ENZYMES; ONTOGENESIS.

75980 Electrophoresis on Mouse Tissue. Johnson, F.M. (National Institute of Environmental Health Sciences, Laboratory of Biochemical Genetics, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-57. **Contract:** D5-E772-CO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$246,000. **Related energy source:** coal(33); oil and gas(33); oil shales and tar sands(34). **R and D categories:** Health effects.

No practical methodology exists for the determination of newly induced point mutations in mammals and such mutations may, individually and/or in accumulation, be associated with effects detrimental to the health and wellbeing of present and future human populations. The objective of this work is the investigation and evaluation of various possible technical approaches for their potential and suitability to detect the presence of newly induced gene point) mutations in mice and by inference, other mammals and umans. In progress is work with starch gel electrophoresis and nzyme characteristics determined spectrophotometrically. Appropriate to the detection and quantitation of a variety of molecular species will be investigated in concern with the application of conventional mutation test methodologies.
Keywords: MICE; MUTAGENESIS; MUTANTS; HUMAN POPULATIONS; HEALTH HAZARDS; MUTATIONS; TISSUES; BIOASSAY; BIOLOGICAL INDICATORS; AIR POLLUTION; WATER POLLUTION; TOXICITY; EPIDEMIOLOGY; HYDROCARBONS; ELECTROPHORESIS.

75981 Fossil Fuel Carcinogens. Nettesheim, P. (National Institute of Environmental Health Sciences, Pulmonary Function and Toxicology Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-58. **Contract:** D5-E772-CO. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
R and D categories: Health effects.

The lung is a major target for a great variety of toxicants, including carcinogenic agents. Many of these are generated during incomplete combustion of fossil fuels and during coal conversion process. The purpose of the studies is to determine the effects of fossil fuel carcinogens on epithelial cells of the respiratory tract (and also of another target organ system, namely the skin) and to obtain basic information needed to design effective measure for therapeutic intervention and early diagnosis of lung cancer. The studies are carried out in newly developed in-vitro and in-vivo models. They focus on the early cellular events following the interaction of fossil fuel carcinogens, including aromatic polycyclic hydrocarbons with intracellular biochemical target sites. The goal is to discover and characterize the cellular and biochemical changes occurring during the development of epithelial neoplasia and to develop markers for the multiphasic process of neoplastic development. Modifications, i.e., inhibitors and promoters of postinitiation events, are also being investigated.
Keywords: FOSSIL FUELS; COMBUSTION PRODUCTS; TOXICITY; ENERGY CONVERSION; RESPIRATORY SYSTEM; SKIN; LUNGS; CARCINOGENESIS; NEOPLASMS; EPITHELIUM; COAL INDUSTRY; HEALTH HAZARDS; DIAGNOSIS; THERAPY; PHYSIOLOGY; FLUE GAS; FLY ASH.

75982 NO2 and O3 Effects on Cells. Wenzel, D.G. (University of Kansas, Department of Pharmacology and Toxicology, 327 Malott Hall, Lawrence, KS, 66044). **Project number:** V625F-59. **Contract:** D5-E772-CU. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$51,000.
R and D categories: Health effects.

This grant proposal is concerned with the effect of oxidizing gases (NO2 and O3) on specific target cells. The grantee will examine the effect of direct NO2 and O3 exposure on cell cultures of brain, myocardium, endocardium, and suspensions of pulmonary macrophages, fibroblasts and platelets. Following an exposure period of up to 24 hours, tests will be made of cell viability, membrane structure, lysosomal integrity and mitochondrial function. The major objective of this work is to characterize the potentially injurious effects of selected oxidizing gases at the cellular level without the intervention of the complicated feedback systems found in the intact organism.
Keywords: NITROGEN DIOXIDE; OZONE; BIOLOGICAL EFFECTS; CELL CULTURES; BRAIN; MYOCARDIUM; HEART; MACROPHAGES; FIBROBLASTS; BLOOD PLATELETS; CELL MEMBRANES; MITOCHONDRIA; LYSOSOMES; TOXICITY; PATHOLOGICAL CHANGES; PHYSIOLOGY; CYTOLOGY; ANIMAL CELLS.

75983 Shale Oil Bioeffects. Chignell, C.F. (National Institute of Environmental Health Sciences, Environmental Biophysics Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-60. **Contract:** D5-E772-CU. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$80,000.
R and D categories: Health effects.

Waste effluents from shale oil production contain high concentrations of many heavy metal ions, many of which (e.g., Cu, Co, Ni, Mn) are paramagnetic. We propose to study the binding of these metal ions with proteins and membranes with the aide of electron spin resonance spectroscopy. Two biological systems, serum albumin and erythrocyte ghost membranes, will be employed in these studies. Serum albumin is known to bind a large number of endogenous and exogenous ligands. The binding of heavy metals by serum albumin has important toxicological implications. Firstly, metals bound to albumin are effectively removed from circulation thereby reducing the amount of metal ion available for distribution into the tissues. However, at the same time albumin also functions as a transport protein for heavy metals carrying them to all parts of the body. Thus it is essential to understand the mechanism of interaction between heavy metals and albumin. Membranes play a key role in cellular function. Although membranes contain a number of potential metal binding sites, e.g., phospholipids, lipids, proteins, little is known about how metal ions interact with membranes. In our studies, the binding of several paramagnetic metal ion constituents of waste effluents from shale oil production with erythrocyte ghost membranes will be examined with the aid of electron spin resonance spectroscopy. The aim of this work will be to identify those membrane components that interact with heavy metals. Recent studies

have shown that incubation of benzo(a)pyrene with rat liver microsomes and NADPH generates a free radical intermediate which was identified as 6-oxobenz(a)pyrene by means of electron spin resonance (esr) spectroscopy. Several aromatic drugs have also been shown to be metabolized via free radical intermediates.
Keywords: SHALE OIL; OIL SHALE INDUSTRY; BIOLOGICAL EFFECTS; METALS; TOXICITY; COPPER; COBALT; NICKEL; MANGANESE; PROTEINS; CELL MEMBRANES; BIOCHEMICAL REACTION KINETICS; BENZOPYRENE; POLYCYCLIC AROMATIC HYDROCARBONS.

75984 Extrapolation of PCB Disposition. Eling, T.E. (National Institute of Environmental Health Sciences, Pulmonary Function and Toxicology Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-61. **Contract:** D5-E772-CT. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$109,000.
R and D categories: Health effects.

The objectives are: (1) to complete contracted studies of PCB distribution and excretion in dogs and monkeys, and of the resolution of total radioactivity in the tissue, excreta and bile from these animals into the relative amounts of parent compound and metabolites; (2) to determine if the dog's ability to metabolize a PCB which does not have two adjacent unsubstituted carbon atoms is due to a greater ability to perform the insertion reaction or to form an arene oxide between a halogenated and an unhalogenated carbon atom; (3) to ascertain if the monkey's inability to metabolize most PCBs is due to a lack of ability to perform the insertion reaction compounded by a restricted capability to form an arene oxide intermediate only when two adjacent unsubstituted carbon atoms are in the meta and para positions; and (4) to produce mathematical models which will facilitate the extrapolation of data obtained with laboratory animals to predict the disposition and toxicity of various PCBs in man.
Keywords: ORGANIC CHLORINE COMPOUNDS; AROMATICS; METABOLISM; DOGS; MONKEYS; METABOLITES; HUMAN POPULATIONS; HEALTH HAZARDS.

75985 Lifelong Assessment of the Behavioral Effects of Prenatal Exposure to Microwaves. Mitchell, C.L. (National Institute of Environmental Health Sciences, Laboratory of Behavioral and Neurologic Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-62. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.
R and D categories: Health effects.

Microwave-generating devices are being employed in a variety of military, industrial, and civilian applications. As the uses and power of such devices increase, the extent to which humans and other animals suffer exposure to microwave energy will also increase. Thus, the health implications of exposure to this type of radiation have come under intense investigation. The developing organism has been shown to be more sensitive than mature adults to chemical insult, and the possible long-term effects of perinatal exposure to microwave energy deserve further investigation. A decrement in performance in a conditioned avoidance procedure in offspring of female rats receiving 915 mHz cw microwave irradiation at a power density of 5 Mw/cm2 during pregnancy has been observed. No such effects were observed in rats irradiated after birth. Moreover, preliminary experiments at NIEHS (McRee) have indicated that embryonic Japanese quail exposed to 2450 mHz cw microwave irradiation at a power density of 5 Mw/cm2 exhibit immunological deficiencies which become more pronounced with age. In the proposed project, attempts will be made to investigate the consequences of prenatal exposure to microwave irradiation on neurobehavioral functioning at various points during the lifetime of the progeny.
Keywords: MICROWAVE RADIATION; EMBRYOS; BIOLOGICAL EFFECTS; BIRDS; BEHAVIOR; MAN; ANIMALS.

75986 Lifelong Assessment of the Behavioral Effects of Perinatal Exposure to Heavy Metals. Tilson, H.A. (National Institute of Environmental Health Sciences, Behavioral Toxicology Work Group, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-63. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$86,000.
R and D categories: Health effects.

It is well known that the combustion of coal and other fossil fuels results in the emission of heavy metals, such as lead and mercury, into the environment. The continued use of leaded gasoline represents an additional source of lead contamination. The ubiquity of lead and mercury in the environment, in addition to their known neurotoxic potential, underscores the need to study the potentially harmful effects of long-term exposure to these agents. The developing, immature organism is notably more sensitive than young adults to certain environmental insults, and there is a need to evolve and standardize procedures to assess the long-term behavioral and neurological effects that may result from perinatal exposure to low concentrations of mercury and lead. In the proposed research project, the effects of perinatal exposure to mercury and lead on the neurobehavioral development and maturation of research animals will be studied. Consummatory responses, such as ingestion of food and water, and the occurrence of various types of locomotor activity will be used as dependent variables since they occur during all stages of the life cycle and are, therefore, comparable on a longitudinal basis. The measurement of such responses is also non-invasive and will not confound the experiments by overly stressing the subjects.
Keywords: BEHAVIOR; METALS; BIOLOGICAL EFFECTS; LEAD; MERCURY; GASOLINE; ADDITIVES; NEUROLOGY; ENVIRONMENTAL IMPACTS; TERATOGENESIS.

75987 Effects of Heavy Metals on Neurotransmitter Translocation. Bondy, S.C. (National Institute of Environmental Health Sciences, Neurochemistry Work Group, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-64. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
R and D categories: Health effects.

There is increasing concern about heavy metals due to the greater exposure of both industrial workers and the general population year by year. Very often specific neurological symptoms appear in heavy metal poisoning before signs of general systemic toxicity. Such specific neurological symptoms may be measured as seizures or they may be more subtle, such as mild tremor or impaired coordination. It is possible that effects on the brain may be a reflection of a selective disturbance of neurotransmitter metabolism. A key area in neurotransmission is the synapse, and we plan to study the effects of several heavy metals on synaptic processes. Such metals will include lead, mercury, and cadmium. Preliminary work has shown the importance of testing both the organic and inorganic force of these metals since their toxicities may be considerably different.
Keywords: METALS; NEUROLOGY; BIOLOGICAL EFFECTS; BRAIN; TOXICITY; LABELLED COMPOUNDS; BEHAVIOR; ANIMALS.

75988 Effects of Gestational Chemical Exposure. Staples, R.E. (National Institute of Environmental Health Sciences, Teratology Section, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-65. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
R and D categories: Health effects.

Positive teratogenic effects were obtained following administration of symmetrical polychlorinated biphenyls to mice from days 6 through 15 of gestation. Correlations are sought between the teratogenicity found and chemical structure of other physiochemical properties of these PCB isomers. Other compounds that have been or are being tested are formaldehyde, glutaraldehyde, and n-hexane. The project officer is meeting with scientists from the Shell Oil Company to identify energy-related compounds for testing in this contract.
Keywords: REPRODUCTION; CHEMICAL EFFLUENTS; TERATOGENESIS; AROMATICS; ORGANIC CHLORINE COMPOUNDS; BIOLOGICAL EFFECTS; PETROLEUM INDUSTRY; HEALTH HAZARDS; FORMALDEHYDE; HEXANE; GLUTARIC ACID.

75989 Environmental Teratology Information Center. Staples, R.E. (National Institute of Environmental Health Sciences, Teratology Section, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-66. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$130,000.
R and D categories: Health effects.

ETIC is a computerized teratology data bank being developed by the NIEHS. Its purpose is to provide government agencies, industry, and scientists-at-large an access to all publications that contain data pertinent to the teratogenic potential of environmental agents, including energy-related chemicals. To date, more than 14,000 references to studies performed on warm-blooded animals have been identificd and assembled. Information obtained in ETIC can be accessed as a subfile of Toxline (Toxicology Information On-Line), which is available through the National Library of Medicine, or as a subfile of RECON, which is available through Oak Ridge National Laboratories. The NIEHS-ETIC staff provides information to those individuals that do not have access to these on-line systems. The importance of ETIC to research on energy-related teratogens is three-fold: it provides information on the teratogenic potential of compounds; it prevents unplanned duplication of research effect; and it aids in priority determination for future research.
Keywords: TERATOGENESIS; ENVIRONMENT; INFORMATION SYSTEMS; CHEMICAL EFFLUENTS; BIOLOGICA EFFECTS; HEALTH HAZARDS.

75990 Development of the Probability Matched Gas Chromatographic Mass Spectrographic System to Screen Biological Tissues. Dixon, R.L. (National Institute of Environmental Health Sciences, Environmental Toxicology Laboratory, P.O. Box 12233, Research

Triangle Park, NC, 27709). **Project number:** V625F-67. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$55,000.
R and D categories: Physical and chemical processes and effects.

A survey of environmental chemicals present in biological fluids of the mother and newborn infant has been undertaken in conjunction with the Veteran's Hospital in Palo Alto and the Columbia Hospital for Women in Washington, DC. Chemical concentrations in the mother's blood, adipose tissue, urine, and breast milk will be monitored as well as the levels in amniotic fluid, cord blood, and the infant's urine. Biological tissues supplied by the Columbia Hospital for Women will be examined using a probability matched gas chromatographic/mass spectrographic system at the Palo Alto Veteran's Hospital. The system is capable of quickly making a qualitative and quantitative determination of as many as sixty preselected chemicals.
Keywords: MUTAGEN SCREENING; TISSUE CULTURES; BODY FLUIDS; GAS CHROMATOGRAPHY; TERATOGENESIS; MASS SPECTROSCOPY; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS.

75991 DNA Repair Capacity and the Mutagenic and Carcinogenic Effects of Chemicals in Eukaryotes. Deserres, F.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-68. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$41,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Health effects.

It is known that reduced capacity to repair DNA lesions induced by chemicals alters the resulting mutations both quantitatively and qualitatively. Human syndromes which result in increased risk of cancer are frequently characterized by reduced DNA repair capacity. Through use of the AD-3 system of Neurospora crassa, which detects the complete range of genetic thought to produce deleterious effects in humans, along with available repair-deficiency mutations, investigations will be conducted with chemical mutagens and carcinogens to obtain a better understanding of the correlation between mutagenic and carcinogenic activity at the molecular level.
Keywords: DNA; BIOLOGICAL REPAIR; MUTAGENESIS; CARCINOGENESIS; CHEMICAL EFFLUENTS; NEUROSPORA; COAL INDUSTRY; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; OIL SHALE INDUSTRY.

75992 Aneuploidy Workshop. Deserres, F.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-69. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$35,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Health effects.

One genetic consequence of chemical exposure is the production of cells with irregular numbers of chromosomes (aneuploid cells). In humans, aneuploidy can result in severe physical and mental disorders as in the cases of Down's Syndrome and Turner's Syndrome. Although chemicals are known which induce no other genetic effects except aneuploidy, assay systems designed to detect this important genetic endpoint are limited and inadequate. A workshop will be held to evaluate current aneuploidy assay systems and the available chemical data from these systems. Such an evaluation will allow for the determination of the research necessary to provide aneuploidy assay systems relevant to man. Assays capable of detecting the induction of aneuploidy must be part of any comprehensive battery of mutagenicity tests used to determine the risk to human genetic welfare posed by environmental pollutants such as those associated with energy activities.
Keywords: CHEMICAL EFFLUENTS; CHROMOSOMAL ABERRATIONS; BEHAVIOR; HEALTH HAZARDS; GENETIC EFFECTS; MUTAGENESIS; COAL INDUSTRY; OIL SHALE INDUSTRY; NATURAL GAS INDUSTRY; PETROLEUM INDUSTRY; HEALTH HAZARDS.

75993 Mutagenic Mechanism. Drake, J.W. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-70. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$174,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Health effects.

A major problem arising from potential human mutagens introduced into the environment from fossil fuel sources is the multiplicity of chemicals involved, with the resulting need to determine whether they act by a common or different mechanism, and whether they produce base pair substitutions, frameshift mutations, or deletions and other macrolesions, each of which has a qualitatively and quantitatively different deleterious impact. DNA polymerases are known to possess mechanisms for the avoidance of both spontaneous and chemically induced mutagenesis, but with the exception of associated 3' exonucleases, our understanding of these mechanisms is very poor. In vitro DNA polymerase misincorporation experiments will therefore be conducted to characterize preincorporation mechanisms guarding against insertion of incorrect bases. Additional determinants of fidelity in DNA replication (besides the DNA polymerase itself) are strongly inferred from the existence of mutator mutations in several other genes whose products are required for DNA synthesis in vivo. A set of such mutator mutations will be selected which are distinct from, but must interact with, the DNA polymerase in order to express their mutator phenotypes. The error-prone repair system of bacteriophage T4 will be characterized both genetically (by discovery and formal genetic analysis of the responsible genes) and chemically (by discovery and formal biochemical analysis of the corresponding gene products). A major structural protein of DNA replication and repair, appearing in bacteriophage T4 as the gene 32 protein, is known to interact physically both with DNA and with the DNA polymerase, and at least functionally with a number of host and viral genes as well. Mutational analyses have divided this protein into a number of domains exhibiting specialized function. In order to understand the central role of this protein, its primary amino acid sequence will be determined.
Keywords: MUTAGENESIS; BIOCHEMICAL REACTION KINETICS; HUMAN POPULATIONS; DNA; CHEMICAL EFFLUENTS; COAL INDUSTRY; OIL SHALE INDUSTRY; PETROLEUM INDUSTRY; NATURAL GAS INDUSTRY; TOXICITY.

75994 Identification of Markers for Preneoplasia in Respiratory Epithelium. Nettesheim, P. (National Institute of Environmental Health Sciences, Laboratory of Pulmonary Function and Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-71. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$100,000.
R and D categories: Health effects.

Together with investigators from the Livermore Laboratory in California, we plan to study quantitative cytological parameters during the progression from initiation to benign neoplasia. Using flow microfluorometry, we will assess DNA content, cell cycle times, nuclear cytoplasmic ratio, cell size distribution, and various cellular enzymes that have shown promise in studies of hepatocarcinogenesis. Such studies will be conducted on mixed and cloned cell populations cultured in vitro and in vivo (using a system which allows retrieval of inoculated cells). Simultaneously we will monitor the cultures for their capacity to grow in soft agar and for development of oncogenicity. It was recently shown that the chemically induced squamous carcinomas induced in rats carry cell surface antigens which can be detected with various immunological techniques. It was shown that some, if not all, of these tumors share some of these antigens. It was also shown that these antigens are more readily expressed if the tumor cells are grown for some time apart from host immune mechanisms in tissue culture. We will make use of these recent findings to study the appearance of neoantigens during evolution of neoplasia. Various initiated and preneoplastic cell lines will be tested for development of these antigenic markers as they progress toward malignancy. These tests will be carried out with specific radiolabeled antibodies raised in isologous hosts and with immune lymphocytes from hosts immunized with the appropriate tumor cells. A microcytotoxicity test adapted in our laboratory will be used for these studies. The experiments will be carried out in collaboration with the immunology group at the Oak Ridge National Laboratory.
Keywords: BIOLOGICAL INDICATORS; NEOPLASMS; RESPIRATORY SYSTEM DISEASES; EPITHELIUM; CARCINOGENESIS.

75995 Biochemical Mechanisms of Pulmonary Injury. Hook, G.E. (National Institute of Environmental Health Sciences, Laboratory of Pulmonary Function and Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-72. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$64,000.
R and D categories: Health effects.

This program is focused on two important issues of biochemical toxicology of the lung which have a great bearing on energy related toxicology. The acellular living layer of the alveoli is of great importance for the normal function of the blood gas barrier. Many investigators have studied the phospholipid components of this layer (surfactant). However, little is known about the proteins associated with the alveolar surfactant in normal and diseased lungs. This laboratory has studied the enzyme activities (hydrolases), and their origin in the alveolar lining layer of several laboratory animal species and humans. We intend to expand our efforts to study pathological disturbances of its normal enzyme composition in

humans in various types of pulmonary diseases and in animals exposed to gaseous and particulate air contaminants. Benzo(a)pyrene and other PCH's are common byproducts of incomplete combustion of fossil fuels. Their role as etiological factors in the pathogenesis of lung cancer is unquestioned. To exert their toxic and carcinogenic effects, the PCH's have to be enzymatically activated. Recent studies in this laboratory indicate that besides the mixed function oxygenases, which are widely studied as major systems of metabolic activation of PCH's, other metabolic pathways may exist. It was shown that during the formation of prostaglandins (PG) from arachidonic acid in the lung, BaP was oxidized to electrophilic products which bind to DNA. Since the lung is particularly active in PG synthesis and metabolism, this finding is potentially of great importance for our understanding of the activation and detoxification mechanism of PCH's in this tissue.

Keywords: BIOCHEMICAL REACTION KINETICS; LUNGS; BENZOPYRENE; METABOLISM; ETIOLOGY; NEOPLASMS; POLYCYCLIC AROMATIC HYDROCARBONS; AIR POLLUTION.

75996 Biology and Pathobiology of Pulmonary Epithelial Cells. Wu, R. (National Institute of Environmental Health Sciences, Laboratory of Pulmonary Function and Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-73. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$66,000.

R and D categories: Health effects.

This research has as its main goal the elucidation of the functions of major classes of epithelial cells in the respiratory tract in health and disease. Studies will be initiated to investigate specialized epithelial cell populations in the lungs and the effects of environmental insults, such as inhaled gaseous pollutants, on their functions. We will also investigate the role of such cells and their products (mucus cells, neuroendocrine cells) in the development of environmental pulmonary diseases. Recent evidence suggests that neuroendocrine cells (APUD cells) occur in various segments of the respiratory tract. These cells have been shown to respond to hypoxia, hyperoxia, and exposure to a group of environmental carcinogens, the nitrosamines. These cells are also thought to be the origin of oat cell carcinomas. It is suspected that the neuroendocrine cells in the lung may be important in controlling vaso-motor activity, broncho constriction, and/or bronchial secretion. However, the nature of their endocrine product and their function are unknown. The purposes of the proposed studies are to investigate the distribution of these cells in the respiratory tract of two major laboratory animal species (namely hamsters and rats), to investigate changes in the number of such cells upon exposure to environmental agents including nitrosamines, and to study the histochemical and ultrastructural level of changes occurring in their morphology following such exposure.

Keywords: BIOLOGICAL EFFECTS; PATHOLOGICAL CHANGES; EPITHELIUM; LUNGS; HUMAN POPULATIONS; RESPIRATORY SYSTEM DISEASES; ORGANIC NITROGEN COMPOUNDS; TOXICITY; ETIOLOGY.

75997 Pathogenetic Mechanisms in the Development of Emphysema and Pneumoconioses. Brody, A.R. (National Institute of Environmental Health Sciences, Laboratory of Pulmonary Function and Toxicology, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-74. **Contract:** D8-772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$200,000.

R and D categories: Health effects.

Two major lines of investigation will be conducted: (1) effects of nitrogen dioxide and other reactive gases on the distal airways of the lung; and (2) mechanism of injury induced by natural and man-made fibers and fibrogenic particles. Both areas of investigation are directed toward major human health problems related to generation of fossil fuel energy, i.e., toxic gases produced during combustion of fossil fuels and toxic particles related to processing of coal (mining, etc.) and to energy conservation (asbestos, glass fibers, etc.). Studies with reactive gases are aimed at identification of host factors instrumental in determining susceptibility to prototype gaseous air pollutants and at identification of mechanisms involved in the pathogenesis of emphysema. Studies with fibrogenic dusts include a group of common, severely debilitating pulmonary fibrosis and/or granuloma formation. Many of these are caused by inhaled mineral dusts or fibers. Typical examples are asbestosis, silicosis, and coal miners' pneumoconiosis. While the anatomic pathology of these pulmonary reactions is fairly well established, the mechanism of injury involved as well as the pathogenesis of the disease processes are not understood.

Keywords: EMPHYSEMA; PNEUMOCONIOSES; DUSTS; HEALTH HAZARDS; COAL MINING; ENERGY CONSERVATION; ASBESTOS; NITROGEN DIOXIDE; GASEOUS WASTES; INHALATION; FOSSIL FUELS; COMBUSTION; OCCUPATIONAL DISEASES; ETIOLOGY.

75998 Identification of Peripheral and Central Receptors Mediating the Effects of Microwave Radiation on Brain Activity. Wilson, E (Research Triangle Institute, P.O. Box 12194, Research Triangl Park, NC, 27709). **Project number:** V625F-75. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$40,000.

R and D categories: Health effects.

One of the primary reported effects of microwave radiation is on the central nervous system. Basic studies to determine the interaction mechanisms are required. Some recent findings have covered some deficits in the present understanding of the mechanisms of effects of microwave radiation on the activity of the auditory system. Specifically, the thermoacoustic expansion pulse hypothesis cannot account for the observed effect of pulsed microwave radiation on auditory nerve activity resulting from direct stimulation of cochlear hair cells. One set of experiments proposed is designed to extend knowledge of the mechanisms of these effects of microwave radiation on auditory activity. Recordings of response of single units in auditory nerve and cochlear nucleus to microwave and acoustic stimuli will be used as the primary method for this first set of experiments. The (14C) 2DG method will also be used in some instances to corroborate and complement the results obtained with the electrophysiological method. An additional set of experiments is proposed to detect effects of nonionizing radiation on the activity of brain structures other than nuclei of the auditory system. For these experiments, the (14C)2DG method will be used. Because the method allows for simultaneous, in-vivo determination of glucose consumption at individual structure of the brain, effects on the activity of nuclei in sensory systems resulting from stimulation of peripheral receptors can be identified and separated from pervasive effects on brain activity resulting from radiation-induced shifts in the environment of central neurons. Possible effects on brain activity resulting from stimulation of vestibular and hypothalamic receptors will be evaluated, as will possible effects resulting from radiation-induced alterations in the permeability of the blood-brain barrier and in the binding of calcium ions in cerebral tissue.

Keywords: MICROWAVE RADIATION; BIOLOGICAL EFFECTS; BRAIN; PHYSIOLOGY; NEUROLOGY; NERVE CELLS; RECEPTORS; BIOLOGICAL STRESS.

75999 Metabolism and Disposition of Hydrocarbons and Epoxides by Rabbit Lung and Pulmonary Biotransformation Systems. Bend, J.R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-76. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.

R and D categories: Health effects.

Since the lungs of many mammalian species are particularly susceptible to polycylic aromatic hydrocarbon (PAH) induced toxicity, and since humans appear to share this susceptibility, the understanding of how chemicals are metabolized in this tissue, and the relationship between biotransformation and toxicity, are particularly important. Moreover, PAH is present in respirable form and has direct access to pulmonary tissue metabolism of these chemicals in this organ as part of our pass-through research strategy.

Keywords: METABOLISM; HYDROCARBONS; EPOXIDES; RABBITS; LUNGS; PHYSIOLOGY.

76000 Pharmacokinetics of Pulmonary Uptake and Metabolism. Wilson, W.E. (National Institute of Environmental Health Sciences, Behavioral and Neurologic Toxicology Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-77. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$35,000.

R and D categories: Health effects.

It is proposed to study the pharmacokinetics of pulmonary uptake and metabolism of inhaled environmental pollutants, including several that are byproducts of coal conversion processes. An Isolated Perfused Lung (IPL) system has been developed which permits uptake studies of respirable air particulates or vapors. Pharmacokinetic data obtained from such studies will be correlated with pharmacological, biochemical, physiological, and toxicological changes. The IPL and whole animal data will be used to develop pharmacokinetic models. The lungs play an important role in the removal and metabolism of a number of endogenous (e.g., 5-hydroxytryptamine, prostaglandins, noradrenaline, angiotensin) and exogenous compounds. The effect of inhalation of pollutants on the pulmonary clearance and metabolism of such compounds as 5 hydroxytryptamine in the IPL will be studied. This approach is being applied initially in a study of the widely used industrial solvents, including toluene and benzene, which are known byproducts of coal conversion and volatilization processes.

Keywords: LUNGS; UPTAKE; METABOLISM; DRUGS; BIOCHEMICAL REACTION KINETICS; HYDROCARBONS;

COAL INDUSTRY; CHEMICAL EFFLUENTS; TOXICITY; INHALATION; ANIMALS.

76001 Pharmacology of PCBs. Matthews, H.B. (Public Health Service, Laboratory of Pharmacokinetics, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-78. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$25,000.
R and D categories: Health effects.

Studies of the PCBs are important not only because of their extensive use in association with the use of electrical energy, but also because this group of environmental contaminants represents, perhaps better than any other, the wide range of biological stability which can be attributed to simple modifications of molecular structure. More specifically, the biological half-life of a given PCB may vary from a matter of hours to infinity depending upon the degree and position of chlorination of the biphenyl rings. Thus, we propose to study the relationship between the degree and position of chlorination of PCBs and the pharmacological effects of PCBs as they relate to the biological half-lives and tissue distribution of these compounds. In addition, the PCBs are in many respects quite similar to many other compounds which are or will be used in the transmission and use of electrical energy; therefore, the PCBs may be considered model compounds. And, these studies of the PCBs will facilitate similar studies of other energy related synthetic compounds.
Keywords: BIOCHEMICAL REACTION KINETICS; ORGANIC CHLORINE COMPOUNDS; AROMATICS; PHARMACOLOGY; METABOLISM; TISSUE DISTRIBUTION; WATER POLLUTION; GROUND WATER.

76002 Isolation and Culture of Rabbit Lung Cell Types: Hydrocarbon Metabolism Within the Lung and Toxication/Detoxication Mechanisms in Cells. Bend, J.R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-79. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$33,000.
R and D categories: Health effects.

Mammalian lung is composed of more than forty different cell types, several of which contain endoplasmic reticulum and are capable of carrying out cytochrome P-450-dependent mixed-function oxidation reactions. This project will use various enzyme preparations for dispersal of lung cells; the cell populations will be separated according to their relative rates of sedimentation during centrifugal elutriation. Finally, benzo(a)pyrene and benzo(a)pyrene 4,5-oxide metabolism and toxicity will be evaluated in the various cell populations.
Keywords: RABBITS; LUNGS; CELL CULTURES; TOXICITY; HYDROCARBONS; PHYSIOLOGY; BIOCHEMICAL REACTION KINETICS; BENZOPYRENE.

76003 Effects of Exposure to Selected Industrial Hydrocarbon Metabolism and Toxicity in Lungs. Bend, J.R. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-80. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$90,000.
R and D categories: Health effects.

P-xylene, an important industrial solvent, has been shown to preferentially destroy pulmonary cytochrome P-450 (relative to liver) following administration to rabbits. This preferential destruction of lung cytochrome P-450 also occurs in vitro following incubation of microsomes with P-xylene. Initially, other alkylated benzene compounds, such as toluene, will be studied to see whether the P-xylene effect on pulmonary cytochrome P-450 is specific or general. The effect of P-xylene exposure on the subsequent metabolism benzo(a)pyrene and of benzo(a)pyrene 4,5-oxide will be determined in isolated, perfused lung preparations; in vitro studies will be determined in isolated, perfused lung preparations; in vitro studies will determine whether there is any effect on epoxide hydrase or glutathione s-transferase activities using benzo(a)pyrene 4,5-oxide as substrate. The ratios of the various position-specific radioactive metabolites of benzo(a)pyrene will be compared in microsomes from lungs of control and P-xylene treated rabbits, and in reconstituted mixed-function oxidase systems from lungs of control and preexposed animals. The mechanisms of cytochrome P-450 destruction by P-xylene will also be investigated.
Keywords: HYDROCARBONS; TOXICITY; METABOLISM; LUNGS; CHRONIC EXPOSURE; OCCUPATIONAL DISEASES; LIVER; SOLVENTS; BENZOPYRENE; RABBITS; ANIMALS; XYLENE-PARA; RADIOACTIVITY; RADIONUCLIDE KINETICS.

76004 Species-to-Species Extrapolation. Hogan, M. (Public Health Service, Biometry Branch, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-81. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$20,000.
R and D categories: Health effects.

The objectives are: (1) to identify some of the factors which contribute to species differences in response to carcinogenic exposures, and (2) to develop a better understanding of the quantitative differences between human and animal cancer risk. Literature-based data on human laboratory animal carcinogenesis (generated from a contract funded in part under the energy program) will be combined with independently collected data and subjected to detailed statistical analyses in an attempt to account for species-to-species variability in response. Particular attention will be given to the effects of various quantifiable factors such as the unit of dosage measurement and lengths of exposure expressed in terms of relative life-times on the estimated relative risks for different species.
Keywords: TOXICITY; METABOLISM; COMPARATIVE EVALUATIONS; GENETIC VARIABILITY; CARCINOGENESIS; HUMAN POPULATIONS; ANIMALS.

76005 Childhood Health Effects of PCBs. Rogan, W.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-82. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$367,000.
R and D categories: Health effects.

The epidemiological component of this project is being initiated (1) to determine the extent to which residues of persistent, fat-soluble, chlorinated hydrocarbon pesticides and polychlorinated biphenyls (PCBs) are present in mothers' breast milk; (2) to investigate the relationship between PCB and total organic chlorine levels in mothers' milk and various developmental outcomes and indices of infant well being; and (3) to establish cohorts of breast and formula-fed children for follow-up studies. The related PCB (non-human) primate study is directed at determining how long after the cesation of maternal exposure to PCBs deleterious physical and psychological effects will continue to be observed in their newborn offspring. In the breast milk contamination study, prospective data on approximately 1000 mothers giving birth in three separate North Carolina hospitals will be generated over a two year interval. Newborns will be examined according to a fixed protocol, and samples of blood and placenta will be collected and analyzed, along with samples of maternal blood and breast milk. Chemical analysis of total organic chlorine and individual contaminant levels will be performed under contract at two independent laboratories. Follow-up examinations will be scheduled for six weeks, three and six months. All data will be stored and processed through the Institute's computer facilities. The PCB study will focus on fourteen female rhesus monkeys who were exposed to PCB at levels of 2.5 and 5.0 ppM for an interval of 18 months. After the infants born to these females during the exposure period were weaned, the adult females were placed on a control diet for one year, at which time they were bred again. The same females, who have now been on control diets for two years, will be rebred (at least one more time), and the resultant offspring will be compared to those of two previous matings.
Keywords: CHILDREN; HEALTH HAZARDS; AROMATICS; ORGANIC CHLORINE COMPOUNDS; METABOLISM; MAMMARY GLANDS; MILK; HYDROCARBONS; PESTICIDES; INGESTION; FOOD CHAINS; CONTAMINATION.

76006 Validation of Short-Term Tests for Mutagenicity as Predictors of Potential Carcinogenic Activity. Deserres, F.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-83. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$123,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Health effects.

The high correlation between mutagenic and carcinogenic activity of many chemicals has opened up the possibility of using short-term mutagenicity tests to screen a large number of chemicals for potential carcinogenicity. As carcinogenicity prescreens, short-term tests cannot determine carcinogenicity but can provide data valuable in determining testing priorities for more costly long-term tests. An extensive international collaborative study has been initiated by the Medical Research Council, Imperial Chemical Industry, Ltd., of England, and NIEHS to determine the efficacy of several short-term tests as carcinogen prescreens. Forty-two coded compounds will be tested in about twenty-five short-term tests involving approximately fifty investigators. The compounds will comprise pairs of carcinogens and noncarcinogenic structural analogs with the object of the study being to determine the accuracy with which each assay responds positively to the carcinogen and negatively to the non-carcinogen in each pair. Several energy-related compounds are included in this test-system validation study and the outcome will

have far-reaching applications in future toxicological evaluation of energy-related activities.
Keywords: MUTAGENESIS; BIOCHEMICAL REACTION KINETICS; CARCINOGENS; FORECASTING; BIOLOGICAL INDICATORS; CHEMICAL EFFLUENTS; MUTAGEN SCREENING.

76007 Interaction of Lead with Body Tissues and Fluids. McKinney, J.D. (Public Health Service, Chemistry Section, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-84. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$28,000.
R and D categories: Health effects.

Lead continues to be the most abundant trace metal produced as an energy by-product. Lead is one of man's oldest poisons and there is no evidence at present to indicate that lead serves any useful function in the body. The major sites of toxicological effects of lead include red blood cells, nervous system, kidney, embryo and bone. Although there have been many studies in the past on the toxicity of lead, little is known about the interactions of lead with body fluids and tissues that are responsible for lead's toxic effects. It is essential to know and understand the specific types of metal coordination and required ligands responsible for the toxicity of lead. Because the preliminary experiments show 207-Pb nuclear magnetic resonance (nmr) spectroscopy to be sensitive to binding interactions, studies of lead binding interactions using nmr should be particularly informative. The study should provide information not only about the sites of interaction (what atom or groups of atoms are involved) but also the relative strength of the interactions. Preliminary experiments show that 207-Pb nmr parameters are extremely sensitive to the immediate surroundings of lead. Initial studies would examine the binding interactions of lead with chemical models, membrane components, isolated membrane enzymes and red blood cells. We would hope to correlate binding affinities with specific organ toxicities and provide data that may permit one to prevent or reverse detrimental binding. As time permits, other trace metals including mercury, cadmium, and arsenic will be investigated.
Keywords: LEAD; METABOLISM; TISSUES; BODY FLUIDS; TOXICITY; BLOOD CELLS; LEAD 207; CHEMICAL BONDS; BIOCHEMICAL REACTION KINETICS; CENTRAL NERVOUS SYSTEM; MERCURY; CADMIUM; ARSENIC.

76008 Photodegradation of Absorbed Polycyclic Arenes. Daisey, J.M. (New York University, School of Medicine, Environmental Medicine Inst., 550 1st Avenue, New York, NY, 10016). **Project number:** V625F-85. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$25,000.
R and D categories: Health effects.

Carcinogenic pollutants, including the polycyclic aromatic hydrocarbons (PAH), exist almost completely in an absorbed state in our environment. The objective of this grant proposal is to show that aromatic carcinogens more readily undergo photooxidative reactions in the absorbed state than in solution. In the proposed studies the interaction between light and PAH absorbed onto various solids will be examined. The experiments will employ a fluidized bed photochemical reactor to examine the photodegradation and chemical half lives of pyrene, benzo(a)pyrene and benz(a)anthracene absorbed onto various substrates under different conditions of light, temperature and humidity. The products formed during photodegradation will be identified with particular emphasis on arene epoxide derivatives.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; AROMATICS; PHOTOCHEMISTRY; SYNERGISM; BIOLOGICAL EFFECTS; CARCINOGENS; PYRENE; BENZOPYRENE; BENZANTHRACENE; EPOXIDES; AQUEOUS SOLUTIONS; ABSORPTION; VISIBLE RADIATION; CHEMICAL REACTIONS; CARCINOGENESIS.

76009 Interactions Between Light and Environmental Agents. Chignell, C.F. (Public Health Service, Environmental Biophysics Lab., P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-86. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$29,000.
R and D categories: Health effects.

The photosensitization of exposed tissues such as the skin and eyes is known to result from an interaction between light and various chemical agents in these tissues. Among the agents known to cause photosensitization are drugs, topically applied compounds, natural products of plant origin as well as the aromatic constituents of such mixtures as coal tar. Photosensitization may be characterized either as a phototoxic or a photoallergic response. Phototoxicity is generally manifested immediately after exposure as an exaggerated sunburn. It may be elicited in any individual provided that the amount of chemical and intensity of light are sufficiently high. In contrast the photoallergic response, which is of the delayed hypersensitivity type, is observed in some individuals but not in others. We plan to study the disposition of a number of photosensitizing agents in the skin of experimental animals. For our initial studies a number of model compounds will be employed among which will be several polycyclic aromatic hydrocarbon components of waste effluents from energy-related processes. An attempt will be made to identify those cellular components found in the skin and eyes which function as targets for photosensitizing agents. The fate of these compounds in the skin will be studied as a function of their route of administration (topical vs. parenteral), the wavelength and intensity of light and pretreatment of the animals with other chemical agents such as those which are known to induce xenobiotic metabolism. Studies will also be carried out using cell cultures of cells found in the skin since these should be easier to manipulate.
Keywords: VISIBLE RADIATION; POLLUTION; SYNERGISM; PHOTOSENSITIVITY; SKIN; CRYSTALLINE LENS; TOXICITY; SOLAR FLUX; CHEMICAL REACTIONS; BIOLOGICAL EFFECTS; CELL CULTURES; ULTRAVIOLET RADIATION; CHEMICAL EFFLUENTS.

76010 Effects of Microwave Radiation on Neural Response and the Central Nervous System. McRee, D.I. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-87. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$39,000.
R and D categories: Health effects.

With the possible exception of thermal effects, the basic mechanisms of interactions between microwave radiation and biological systems is still largely unknown. Research is needed to detect and define the effects of microwave radiation on specific tissues and organs. There have been several reports that microwaves can affect the central nervous system and the suggestion has been made that microwave radiation may directly affect neuronal function. We therefore plan to expose isolated nerve preparations to different microwave frequencies, intensities and modulations in an attempt to determine whether microwave radiation has a direct effect on nerve function. One possible site of interaction may be the neuronal membrane since it plays an important role in maintaining the ionic gradients that are necessary for the propagation of electrical impulses. Preliminary experiments in our laboratory have shown that microwave irradiation causes a faster rundown of nerves that are continuously stimulated. We plan to continue these experiments to determine whether microwaves have a direct effect on membrane permeability to cations.
Keywords: MICROWAVE RADIATION; NEUROLOGY; CENTRAL NERVOUS SYSTEM; BIOLOGICAL EFFECTS; PHYSIOLOGY; THERMAL POLLUTION; CATIONS; ORGANS; TISSUES.

76011 Biological Effects of Sixty Hertz Electric Fields. Marino, A.A. (Veteran's Administration Hospital, Irving Avenue and University, Syracuse, NY, 13210). **Project number:** V625F-88. **Contract:** D8-E772-GL. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$33,000.
R and D categories: Health effects.

Sixty hertz electric fields arising from electric power transmission lines are ubiquitously present in the environment. The strength of such fields varies directly with the operation voltage of the transmission line and inversely with the distance from the line. While the specific biological effects of low frequency electric fields are unknown, it is believed that they do act as a general biological stressor. The proposed research will be concerned with the effects of low frequency electric fields on rats. Specific parameters to be studied include serum hydroxcoritcosterone proteins and triglycerides. Growth, development tissue structure, and food and water consumption will also be monitored as a function of field strength and frequency. Reproduction, growth, and development will be measured in three generations of exposed mice.
Keywords: ELECTRIC FIELDS; BIOLOGICAL EFFECTS; HEALTH HAZARDS; POWER TRANSMISSION; POWER TRANSMISSION LINES; MICE; GENETIC EFFECTS.

76012 Tradescantia Mobile Laboratory. Deserres, F.J. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-89. **Contract:** D5-E772-CS. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$175,000.
Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

Further work will be carried out to develop and validate the utility of the mobile mutagen monitoring laboratory in detecting mutagens in ambient air. Preliminary studies have produced promising results in the ability of this system to detect low levels of mutagenic air pollutants such as those which may be produced by the burning of fossil fuels.

Keywords: MUTAGEN SCREENING; AIR POLLUTION; FOSSIL FUELS; COMBUSTION PRODUCTS; ENVIRONMENTAL IMPACTS; BENCH-SCALE EXPERIMENTS; TRADESCANTIA.

76013 Low Dose Toxicity Estimation. Hoel, D.G. (National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC, 27709). **Project number:** V625F-90. **Contract:** D5-E772-CT. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.
R and D categories: Health effects.

The objective is to devise statistical and mathematical methodology to assist in the interpretation of results from toxicological experiments with low dose risk assessment. The initial effort is focusing on the extension of the type of methodological results used in low-dose carcinogenesis extrapolation to teratology studies, where the basic experimental unit is a litter rather than an individual animal. Attempts are being made to fit general classes of curves (e.g., functions that are broad enough to encompass both logit- and probit-type curves) that take litter associations into account to both real and simulated experimental data. Analysis of the results obtained from curve-fitting will hopefully provide easily applied yardsticks against which to assess the safety of chronic exposure to environmental chemicals. Extension of this work will involve the development of simple mechanistic models for various teratologic processes to enhance the biological underpinnings of decision procedures.
Keywords: TOXICITY; FORECASTING; MATHEMATICAL MODELS; STATISTICAL MODELS; CARCINOGENESIS; MUTAGENESIS; TERATOGENESIS; ANIMALS; GENETIC EFFECTS; CHEMICAL EFFLUENTS; DECISION MAKING.

76014 Assessment of Energy Industry Occupational Health Problems. Knowles, D. (HEW, Public Health Service, Division of Respiratory Diseases, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-91. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000. **Related energy source:** all(100). **R and D categories:** Health effects.

Continuing assessment of occupational health problems associated with energy industries is indicated. Replacement of the task order contract approach with an in-house assessment is recommended. Supplemental contracted assistance in certain areas through limited-scope purchase orders or small contracts will provide effort not available in-house. Energy areas requiring assessment are magnetohydrodynamics, power generation, conservation, direct coal burning, and a variety of small energy areas (i.e., oil shale, tar sands, biomass, solar, geothermal, wind power, ocean thermal, tidal power, etc.). The objective of this project is to provide information necessary for use in planning in-depth studies for use in the context of future criteria documents, and for support of the overall NIOSH energy program.
Keywords: ENERGY; OCCUPATIONAL DISEASES; HEALTH HAZARDS; RISK ASSESSMENT; MAGNETOHYDRODYNAMICS; POWER GENERATION; ENERGY CONSERVATION; COAL; COMBUSTION; OIL SHALE INDUSTRY; OIL SANDS; BIOMASS; SOLAR ENERGY; GEOTHERMAL ENERGY; WIND TURBINES; TIDE; INDUSTRIAL MEDICINE.

76015 Industrial Hygiene Study of Solar Energy Component Manufacturers. Boeniger, M. (HEW, Public Health Service, Division of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-92. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$145,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment; Health effects.

A new technology which will be playing an increasing role in meeting this country's energy demands will be the utilization of solar energy cells for direct conversion of sunlight to electricity. While rapid technological developments are occurring in this field, the present view is that the silicon and cadmium sulfide type photovoltaic cells will dominate the future market. Though photovoltaic conversion of solar energy still plays a very minor role in the total energy supply, it will probably make dramatic gains in the near future. For instance, at the close of 1975, approximately 10 kw from terrestrial applications was obtained from solar cells while in 1977, 650 kw are anticipated. Major declines in cost of these cells with moderate increases in efficiency are foreseen and will further their acceptance. Corresponding manpower demands would also be expected. The production of the final solar collection panel is preceded by many refining steps. Potential health hazards exist, beginning with the initial mining and purification of cadmium and silica bearing ore, the growth and doping of the crystals with boron or phosgene, polishing the crystals with strong acids and caustics, to the installation of the crystals within collection panels. Employee exposures and environmental health aspects in all these refining processes should be evaluated while the industry is still in its infancy. Establishment of practicable production guidelines for the safeguard of employees health and safety would allow this industry to develop without detrimental side effects.
Keywords: SOLAR ENERGY; HEALTH HAZARDS; PHOTOVOLTAIC CELLS; SILICON; CADMIUM SULFIDES; INDUSTRY; BORON; OCCUPATIONAL SAFETY; PERSONNEL; RISK ASSESSMENT; AIR POLLUTION; INHALATION.

76016 Control Technology Assessment for Energy. Gideon, J. (National Institute for Occupational Safety and Health, Division of Physical Sciences, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-93. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The increasing demand for and decreasing supply of fossil fuel sources will have a significant impact on the workplace. The objective of NIOSH energy related research is to assure that this impact will not include increased exposure to occupational hazards. A study of the control technology used in pulp and paper manufacturing ring processes will be conducted in order to provide an understanding of energy-effective control options. Monitoring systems which can be used for workplace air and/or recirculation systems will be studied. The control technology which should be built into present and future coal gasification and liquefaction plants will be documented and evaluated. The nature and control of diesel emissions in the context of mining operations will be studied in a cooperative effort with the Bureau of Mines.
Keywords: ENERGY CONVERSION; POLLUTION CONTROL; TECHNOLOGY ASSESSMENT; OCCUPATIONAL DISEASES; HEALTH HAZARDS; ENVIRONMENTAL IMPACTS; PAPER INDUSTRY; MONITORING; AIR CLEANING; DIESEL ENGINES; COAL MINING; EQUIPMENT; POLLUTION CONTROL EQUIPMENT.

76017 Mortality, Morbidity and Industrial Hygiene Study of Oil Shale Workers. Costello, J. (HEW, Public Health Service, Division of Respiratory Disease, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-94. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA. **Related energy source:** oil shales and tar sands(100). **R and D categories:** Health effects.

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 a total of 429 men who work at Anvil Points oil shale retort and 15 men who worked at the Union Oil Retort in Colorado in the 1950's and 1960's. The project will consist of a mortality study (in-house) and a morbidity study (outside contract). The mortality study will compare the mortality patterns among the male, caucasian, shale oil workers cohort with the mortality patterns of U.S. white males. Comparisons will also be made between those in the study group with high and low exposure to shale oil. The morbidity study will compare the morbidity patterns among the male, caucasian, shale oil worker cohort with the morbidity patterns of a matched control group from the Colorado Plateau (age, race, smoking, skin complexion, years on the Colorado Plateau, and time spent in outdoor activities). High and low shale oil exposure groups would be compared. Attempts to develop exposure indicies in both the mortality and morbidity studies will be made. Representaties of EIB will continue to work with representatives of the USSR on the health effects of oil shale development. Contact will be made with individuals knowledgeable in oil shale technology and involved in industrial hygiene studies related to oil shale processing.
Keywords: OIL SHALE INDUSTRY; PERSONNEL; OCCUPATIONAL DISEASES; MORTALITY; HEALTH HAZARDS; COLORADO; OIL SHALES; MALES.

76018 Industrial Hygiene Study of Resource Recovery Energy Systems. Knowles, D. (HEW, Public Health Service, Division of Respiratory Diseases, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-95. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

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.
Keywords: RESOURCE CONSERVATION; MATERIALS RECOVERY; RECYCLING; HEALTH HAZARDS; OCCUPATIONAL DISEASES; INDUSTRIAL MEDICINE; AIR POLLU-

TION; PARASITES; TOXIC MATERIALS; PARTICLES; AEROSOLS; GASEOUS WASTES; NOISE POLLUTION.

76019 Mortality and Industrial Hygiene Study of Workers in Coal Fired Power Plants: TVA. Ortmeyer, C. (National Institute of Occupational Health, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-96. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Health effects.

Pulmonary diseases and impairment such as airway obstructive diseases and pneumoconiotic lesions, could arise in part from exposures to gases emitted during coal combustion and from coal dust when coal is burned as fuel for steam-powered electricity-generating plants. Those workers who handled the asbestos sheets used to insulate steam pipes may also show evidence of health damage - asbestosis or malignancies. In order to conduct research on occupational safety and health problems of TVA employees, a memorandum of understanding between the NIOSH and TVA was signed in 1976 specifying overall responsibilities for cooperative studies. Sub-agreement I under this memorandum established industrial hygiene studies of workers in coal-fired power plants. The TVA will conduct detailed cross-sectional industrial hygiene studies of workers on selected occupations. Existing industrial hygiene data of past exposures, along with information on control methods will be reviewed in order to retrospectively estimate cumulative working lifetime exposures in occupations where there has been exposure to attempt dose assessment for mortality studies of workers exposed to the same pollutants in the past. The Environmental Investigations Branch will monitor all stages of this study. Sub-agreement II, Epidemiological Mortality Study of TVA Employees, is being carried out to estimate the effects in terms of higher-than-expected death rates and/or early retirement due to disability involving principally cardiopulmonary disease or specified malignancies linked to earlier exposures to air contaminants in the workplace environment. All permanent male employees of the TVA with 5 or more years of employment (at least 2 of those years consecutive), and employed sometime between 1 Jan 1955, and 31 Dec 1972, will be included in the cohort for the study. Required demographic data (age, sex, etc.), most recent and previous addresses, detailed work-histories within TVA, and information about dates and causes of deeath or of early retirement will be obtained.
Keywords: FOSSIL-FUEL POWER PLANTS; OCCUPATIONAL DISEASES; PERSONNEL; MORTALITY; ASBESTOS; DUSTS; NEOPLASMS; DATA ACQUISITION; HEALTH HAZARDS; RISK ASSESSMENT; EPIDEMIOLOGY; LUNGS; CARDIOVASCULAR SYSTEM.

76020 Develop Personal Sampler Performance Specifications. Smith, J. (National Institute for Occupational Safety and Health, Division of Physical Sciences, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-97. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA. **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The evaluation of personal aerosol sampler bias as a function of design specifications is becoming more important as the airborne aerosol concentration of interest decreases and the number of commercially available samplers increases. Also, samplers designed to operate in one specified particulate regime could systematicaly bias results when used to sample in another regime. This project investigates the design specifications and sampling parameters as they effect the indicated concentration of hazardous, airborne substances. Theoretical analysis of the problem is completed, and the results are tabulated into a set of performance specifications for personal aerosol samplers. The specifications are then used for the laboratory evaluation and comparison of an ideal personal aerosol sampler and commercially available models.
Keywords: AEROSOL MONITORING; AIR POLLUTION MONITORS; PERSONNEL; HAZARDOUS MATERIALS; POLYCYCLIC AROMATIC HYDROCARBONS; SAMPLING.

76021 Medical and Industrial Hygiene Study of Workers Exposed to Manganese. Leffingwell. (National Institute for Occupational Safety and Health, Division of Surveillance Hazards, 4676 Columbia Parkway, Cincinnati, OH, 45266). **Project number:** V625F-98. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring; Health effects.

Manganese and its compounds are widely used in alloy making, the chemical industry ceramics, animal feed, etc. Manganese exposures are found in ore mining, ore processing, and in many industrial works in which manganese fumes and dusts are generated. Manganese poisoning is a very insidious and disabling disease. The current standard is a ceiling limit of 5 mg/cubic meter. In view of lack of definite documentation, there is a suspicion that chronic exposure at about this level may result in neurological abnormalities. This study will consist of a cross-sectional medical and industrial hygiene evaluation of workers exposed to 1 to 10 mg/cubic meter range of manganese in various occupations. Medical evaluation will include neurological and psychological testing to detect abnormalities. Together with blood/urine manganese determinations, such test results will be evaluated in the light of environmental data. This study will be of considerable use in the preparation of the Manganese Criteria Document.
Keywords: MANGANESE; HEALTH HAZARDS; OCCUPATIONAL DISEASES; MANGANESE ALLOYS; ANIMAL FEEDS; CERAMICS; PERSONNEL; TOXICITY; BEHAVIOR; MEDICAL SURVEILLANCE; BIOLOGICAL ACCUMULATION; BLOOD; LIVER.

76022 Industrial Hygiene Study of Coal Gasification Plants. Williams, J. (HEW, Public Health Service, Division of Respiratory Diseases, 944 Chestnut Ridge Road, Morgantown, WV, 26505). **Project number:** V625F-99. **Contract:** D8-E773-CX. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$324,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

This project, to be performed by contract, was originally awarded to Bendix, but cancelled by convenience of the government. A new contract has been awarded to Enviro Control. It will be an in-depth industrial hygiene characterization of worker environments in two 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, personal, 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. A final report for each pilot plant will be submitted by the contractor and will include: (1) past and present worker exposure (by job) constructed on the information that is collected on the changes in processing, ventilation, and environmental control work practices; (2) industrial hygiene practices at the facilities; (3) time-weighted and peak concentrations found in the workplace of each job type; (4) recommendations for control of worker exposures; (5) identification of worker design parameters for worker protection controls to be integrated in demonstration and commercial plant designs; and (6) identification of additional problem areas in the coal conversion industry requiring further research. Synthane (Bi-Btu) and combustion engineering (Lo-Btu) have been designated. An initial walk-through at synthane has been done and limited sampling undertaken.
Keywords: COAL GASIFICATION PLANTS; HEALTH HAZARDS; INDUSTRIAL MEDICINE; OCCUPATIONAL DISEASES; DATA COMPILATION; WORKING CONDITIONS; PERSONNEL; HYDROCARBONS; TOXICITY.

76501 Impact of Impingement and Entrainment on Lake Michigan Fish Populations. Spigarelli, S.A. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** EPA-IAG-D7-01184. **Supported by:** Environmental Protection Agency, Chicago, IL (USA). Region V. **Funding:** EPA-$40,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

The objectives are: (1) to assess the lake-wide impacts of water intakes on selected fish species in Lake Michigan; (2) to identify inadequacies in available data; and (3) to recommend research needed to improve the data base. Estimates of fish impingement and entrainment rates obtained from power plant 316(b) studies will be combined with available fish population data to develop models that simulate impacts on species populations. The effects of all power plant, industrial and municipal water intakes will be included in the assessment. Impact simulations (projections) will be developed and used as regulatory tools by the US EPA. A final report summarizing the study results will be submitted to EPA in mid-1979.
Keywords: IMPINGEMENT; ENTRAINMENT; FISHES; LAKE MICHIGAN; COOLING SYSTEMS; INTAKE STRUCTURES; POWER PLANTS; ENVIRONMENTAL IMPACTS; THERMAL EFFLUENTS; MATHEMATICAL MODELS; BEHAVIOR.

76502 Organic Compound Characterization: Indiana Harbor Canal Samples. Raphaelian, L.A.; Harrison, W. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** EPA-IAG-D7-F1049. **Supported by:** Environmental Protection Agency, Chicago, IL (USA). Region V. **Funding:** EPA-$8,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization,

measurement, and monitoring; Physical and chemical processes and effects.

The objective is to trace pollutants in Indiana Harbor Canal and their transport in a sinking plume to the City of Chicago water intakes. This will be accomplished through collection of samples during a sinking plume episode at various depths at various locations in the lake and collection of samples of intake water and identification of organic pollutants by capillary column gas chromatography mass spectrometry. Three samples from the Indiana Harbor Canal, The Grand Calumet River, and the intake of the South Water Filtration Plant, were analyzed and the results reported to U.S. EPA, Region V.

Keywords: INDIANA; WATER QUALITY; CHICAGO; DRINKING WATER; ORGANIC COMPOUNDS; ENVIRONMENTAL TRANSPORT; WATER POLLUTION.

76503 Characterization of Trace Organic Contaminants in the Environment of Saginaw Bay, Lake Huron. Raphaelian, L.A.; Harrison, W. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** EPA-IAG-DG-0066. **Supported by:** Environmental Protection Agency, Grosse Ile, MI (USA). Large Lakes Research Station. **Funding:** EPA-$40,000.

Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to characterize trace organic contaminants from energy intensive industrial activities in surface films, water column, sediments, plankton, fish, and birds of Saginaw Bay, Michigan. Samples will be collected at sixteen stations on Saginaw Bay. Pollutants will be isolated by liquid--liquid extraction. Organic pollutants will be identified by capillary column gas chromatography mass spectrometry. A variety of pesticides, polynuclear aromatic hydrocarbons, plasticizers and other pollutants have been found. Concentrations appear to be highest in the fish and other fauna and in bird eggs. Work is continuing on additional samples.

Keywords: LAKE HURON; ORGANIC COMPOUNDS; WATER QUALITY; SAMPLING; POLYCYCLIC AROMATIC HYDROCARBONS; PLASTICIZERS; ECOLOGICAL CONCENTRATION; FISHES; AQUATIC ORGANISMS; EGGS; BIRDS; SEDIMENTS; AQUATIC ECOSYSTEMS; CHEMICAL ANALYSIS.

77081 Effect of Low Levels of Sulfuric Acid Mist Exposure on Human Pulmonary Function. Horvath, S.M. (University of California at Santa Barbara, Inst. for Environmental Stress, Santa Barbara, CA, 93106). **Project number:** H625F-7161. **Contract:** R804853. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$449,000.

Related energy source: coal(34); oil and gas(33); oil shales and tar sands(33). **R and D categories:** Health effects.

The aim of this investigation is to examine the effects of acute exposure to H2SO4 mist in humans and some of the factors affecting toxicity - temperature, humidity, and duration of exposure. The subjects will be exposed in an environmental chamber to either filtered air 0.20 mg/cubic meter or 0.40 mg/m cubic meter of H2SO4 under four conditions of temperature and humidity; 18 degrees C, 45% rh; 35 degrees C, 85% rh; 35 degrees C, 45% rh; and 35 degrees C, 88% rh. Subjects will exercise intermittently at 25% of their maximum capacity during the exposure period. Pulmonary function tests will be performed before, during, and after exposure. Some aspects of cardiovascular performance will be assessed during the exposure exercise periods. The final report of this study will provide the agency with important information on the effects of acid aerosol exposure in man.

Keywords: SULFURIC ACID; VAPORS; LUNGS; HEALTH HAZARDS; INHALATION; PHYSIOLOGY.

77505 Sorption Properties of Soils and Energy-Related Pollutants. Means, J.C. (University of Illinois, Institute for Environmental Studies, 408 S. Goodwin, Urbana, IL, 61801). **Project number:** K625B-215. **Contract:** 68-03-2555. **Supported by:** Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab. **Funding:** EPA-$1,000.

Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

This two-year study will center on the study of sorption properties of energy-related organic pollutants and various types of soils and sediments. The study will include a detailed review of the literature on soil sorption of organics and the preparation of a critical review on the subject. Laboratory studies will be conducted on 14 sediment samples of varying types and characteristics with at least 11 organic compounds having a broad range of chemical properties. Sorption isotherms for each compound on soil/sediment will be determined using radiolabelled chemicals. Statistical analyses of the data will be run using multivariant analysis to determine if chemical properties and soil/sediment properties can be related to yield predictive information about the behavior of other compounds on the soils studied. To date the literature review phase of the work has been completed and the series of the sediments have been collected and characterized. Final results will include a data set on 11 compounds and 14 test sediments which will be used to evaluate the role of sorbate solubility, octanol/water partition coefficient, molecular charge and the sediment properties, organic carbon content, particle size, CEC, and mineralogic makeup in determining sorptive characteristics of energy-related compounds in the natural sediments. Results will be expressed in the form of quantitative mathematical relationships.

Keywords: SOILS; SORPTIVE PROPERTIES; POLLUTION; ENVIRONMENTAL TRANSPORT; ORGANIC COMPOUNDS; HYDROCARBONS; LABELLED COMPOUNDS; SEDIMENTS.

77547 Interactions of Metal Ions with Organic Ligands in Natural Waters. (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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

78001 In-Stack Diffusion Classification for Aerosol Size Distribution Measurement. Lundgren, D.A. (University of Florida, Dept. of Environmental Engineering, 220 Black Hall, Gainesville, FL, 32611). **Project number:** G712B-BC-50. **Contract:** R805762-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$34,000.

Related energy source: all(100).

The principal objectives of this project are to design, construct, calibrate and field evaluate an in-stack diffusion classification device which can operate under adverse environmental conditions of temperature, pressure, moisture content, and gas composition. After a careful study of known or suspected operational problem areas, a prototype device will be constructed and calibrated in the laboratory. This device will then be field tested and evaluated on several types of industrial effluent gas streams. The final output will be an in-stack diffusion classifier. Preliminary field testing was conducted using a laboratory type system. The system worked and demonstrated that the concept is practical for field use and can produce the desired submicron aerosol mass distribution data.

Keywords: STACK DISPOSAL; AIR POLLUTION CONTROL; AEROSOLS; PARTICLE SIZE; AIR POLLUTION MONITORS; PERFORMANCE TESTING; CALIBRATION; DESIGN; POWER PLANTS.

78002 Workshop on Primary Sulfate Emissions from Combustion Sources. Mitchell, A. (Kappa Systems Inc., 1501 Wilson Blvd., Arlington, VA, 22209). **Project number:** G712B-BC-52. **Contract:** 68-02-1944. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$22,000.

Related energy source: coal(50); oil and gas(50). **R and D categories:** Characterization, measurement, and monitoring.

The objectives are to coordinate and implement a workshop on measurement techniques and characterization of primary sulfate emissions from combustion sources; and to produce a proceedings of the workshop. A 3-day meeting will be scheduled with one day devoted to paper presentations by investigators on their research activities on measurement techniques; one day for presentations on emission characterization data; and one day for working groups to critique paper presentations, to review current status of research and

development, and to make recommendations on future efforts needed in each area. Proceedings are being prepared and will include recommendations of ad hoc working groups. Workshop was held on April 24--26 in Southern Pines, North Carolina. Thirty-one invited papers were presented.
Keywords: COMBUSTION PRODUCTS; MEASURING METHODS; AEROSOL MONITORING; MEETINGS; SULFATES; FLUE GAS; COAL INDUSTRY; WASTE MANAGEMENT; ENVIRONMENTAL IMPACTS; AIR POLLUTION.

78003 Fuel Economy and Emissions Performance of Diesel Automobiles. Gibbs, R.E. (New York State Department of Environmental Conservation, 50 Wolf Road, Albany, NY, 12205). **Project number:** G712B-BC-53. **Contract:** R805934-01. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$76,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.

The objective of this project is the collection of comprehensive emissions and fuel consumption data from a group of fifteen diesel-powered light-duty vehicles in consumer driving. Vehicles will be tested at periodic intervals throughout 18 months of mileage accumulation in normal use. At each test point measurements will include: regulated emissions, fuel consumption, particulate mass, and detailed chemical analysis of particulate and mutagenic activity of particulate extracts by the Ames method. Chemical analysis of diesel particulate will utilize high-pressure liquid--liquid chromatography to prepare extract fractions. Gas chromatography and gas chromatography/mass spectrometry of these fractions will be used to establish correlation of compound and compound groups with mutagenic activity results from Ames tests of these same fractions. On-board fuel meters and data storage will provide comparison of laboratory fuel consumption data to in-use performance. Additional testing for emissions and fuel consumption will be performed after overnight coldsoak at prevailing ambient conditions to establish the effect of seasonal variations on fuel consumption, regulated and particulate emissions.
Keywords: FUEL ECONOMY; AUTOMOBILES; DIESEL ENGINES; EXHAUST GASES; FUEL CONSUMPTION; PARTICLES; CHEMICAL ANALYSIS; PERFORMANCE.

78004 Characterization of Gaseous Emissions from Stationary Sources by Remote Sensing. Herget, W.F. (EPA, Office of Research and Development, Special Techniques Group, Research Triangle Park, NC, 27711). **Project number:** G712B-BD-17. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$20,000.
R and D categories: Characterization, measurement, and monitoring.

The objectives are to use ground-based remote sensing methods to determine species identity and concentration of gaseous pollutants emitted by point and extended area stationary sources and to determine optimum spectral regions for monitoring specific pollutants. Longpath high-resolution infrared spectroscopy will be used in absorption and emission to determine the spectral characteristics of gaseous pollutants emitted by a variety of sources. Laboratory spectra of various species will be obtained to assist in species identification and concentration determinations. Longpath gas-filter correlation methods will also be used. Measurements using a grating spectrometer have been made at coal-burning power plants, incinerators, gas purification plants and carbon black plants. The grating spectrometer has been replaced with a Fourier transform spectrometer to greatly increase spectral resolution and sensitivity. A variety of sources will be studied in future years.
Keywords: REMOTE SENSING; FLUE GAS; AIR POLLUTION; POINT POLLUTANT SOURCES; INFRARED SPECTRA; OPTICAL PROPERTIES; REFLECTIVITY; VISIBLE RADIATION; GASEOUS WASTES; WASTE MANAGEMENT; FOSSIL-FUEL POWER PLANTS; QUANTITY RATIO; INCINERATORS; PURIFICATION; NATURAL GAS; COAL.

78005 Synthesis and Purification of Polynuclear Aromatic Compounds. Eisenbraun, E.J. (Oklahoma State University, Department of Chemistry, Agricultural Hall, Stillwater, OK, 74075). **Project number:** G712B-BE-04. **Contract:** R805419. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA-$40,000.
R and D categories: Health effects.

The synthesis and/or purfication of high-purity (99.9 percent goal) polynuclear aromatic compounds, chiefly hydrocarbons, for possible use as analytical standards, is proposed. These hydrocarbons are of the types found in the products of incomplete combustion (automobile exhaust gases, stack gases, cooking operations), still bottoms, and heavy fuel oil from spills, and hence appear as environmental pollutants. In general, known synthesis routes will be used, but their improvement will be sought through use of new reagents and techniques. High-pressure liquid chromatography and/or zone refining will be included in the purification procedures. Modern analytical techniques (GLC, LC, TLC, nmr, mass, and other spectrometric techniques) will be used for identifying compounds and establishing the purity of the synthesis products. Twenty compounds have been produced during the life of this project. These compounds have been requested by a number of organizations.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; SYNTHESIS; STANDARDS; PURIFICATION; HYDROCARBONS; AUTOMOBILES; EXHAUST GASES; FLUE GAS; COMBUSTION.

78006 Mathematical Methods for X-Ray Analysis. Gardner, R.P. (North Carolina State University, Dept. of Nuclear Engineering, Raleigh, NC, 27607). **Project number:** G712B-BE-60. **Contract:** R802759. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. **Funding:** EPA.
R and D categories: Characterization, measurement, and monitoring.

The objective is to develop mathematical methods for the analysis of x-ray fluorescence spectrum to determine the elemental content of particulate pollutants. This will include developing methods to correct for gain shift, baseline drift, interelement effects, and background subtraction.
Keywords: X-RAY FLUORESCENCE ANALYSIS; MATHEMATICAL MODELS; PARTICLES; POLLUTION CONTROL; GAIN; GROUND WATER.

78007 Compare Pulmonary Carcinogenicity of Pt-Group Compounds and of Pb M Association with Polynuclear Aromatics Using In Vivo Hamster System. Kuschner, M. (State University of New York, Health Science Center, Department of Pathology, Stony Brook, NY, 11790). **Project number:** H601B-7115. **Contract:** 68-02-1299. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(100). **R and D categories:** Health effects.

The objective of this contract is to determine the biologic activity of platinum, specifically the metallic oxide, on the induction of pulmonary neoplasia by a known hydrocarbon carcinogen, benzo(a)pyrene. The data derived from this investigation is to be used in evaluating the potential human health hazard associated with the use of an automotive engine employing a platinum catalytic muffler. In addition, it is the purpose of this contract to examine the action of a lead compound in this same role. This investigation will thereby serve to compare the possible role as a cofactor in carcinogenesis of one of the presently emitted substances, lead, with a substance which might be added de novo to the exhaust stream as a consequence of mandated modifications in the automotive engine. Syrian golden hamsters were given multiple exposures via intratracheal instillation to the agents mentioned above. The comparison cited above was augmented by an exposure group receiving ferric oxide + Pb to serve as both a positive control in the system, and as an index of the ability of either platinum or lead to replace Fe2O3 as a cofactor in the carcinogenesis model. This study is completed and a final report is in preparation.
Keywords: LUNGS; NEOPLASMS; PATHOLOGICAL CHANGES; LEAD; PLATINUM; BENZOPYRENE; CARCINOGENESIS; BIOLOGICAL MODELS; CATALYTIC CONVERTERS; HEALTH HAZARDS; RISK ASSESSMENT; SYNERGISM; HAMSTERS; METABOLISM; BIOLOGICAL EFFECTS.

78008 Operation and Maintenance of the Community Health Air Monitoring Program (CHAMP) Including Mobile Units. Sullivan, R.J. (Xonics, Inc., Environmental Systems Division, 6911 Hayvenhurst Avenue, Van Nuys, CA, 91406). **Project number:** H601C-7226. **Contract:** 68-02-2493. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$340,000.
R and D categories: Integrated assessment; Health effects.

The objective is to quantitatively characterize ambient air pollutants in selected health study communities. A CHAMP monitoring site (fixed or mobile) is located within each study community to obtain measurements representative of the air pollutant exposure of residents within the community. The system utilizes automatic continuous air quality measurement instruments. This contract provides for continuing operation and maintenance of the CHAMP system as necessary to support health studies. Appropriate ambient air quality data have been collected for oxides of nitrogen, sulfur dioxide, carbon monoxide, ozone, hydrocarbons, total particulates, respirable particulates, and meteorological information in support of Population Studies Division's epidemiology program.
Keywords: AIR POLLUTION; MONITORING; HUMAN POPULATIONS; EPIDEMIOLOGY; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; PARTICLES; AEROSOLS; DUSTS; OZONE; ECOLOGICAL CONCENTRATION; HEALTH HAZARDS.

78009 Study of the Toxic Effects of Combustion Gases. Jonek. (Silesian Academy of Medicine, Ul. Poniatowskiego 15, Katowice,

Poland). **Project number:** H601C-7236. **Contract:** JB5-533-11. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA. **R and D categories:** Health effects.

The purpose of this research project is to determine the effect of NO2 on guinea pigs using various times and concentrations of NO2. Evaluation of a number of physiological systems will be made. These will include the following general parameters: hematology, biochemistry, histochemistry, and anatomopathology of several tissues and fluids. Other sensitive tests will be developed and used.
Keywords: COMBUSTION PRODUCTS; TOXICITY; NITROGEN DIOXIDE; GUINEA PIGS; METABOLISM; PHYSIOLOGY; PATHOLOGICAL CHANGES; BIOASSAY.

78010 Studies on the Effects of Air Pollution Exposures on Mortality Variation in Major Metropolitan Areas. Riggan, W.B. (EPA, Office of Research and Development, Population Studies Division, Research Triangle Park, NC, 27709). **Project number:** H601C-7241. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$45,000.
R and D categories: Health effects.

A series of studies on the effect of air pollution exposure on daily mortality variation in selected major metropolitan areas are continuing. Special consideration is given and adjustments are made for weekly and annual cycle, temperature, precipitation, influenza outbreaks, accidental deaths, and holidays. At present, work is focused on upper Ohio River Valley counties. The findings will be presented in a series of reports.
Keywords: AIR POLLUTION; MORTALITY; HUMAN POPULATIONS; URBAN AREAS; HEALTH HAZARDS; ENVIRONMENTAL EFFECTS.

78011 Effects of Controlled Ozone Exposure on Human Immunity. Peterson, M.L. (EPA, Office of Research and Development, Clinical Pathology Branch, Research Triangle Park, NC, 27709). **Project number:** H601C-7262. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$2,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to develop sensitive techniques for assessing the effects of ozone on cellular defense mechanisms in humans exposed under controlled environmental conditions. Measurements include changes in cellular components of peripheral blood lymphocytes and neutrophils such as changes in DNA and RNA synthesis, membrane markers, cytotoxicity and phagocytoxic/microbicidal integrity of these cells. Exposures to low concentrations of ozone have a transient suppressive effect on immunocompetent cells in humans.
Keywords: OZONE; TOXICITY; HEALTH HAZARDS; HUMAN POPULATIONS; IMMUNITY; MICROORGANISMS; INFECTIVITY.

78012 Examine Influence of NO2 and O3. Hu, P. (EPA, Office of Research and Development, Health Effects Research Lab., Clinical Studies Division, Research Triangle Park, NC, 27709). **Project number:** H601C-8386. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$90,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Health effects.

The proposed research is designed to test the effects of air pollutants (NO2, O3, etc.) on the host-parasite interaction during respiratory infections using Mycoplasma pneumoniae infection of Syrian hamsters as the experimental model. The objectives of this work are three-fold: (1) to determine how various air pollutants affect the deposition and clearance of M. pneumoniae from the pulmonary tract; (2) to examine the effect of air pollutants on the histopathological changes of pulmonary tissue during the course of disease production; and (3) to establish a model system for evaluation of the effect of air pollutants on the development of protective immunity against a respiratory surface antigen. This model system, when developed, will provide an ideal model system to assess the effects of environmental pollutants on chronic respiratory infection in respect to the course of disease production and the development of protective immunity in the pulmonary tract. Baseline study on the deposition and clearance patterns has been established. Preliminary data indicate that O3 at 1 ppM for a 3-hour exposure retarded the rate of clearance of M. pneumoniae from respiratory tract. A solid-phase radioimmunoassay has been established which will be used to measure the antibody level in the respiratory tract of the infected animals under the stress of air pollutants.
Keywords: NITROGEN DIOXIDE; OZONE; AIR POLLUTION; ENVIRONMENTAL IMPACTS; BIOLOGICAL EFFECTS; HOST; PARASITES; INFECTIVITY; RADIOIMMUNOASSAY; RESPIRATORY SYSTEM; IMMUNITY; PATHOLOGICAL CHANGES.

78013 Ultrastructure and X-Ray Microanalysis of Macrophages Exposed to Noncriteria Pollutants with Emphasis on Certain Metal Compounds. Shelburne, J.D. (Duke University, Department of Pathology, Box 3711, Durham, NC, 27706). **Project number:** H601D-7316. **Contract:** R805460. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Health effects.

A critical problem in correlating the results of chemical analyses and biological screening tests with respect to the potential biohazards of a given crude sample is the degree to which the biological availability of the sample is understood. That is, we need to know the nature of surface chemistry and the potential of a complex sample to release components to biological fluids and tissues. The objective of the contract is to expose rabbit alveolar macrophages (RAMS) in vitro to a variety of elements (specifically cadmium, vanadium, nickel, manganese, chromium, iron, lead, copper, and zinc) at differing concentrations and times, and to a variety of particles (both fly-ash particles coated with known elements and representative elements selected from urban air) in order to define morphologically the subcellular reaction of these macrophages to injury. Electron probe microanalysis is being used to study the morphology and distribution of the toxic elements in question. Consequently, a parallel and important objective of this work is to examine in detail the limitations and usefulness of a number of microhistological techniques from a qualitative and semi-quantitative point of view in order to optimize techniques for the identification, localization, and distribution of these elements. Techniques have been established for the cultivation of macrophages on strips of aluminum or gold foil with subsequent embedding of one side of the foil in epon. Excellent thin sections have been obtained without interferring metal. Snap freezing in liquid propane has effectively avoided metal translocation and has made it possible to detect and quantitate metals within cellular organelles of macrophages. The techniques will now be applied to cells exposed to metal containing particulate materials.
Keywords: METALS; MACROPHAGES; RABBITS; IN VITRO; CADMIUM; VANADIUM; NICKEL; MANGANESE; CHROMIUM; IRON; LEAD; COPPER; ZINC; METABOLISM; BIOLOGICAL EFFECTS.

78014 In Vitro and In Vivo--In Vitro Systems for Determining Potential Carcinogenicity and Cocarcinogenicity of Environmental Agents. Nesnow, S. (EPA, Office of Research and Development, Metabolic Effects Section, Research Triangle Park, NC, 27709). **Project number:** H601D-7318. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$135,000.
R and D categories: Health effects.

The objective of this program is to develop an augmented internal activation system for C3H10T1/1Cl8 cells, an oncogenic transformation bioassay. Studies will be implemented to stimulate the cell's own enzymatic machinery to metabolize different classes of chemical carcinogens to their active forms. The mechanism of action of naphthalene quinones, inhibitors of microsomal enzymes and chemical carcinogenesis will also be investigated. A series of inducers of enzymes which metabolize carcinogens were applied to cultures of mouse embryo C3H10T1/2Cl8 cells in an effort to identify their use as agents which would increase the sensitivity of this cell system to carcinogens. This was measured by observing their effects on benzo(a)pyrene mediated cytotoxicity. A complete dose response for each agent in the presence and absence of BaP was evaluated. Pregnenolone-1 and phenobarbital were the agents tested. Transformation experiments with these agents are currently underway. The mechanism of the inhibition of benzo(a)pyrene mediated cytotoxicity and transformation by naphthalene quinones was further explored. The quinones strongly inhibit the enzymes which metabolize benzo(a)pyrene and it is this phenomena which probably explains the observed biological effects. The site or sites in the electron transport chain in which these quinones interact has been studied. These quinones increase enzymic NADPH oxidation and do not inhibit enzymic cytochrome C reduction. 1,2-Naphthoquinone can also catalytically oxidize NADPH and reduce cytochrome C but the magnitude of these effects does not explain inhibition of mixed function oxidase activity.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; HEALTH HAZARDS; CARCINOGENS; METABOLISM; BIOASSAY; ENZYMES; INHIBITION; TOXICITY; CELL CULTURES; BENZOPYRENE; PHENOBARBITAL; ORGANIC CHLORINE COMPOUNDS; BIOCHEMICAL REACTION KINETICS; HYDROCARBONS; AEROSOLS; PARTICLES; DUSTS; METALS; PESTICIDES; HERBICIDES.

78015 Coordinate Intramural Efforts Associated with CHAMP Contract Activities. Hinton, D.O. (EPA, Office of Research and Development, Population Studies Division, Research Triangle Park, NC, 27709). **Project number:** H601D-7321. **Supported by:** Environ-

mental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$45,000.
R and D categories: Integrated assessment; Health effects.

The objective is to manage efforts in connection with EPA Contract 68-02-2493. In-house activities consist of: (1) tracking routine items of cost, logistics, equipment, and data collection; (2) approval of station sites; and (3) quality assurance of instrument performance and data validation associated with pollutants. Averages will be compiled of ambient air pollutant concentrations and associated meteorological data by hour and/or day as required to support specific epidemiological studies.
Keywords: SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; PARTICLES; AEROSOLS; DUSTS; OZONE; ENVIRONMENTAL TRANSPORT; DATA ACQUISITION; AIR POLLUTION; QUALITY ASSURANCE; MONITORING; AIR POLLUTION MONITORS; EPIDEMIOLOGY.

78016 Operation and Maintenance of the Community Health Air Monitoring Program (CHAMP) Including Mobile Units. Sullivan, R.J. (Xonics, Inc., Environmental Systems Division, 6911 Hayvenhurst Avenue, Van Nuys, CA, 91406). **Project number:** H601D-7337. **Contract:** 68-02-2493. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$750,000.
R and D categories: Integrated assessment; Health effects.

The objective is to quantitatively characterize ambient air pollutants in selected health study communities. A CHAMP monitoring site (fixed or mobile) is located within each study community to obtain measurements representative of the air pollutant exposure of residents within the community. The system utilizes automatic continuous air quality measurement instruments. This contract provides for continuing operation and maintenance of the CHAMP system as necessary to support health studies. Appropriate ambient air quality data have been collected for oxides of nitrogen, sulfur dioxide, carbon monoxide, ozone, hydrocarbons, total particulates, respirable particulates, and meteorological information in support of Population Studies Division's epidemiology program.
Keywords: AIR POLLUTION; MONITORING; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; PARTICLES; AEROSOLS; DUSTS; ECOLOGICAL CONCENTRATION; HEALTH HAZARDS; EPIDEMIOLOGY; HUMAN POPULATIONS.

78017 Uptake and Distribution of Mn Following Chronic Mn3O4 Exposure. Laskey, J.W. (EPA, Office of Research and Development, Health Effects Research Lab., Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H601E-7824. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA. **Related energy source:** oil and gas(50); oil shales and tar sands(50). **R and D categories:** Integrated assessment; Health effects.

The objective is to evaluate the uptake and distribution of heavy metals administered chronically in the diet or drinking water. Specific attention will be given to placental transfer, milk transfer, and accumulation in the young and pregnant animal (rat). Data will be used to evaluate potential hazard from the use of the fuel additive MMT which when combusted is emitted as Mn3O4. Mn uptake (retention) from Mn3O4 is relatively high (20%) in the young animal as compared to the older animal (2%).
Keywords: MANGANESE OXIDES; MANGANESE; UPTAKE; DISTRIBUTION; DIET; DRINKING WATER; CONTAMINATION; FETUSES; HEALTH HAZARDS; FUEL ADDITIVES; ENVIRONMENTAL TRANSPORT.

78018 Changes in CNS Following Chronic Pb and/or Cd Exposure. Herman, Z.S. (Silesian Academy of Medicine, Department of Pharmacology, Ul. Poniatowskiego 15, Katowice, Poland). **Project number:** H601E-7832. **Contract:** JB5-531-1. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA.
Related energy source: oil and gas(50); oil shales and tar sands(50). **R and D categories:** Integrated assessment; Health effects.

Rats will be chronically exposed to Pb and/or Cd during two generations. Extensive evaluation of CNS changes will be conducted to include behavior and neurochemistry. Additionally, histological evaluation of specific target organs will be conducted. Reproductive development will be assessed. Forty days of chronic Pb and/or Cd exposure in adult rats results in alterations in CNS. Results demonstrate both neurochemical and behavioral alteration. Changes following simultaneous Pb--Cd treatment is not greater than an additive effect.
Keywords: CENTRAL NERVOUS SYSTEM; NEUROLOGY; LEAD; CADMIUM; BEHAVIOR; RATS; PHYSIOLOGY; BIOCHEMISTRY; DYNAMIC FUNCTION STUDIES; REPRODUCTION; SYNERGISM; METABOLISM; TOXICITY; GENETIC EFFECTS; CHRONIC EXPOSURE.

78019 Neurophysiologic and Behavioral Studies of Mn Ingestion. Reiter, L.W. (EPA, Office of Research and Development, Health Effects Research Lab., Neurobiology Branch, Research Triangle Park, NC, 27711). **Project number:** H601E-7838. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$10,000.
Related energy source: coal(100). **R and D categories:** Health effects.

The purpose of this project is to study the effects of chronic exposure to Mn on the central nervous system in the rat. Animals will be exposed to Mn from conception through adulthood. Various measures of central nervous system including behavioral and neurochemical parameters will be measured during the developmental as well as the adult period. The results should provide data helpful in assessing the nervous system effects of chronic low-level exposure to Mn.
Keywords: NEUROLOGY; PHYSIOLOGY; BEHAVIOR; MANGANESE; TOXICITY; INGESTION; CHRONIC EXPOSURE; METABOLISM; DYNAMIC FUNCTION STUDIES; RATS; BIOLOGICAL EFFECTS; TRACE AMOUNTS; CENTRAL NERVOUS SYSTEM.

78020 Growth and Reproductive Effects of Chronic NiO Exposure. Laskey, J.W. (EPA, Office of Research and Development, Health Effects Research Lab., Developmental Biology Branch, Research Triangle Park, NC, 27709). **Project number:** H601E-8831. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$20,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment; Health effects.

The objective is to determine the effect of short term, low-level, chronic exposure to NiO on the early growth and the reproductive development in the rat. The dose effect relationship will be concluded from chronic low level Ni exposure with emphasis on the effects on male reproductive system.
Keywords: NICKEL OXIDES; TOXICITY; CHRONIC EXPOSURE; MALES; REPRODUCTION; RATS; ANIMAL GROWTH; PHYSIOLOGY.

78021 Investigation of Oxidation States of Mn And Melanin in animals. Fisher, H.L. (EPA, Office of Research and Development, Bioengineering Branch, Research Triangle Park, NC, 27711). **Project number:** H601E-8880. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$15,000.
R and D categories: Health effects.

The objective is to develop methods of examining animal tissues, food, and excreta for Manganese II. Effects of oral manganese exposure on biophysical parameters and melanin content are to be assessed. Investigation of the pathway, site, and environment of manganese in the body is proposed. Rats exposed chronically to manganese oxides in their diet are sacrificed at various times. Manganese in organs, tissues, and organella are determined and electron spin resonance spectra are obtained by computer time averaging. Evaluation of manganese distribution and binding to sub-cellular organella is proposed. Currently, analyses of dietary and fecal samples have been completed. Surviving organ tissues have also been processed and Manganese II determined.
Keywords: MANGANESE; MELANIN; ANIMALS; OXIDATION; BIOASSAY; TISSUES; METABOLISM; BIOLOGICAL PATHWAYS; BIOLOGICAL ACCUMULATION; RATS; CHRONIC EXPOSURE; DISTRIBUTION; FOOD.

78022 In Vivo Methods for Assessing Neurotoxicity. Bornschein, R. (University of Cincinnati, Department of Environmental Medicine, Eden and Bethesda Avenues, Cincinnati, OH, 45221). **Project number:** H601E-8897. **Contract:** R805693. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. **Funding:** EPA-$66,000.
Related energy source: coal(100). **R and D categories:** Health effects.

The study will develop new methodologies for the in vivo determination of neurotoxicity within the CNS. The test system will utilize both behavioral and biochemical measures to evaluate heavy metal toxicity in the mouse. This approach will rely heavily upon a procedure, developed by Anden, et al., in which the functioning of the extrapyramidal system is reflected in an animal's asymmetric posture and locomotion. This rotational behavior will be used (1) to evaluate the effects of acute intracerebral administration of neurotoxins, and (2) to unmask covert changes in neural function which may arise as a result of long-term low level systemic exposure to neurotoxins. The aim is to develop an approach which lies between strict behavioral analyses of neurotoxicity which do not lend themselves to studies of mechanism of action, and the more classical in vitro biochemical and neurophysiological assays which do not readily permit extrapolation to the behavioral level. Initial studies will focus on the usefulness of this methodology in the assessment of neurotoxicity arising from exposure to heavy metals, particularly inorganic lead, cadmium and mercury.

Keywords: LEAD; MERCURY; CADMIUM; TOXICITY; NEUROLOGY; CENTRAL NERVOUS SYSTEM; BEHAVIOR; MICE; METALS; BIOASSAY.

DEPARTMENT OF ENERGY

80001 External Radiation Toxicity: Neutron and Gamma-Ray Toxicity Studies. Thomson, 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:** Health effects.

This program is concerned with late effects of neutron and gamma radiation in experimental animals. The activities include life-span experiments that 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 specific diseases. From these dose responses, models are formulated to predict radiation hazards to man. On the basis of life shortening, we conclude that: (1) whereas life shortening per rad is relatively constant for single doses of gamma radiation, it varies inversely with dose for neutron irradiation; (2) fractionation of the gamma dose produces a sparing effect, whereas fractionation of the neutron dose (240 rad) increases life shortening; (3) female mice are more sensitive than males to neutron radiation but not to gamma radiation; (4) life shortening per rad is lower in older animals. These conclusions are based on data from relatively high doses. Future experiments will concentrate on low dose exposures and interspecies comparisons, with life shortening, tumorigenesis, and genetic effects as endpoints. A second task in this program is concerned with functional and structural changes in the cardiovascular system of irradiated mice. Of particular interest is the high sensitivity of the coronary artery to fractionated neutron irradiation.
Keywords: FISSION NEUTRONS; GAMMA RADIATION; BIOLOGICAL RADIATION EFFECTS; MICE; HEALTH HAZARDS; LIFE SPAN; NEOPLASMS; BIOLOGICAL MODELS; DOSE-RESPONSE RELATIONSHIPS; ANIMAL CELLS; RBE; CELL PROLIFERATION; RADIOISOTOPES; AIR POLLUTION; GAMMA RADIATION; DISEASES; IN VIVO.

80002 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: fossil fuels(80); coal(20). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective is to study synergistic effects, on tumor production, of environmental pollutants from energy-related technologies and other sources. The research will focus on lung and liver. The lung will be used to examine synergistic interactions of various energy-related pollutants in respiratory tumor production, with the expectation that (1) insight will be gained into the mechanisms of such interactions, and (2) direct rapid tests for estimating the tumorigenic potential of these interactions can be developed. In this system we will study the effects of the same test compounds in (a) an in vitro rapid cellular transformation assay utilizing tracheal organ cultures, and (b) an in situ tumorigenic assay utilizing tracheal implants or intratracheal instillations. Correlations can be made between changes in biochemical and morphological parameters in the in vitro system and tumor production in the in vivo system. The liver will continue to be used to analyze mechanisms of synergism in tumor formation. Studies of biochemical effects of tumor promoters in liver will be used in an effort to uncover those effects specifically associated with promoting activity. Mechanisms of enzyme regulation in normal liver will be studied because derangements in the control of gene expression are among the primary events of neoplasia.
Keywords: CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL MODELS; SYNERGISM; ENVIRONMENT; LUNGS; LIVER; NEOPLASMS; CHEMICAL EFFLUENTS; HYDROCARBONS; AEROSOLS; METALS; ORGANIC COMPOUNDS; TOXICITY.

80003 Radiation Pathology and Viral, Radiation, and Environmental Oncology. Finkel, M.P. (Argonne National Lab., Div. of Bilogical 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: coal(5); nuclear fuels(general)(95). **R and D categories:** Health effects.

The program objective is to provide basic information for estimating the cancer risk to man from environmental pollutants associated with energy production. The historical approach has been to discover where and when following exposure to ionizing radiation the cancer event occurs and to determine how much energy must be absorbed to initiate the oncogenic process. Animal experiments are aimed at (1) defining the true latent period, or time to irreversible neoplastic change, and determining whether it varies with sex, age, species, dose, nuclide, or radiation quality; and (2) locating the microscopic site of neoplastic change, estimating the actual amount of energy delivered to that site, and assessing the influence of dose-rate and exposure pattern on the oncogenic response. Whereas some studies continue in this area, a second approach now receiving most effort is directed toward discovering whether radiation and chemical agents cause cancer by activating endogenous viral information. The virus experiments are aimed at: (1) characterizing the three murine ERP/ANL bone tumor viruses biochemically, biophysically, and biologically, (2) obtaining molecular evidence that sarcoma viruses can be activated by radiation, and (3) determining whether viruses are involved in other spontaneous and induced neoplasms of mice, dogs, and man.
Keywords: IONIZING RADIATIONS; HEALTH HAZARDS; MAN; BIOLOGICAL RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS; MICE; DOGS; STRONTIUM 90; DOSE RATES; BONE TISSUES; NEOPLASMS; YTTRIUM 90; X RADIATION; VIRUSES; CARCINOGENESIS; RADIOINDUCTION; INGESTION; TOXICITY; ANIMALS; ONCOGENIC VIRUSES; BIOLOGICAL MODELS; RISK ASSESSMENT.

80007 Genetic Effects of High LET Radiations. 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:** Health effects.

The nuclear fuel cycle for the LWR's and proposed LMFBR's involve large quantities of plutonium, small quantities of which might be released to the environment during fuel fabrication, conversion, reprocessing and waste handling, leading to its uptake and retention in the human population. The gonadal retention and distribution will be experimentally studied in animals while concurrent measures of short-term genetic damage will be carried out. Pu citrate solutions will be injected intravenously into B6CF/1 hybrid young adult mice at dose levels to yield final gonad burdens that produce 0.5 to 1 rad/week of alpha irradiation to the total testes tissues. Microdistribution will be studied autoradiographically. Genetic damage will be measured by the dominant lethal mutation rate, frequency of abnormal sperm, changes in testes weight and sperm count, and frequency of translocations induced in spermatogonia. Concurrent single and weekly neutron and gamma ray exposures and continuous gamma irradiation will provide a data-base for full comparative analysis. The 239-Pu alpha particle has the same mutagenicity as fast neutrons for dominant lethal mutation induction and a 15-fold greater effectiveness than low dose rate gamma-rays. Pu is less effective than neutrons in the induction of chromosome breakage in germinal stem cells. Depending upon dose rate, neutrons are 4 to 40-fold more effective than gamma-rays.
Keywords: LET; NUCLEAR FUELS; FUEL CYCLE; REACTORS; PLUTONIUM; FUEL FABRICATION PLANTS; REPROCESSING; ENVIRONMENTAL EFFECTS; GONADS; GENETICS; MICE; TISSUE DISTRIBUTION; ALPHA PARTICLES; SPERMATOZOA; NEUTRONS; GAMMA RADIATION; RBE; BIOLOGICAL RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS; IN VIVO; MUTATIONS; PLUTONIUM; ANIMAL BREEDING; ANIMALS; AMERICIUM.

80008 Mutagenic and Lethal DNA Damage from Energy-Related Pollutants. 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: fossil fuels(40); coal(40); oil and gas(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objective of the project is to determine potential genotoxic hazards to man from coal gasification effluents, currently primarily for the HYGAS pilot plant in Chicago. Objectives include: identification of biologically hazardous process effluents; correlation of changes in risk from effluents with changes in coal processing conditions; establishment of priorities for testing in whole animals; and establishment of priorities for analytical analyses of effluent

chemical composition. Potential hazards are tested both by bacterial and mammalian cell systems, examining for lethality and for mutagenicity. The Ames Salmonella microsome mutagenesis assay is used to test all effluent samples and sample fractions because this test is a standard in the field, has one of the broadest ranges of detection of mutagen classes, and provides a strong correlation between mutagenesis and carcinogenesis. Mammalian cell tests extend detection of genotoxins to those causing lethality and inducing malignant cell transformation in cells more representative of man. Other cell testing systems also are under development.
Keywords: PILOT PLANTS; HYGAS PROCESS; CHEMICAL EFFLUENTS; CARCINOGENESIS; MUTAGENESIS; BACTERIA; ANIMAL CELLS; MUTAGEN SCREENING; RISK ASSESSMENT.

80009 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: fossil fuels(10); coal(10); nuclear fuels(general)(10); nuclear fission(70). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective is to determine the mortality rates and clinical, biochemical, and pathologic responses of beagle dogs subjected to continuous irradiation of the whole body at one of a number of daily exposure rates that allow for survival times approaching those of unirradiated controls. The results are used in interspecies comparisons of responses aimed at developing rational models of mechanisms of radiation-induced injury that will allow for extrapolations to effects to be expected in exposed populations of humans. Dogs are caged in special facilities containing Co-60 gamma-ray sources in such a manner that they are irradiated continuously, at one of 7 exposure rates ranging from 0.4 to 35 R/day, for 22 hours each day. Young adult beagles of both sexes are irradiated either (a) for duration of life, or (b) until they have accumulated total exposures ranging from 600 to 4000 R delivered at one of the available exposure rates ranging from 5 to 35 R/day. Pregnant beagles are similarly irradiated from conception to parturition to determine the effects on the developing fetus, and especially on the reproductive capacities of dogs irradiated while in utero.
Keywords: COBALT 60; GAMMA RADIATION; EXTERNAL IRRADIATION; CHRONIC IRRADIATION; LOW DOSE IRRADIATION; WHOLE-BODY IRRADIATION; BEAGLES; DELAYED RADIATION EFFECTS; REPRODUCTION; MORTALITY; DOSE RATES; SURVIVAL TIME; IN VIVO; TOXICITY; ANIMALS; CARCINOGENESIS; BIOLOGICAL RADIATION EFFECTS; PATHOLOGICAL CHANGES.

80012 Metabolism and Effects of Internally Deposited Radionuclides and Trace Elements. Stehney, A.F. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 000302. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$2,600,000.
Related energy source: nuclear fission(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

The objective is to determine the long-term effects of radium, thorium, and other internal emitters in humans. Epidemiological and clinical studies of human beings who have been occupationally or iatrogenically exposed to intake of alpha-emitting radionuclides will be undertaken. Medical and dosimetric data are obtained by study of living persons and autopsy material and from medical records. The principal end-points are mortality by cause, neoplasms, and pathological changes in bone and lung. Whole body counting (in vivo), radiochemistry, and microscopic techniques are employed. Expected results include identification of diseases associated with internally deposited radionuclides and determination of quantitative relationships between dose and effect. These results are needed for assessment of risk from radionuclides in nuclear fuel cycles.
Keywords: RADIUM; TOXICITY; EPIDEMIOLOGY; DOSIMETRY; NEOPLASMS; RADIOINDUCTION; SKELETON; PATHOLOGICAL CHANGES; WHOLE-BODY COUNTING; METABOLISM; RADIOISOTOPES; MAN; THORIUM; ALPHA PARTICLES; RADIONUCLIDE KINETICS; BONE TISSUES; LUNGS; RESPIRATORY SYSTEM DISEASES; NUCLEAR FUELS; FUEL CYCLE; RISK ASSESSMENT.

80013 Great Lakes: Fate of Pollutants Related to Energy Conversion. Edgington, D.N. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000501. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$435,000.
Related energy source: fossil fuels(60); nuclear fission(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This program investigates the degree to which energy conversion activities may lead to ecologically significant increases in the concentrations of trace contaminants in the Great Lakes. The goal of this work is to develop quantitative descriptions of the biogeochemical processes governing the transport, fate and biological availability of energy-related pollutants released to the Great Lakes. The basic biogeochemical processes under investigation are those affecting (a) bioconcentration and biomagnification, (b) sedimentation in the water column, (c) distribution and resuspension of surficial sediments, and (d) exchange at the water-sediment boundary layer. Verification of the hypotheses and models derived from experimental observations in Lake Michigan requires detailed sampling in other Great Lakes and large lakes elsewhere. These studies will provide an essential experimental and theoretical base for the meaningful assessment of the environmental impact of energy-related activities on the Great Lakes. The results of this project will be closely coordinated with biological effects and transport studies.
Keywords: GREAT LAKES; POLLUTION; ENVIRONMENTAL EFFECTS; HEALTH HAZARDS; BIOGEOCHEMISTRY; HYDRODYNAMICS; HUMAN POPULATIONS; LAKE MICHIGAN; FUNCTIONAL MODELS; WIND; VELOCITY; FOSSIL FUELS; FOOD CHAINS; AQUATIC ECOSYSTEMS; TOXICITY; TRACE AMOUNTS; METEOROLOGY; WATER; ENVIRONMENTAL TRANSPORT; INVERTEBRATES; EMISSION.

80014 Great Lakes: Pollutant Transport Studies. Edgington, D.N. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000502. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$173,000.
Related energy source: fossil fuels(60); nuclear fission(40). **R and D categories:** Physical and chemical processes and effects.

The principal physical transport processes involved in determining the ecological effects and geochemical fate of energy-related pollutants in the Great Lakes will be examined in this newly redirected program. Principal pollutant sources and sinks will be identified and the relevant pathways, timescales, and magnitudes of the pollutant fluxes will be determined. The ultimate objective is the development of models to predict these factors. This requires the investigation and parameterization of the various transport processes, including (a) atmospheric input in the form of wet and dry deposition at the air-water interface, (b) resuspension and redistribution of polluted bottom sediments, and (c) large scale vertical mixing and lateral transport associated with wind-induced upwelling circulations. Field experiments utilizing specialized equipment will be conducted to obtain the data required for these investigations. It is anticipated that these studies will result in a better understanding of the process controlling the fate of pollutants from input to ultimate sink.
Keywords: GREAT LAKES; ENVIRONMENTAL TRANSPORT; AIR POLLUTION; WATER POLLUTION; RADIOACTIVITY; RADIONUCLIDE MIGRATION.

80015 Carbon-14 Assays in the Stratosphere and Krypton-85 Monitoring at Savannah River. Gray, J. Jr. (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: fossil fuels(30); nuclear fuels(general)(20); nuclear fission(30); nuclear fusion(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Assays of carbon-14 collected at several altitudes in the stratosphere are used by NOAA meteorologists to study and model the carbon dioxide cycle in the atmosphere. Detonations of nuclear devices greatly increased the normal cosmic-ray produced 14-C concentration. Calculated excess 14-CO2 values (measured concentration minus pre-bomb equilibrium background) are used to quantitatively assess the circulation, mixing, and diffusion patterns of carbon dioxide in the stratosphere. Experiments are currently being conducted to determine if the modifications of the existing collection apparatus, molecular sieve materials, and laboratory recovery procedures will permit quantitative recovery of other atmospheric constituents (e.g., oxides of nitrogen and fluorocarbons). Assays of krypton-85 are used by Savannah River and NOAA meteorologists to develop models of air mass movements in the area. When irradiated fuel is processed, the fission product krypton-85 is vented to the atmosphere. Calculated excess Kr-85 values (measured concentration minus background concentration) provide the data base for precise transport calculations. Carbon dioxide samples are collected on activated molecular sieves. Krypton samples are collected by cryogenic collectors. Sample canisters for both programs are shipped to ANL for product recovery. After recovery, they are reactivated and returned to field locations. Carbon-14 collections are made at Alaska, Panama, and New Mexico. Krypton-85 samples were collected at 13 stations at distances of 5 to 100 miles from the Savannah

River Site. The results have been used by NOAA to test atmospheric transport models. The Savannah River studies have been completed. A continuing program for CO2 and development for the assay of additional constituents is expected.
Keywords: SAVANNAH RIVER PLANT; CARBON 14; KRYPTON 85; RADIATION MONITORING; STRATOSPHERE; CARBON DIOXIDE; AIR SAMPLERS; ALASKA; NEW MEXICO; PANAMA; AIR POLLUTION; METEOROLOGY; TRACER TECHNIQUES; EARTH ATMOSPHERE.

80016 **MAP3S Boundary Layer Investigations.** Hicks, B.B. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000543. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$400,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The Multi-state Atmospheric Power Production Pollution Study (MAP3S) has the goal of developing an improved capability for the regional assessment of the effects of pollutants emitted by conversion and combustion of fossil fuels. In order to achieve this goal, advanced numerical models involving improved parameterizations of atmospheric transport and removal processes are developed. A series of investigations of the Planetary Boundary Layer employs advanced remote-probing techniques and high-resolution sounding methods. Supporting micrometeorological studies evaluate the relevant surface fluxes required for parameterization of the efficiency of mixing in the atmosphere, and of the rate of removal of pollutants at the surface. Improvements are incorporated in numerical models accordingly. Mathematical models of the dispersion and deposition of atmospheric sulfur oxides have been improved, as a direct result of a series of field investigations of atmospheric diffusion and surface pollutant fluxes.
Keywords: EARTH ATMOSPHERE; BOUNDARY LAYERS; MATHEMATICAL MODELS; SULFUR DIOXIDE; ENVIRONMENTAL TRANSPORT; DIFFUSION; REMOVAL; MIXING; DEPOSITION.

80017 **Effects of Sulfur Oxides on Crop Plants.** Miller, J.E. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000601. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$225,000.
Related energy source: fossil fuels(33); coal(33); oil and gas(34). **R and D categories:** Ecological/biological processes and effects.

The overall objective is to determine subtle effects of ambient low-level SO/sub 2/ concentrations resulting from fossil fuel combustion on crops. Primary emphasis is being placed on field experimentation using a fumigation system simulating actual pollution episodes. Parameters of interest are photosynthesis, growth, yield, crop quality, varietal sensitivity, and the uptake and biotransformation of SO/sub 2/. Data will be obtained to establish thresholds for economically significant yield reductions of major midwestern crops due to SO/sub 2/ pollution. Information on the physiological manifestations of SO/sub 2/ damage and environmental modification of pollutant effects will also be obtained to give the data more general applicability. To date, field experiments with soybeans have indicated yield reductions at SO/sub 2/ concentrations not exceeding the current air quality criteria for SO/sub 2/ (one year's data).
Keywords: SULFUR DIOXIDE; ENVIRONMENTAL EFFECTS; CROPS; PLANTS; FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; SOYBEANS.

80018 **Great Lakes: Biological Effects.** Spigarelli, S.A. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000674. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$385,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The long-range goal is to evaluate the significance of the effects of energy-related activities on the Great Lakes ecosystems. Near-term objectives include: (1) characterization of biological processing and bioaccumulation of toxic inorganic, organic and radioactive materials resulting from energy production; (2) measurement of the direct effects and projection of overall impacts of priority pollutants; (3) quantification of the relationship between temperature exposure and toxicant accumulation by fish; and (4) increased understanding of natural changes in ecosystem structure and function. Field studies are providing baseline data on existing toxicant concentrations and pathways. Simultaneous studies of spatial and temporal variations in important state variables are providing information necessary to assess impacts at the population and community levels. Controlled experiments in the laboratory and the field quantify dose-response relationships of selected pollutants (e.g., Cd).
Keywords: GREAT LAKES; ECOSYSTEMS; WATER POLLUTION; ENERGY CONVERSION; BIOLOGICAL ACCUMULATION; BASELINE ECOLOGY; ENVIRONMENTAL EXPOSURE PATHWAY; PUBLIC HEALTH; DOSE-RESPONSE RELATIONSHIPS; ENVIRONMENTAL IMPACTS; ENERGY; FISHES; ORGANIC COMPOUNDS; RADIOACTIVE EFFLUENTS; CHEMICAL EFFLUENTS; THERMAL EFFLUENTS.

80019 **Molecular Radiation Physics.** Inokuti, M. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 000701. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$364,000.
Related energy source: nuclear fission(70); nuclear fusion(20); other advanced(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

This activity is primarily aimed at extending our knowledge of elementary molecular processes which take place at the earliest stages of radiation actions on any molecular substance including the biological cell and which involve electronic excitation and ionization. Elucidation of those processes is an essential prerequisite to sound and detailed modeling of subsequent chemical reactions and of biological changes brought forth by ionizing radiations in general. A secondary objective is to contribute to development of advanced instrumentation for radiation dosimetry. Methods of research include both laboratory experiments and theoretical-physics techniques. The project will generate comprehensive data on the excitation and ionization processes of diverse molecules by energetic agencies, including photons, electrons, and other charged particles, and on the properties of initial products such as excited species, radicals, ions, and secondary electrons. The resulting data will be applied to interpretation and prediction of various phenomena in radiation chemistry and biology.
Keywords: PHOTONS; ELECTRONS; CHARGED PARTICLES; BIOLOGICAL RADIATION EFFECTS; BIOLOGICAL MATERIALS; MOLECULES; BIOPHYSICS; RADICALS; IONIZATION; EXCITATION; GAMMA RADIATION; ULTRAVIOLET RADIATION; X RADIATION.

80020 **Slotted Coaxial Germanium Camera.** Straus, M.G. (Argonne National Laboratory, Argonne, IL). **Project number:** 000703. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

The high energy resolution of germanium detectors offers several potential benefits to radionuclide organ imaging, such as nearly complete rejection of tissue scatter and more effective imaging when polyenergetic gamma rays are used. The objective of this program is to develop a gamma-ray camera using a coaxial germanium detector, and to determine the efficacy of germanium imaging devices in general. We have developed a system whereby the position of interaction of a gamma ray in a coaxial Ge(Li) detector is determined in polar coordinates. A spatial resolution of 1 mm at 122 keV was obtained. A figure of merit for the efficiency with which a detector utilizes the radiation to produce an image was derived using signal-to-noise ratio as criterion. The imaging efficiency of germanium was calculated, using peak efficiency values obtained from measurements at 136 keV. A study is underway to determine how signal-to-noise ratio affects perception of void images.
Keywords: PATIENTS; ORGANS; RADIOISOTOPES; SCINTISCANNING; LI-DRIFTED GE DETECTORS; PERFORMANCE TESTING; GAMMA CAMERAS; RESOLUTION.

80021 **Human Health and Energy Production.** Grahn, D. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 000811. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$140,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

Causes of death in man are sensitive to socio-economic, cultural, occupational and general environmental pollutant variables. This project is therefore designed to identify the contribution of each factor to the age and cause of death, to quantify its effect and to develop predictive models for impact analysis of energy facility sites and regions of resource development. The models should permit reevaluation of other cause-effect studies of air pollution and human health and the development of a rational cost-benefit analysis of health effects vs. effluent control technology. The study will utilize existing data bases such as the U.S. vital statistics, census data, commercial and industrial activity data. Standard methods of demographic and life-table analysis will be employed to isolate specific relationships between health effects and socio-economic, etc., factors. The methods of multiple regression and factor analysis will also be employed. Wherever possible we will use data bases existing in our own and other DOE facilities. Major factors such as education,

income, occupation, migration account for 30% to 60% of variation in age standardized death rate. Demographic projection models have been developed to estimate effects of radioactive and non-radioactive pollutants on life expectancy, cause and rate of mortality.
Keywords: ENERGY SOURCE DEVELOPMENT; SOCIAL IMPACT; ECONOMIC IMPACT; SOCIO-ECONOMIC FACTORS; HUMAN POPULATIONS; SURVIVAL CURVES; DEATH; AGE DEPENDENCE; OCCUPATIONS; BIOLOGICAL MODELS; HEALTH HAZARDS; TECHNOLOGY ASSESSMENT; POLLUTION CONTROL; DATA ANALYSIS; EDUCATION; RISK ASSESSMENT; INCOME; POPULATION RELOCATION; RADIOACTIVE EFFLUENTS; CHEMICAL EFFLUENTS; TECHNOLOGY UTILIZATION; EPIDEMIOLOGY; BIOLOGICAL EFFECTS; BEHAVIOR.

80023 National 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: all(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

80025 Behavior of Transuranic Elements in Natural Waters. Larsen, R.P. (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:** Physical and chemical processes and effects.

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.

80026 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects.

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.

80027 Mechanisms of Lethality: Their Relation to DNA Damage in 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: fossil fuels(40); nuclear fission(40); nuclear fusion(10); solar(10). **R and D categories:** Health effects.

This project is aimed at elucidating the mechanisms of mammalian cell killing (i.e., division suppression) and the relationships between lethality and other functional changes. To study these processes, cultures of asynchronous and synchronized mammalian cells are used. Effects on cell growth, division, and macromolecular syntheses are followed, in addition to variations in response correlated with the aging of cells in their growth cycle. Damage-repair processes, expressed at the level of cell function (i.e., survival, mutation, and neoplastic transformation) are examined. Methods have been worked out for the measurement of functional changes induced by chemicals (e.g., coal-derived carcinogens); ionizing radiation (e.g., fission-spectrum neutrons); nonionizing radiation (e.g., sunlight-simulating ultraviolet light); and combinations of the above. In addition, DNA damage and metabolic changes in macromolecular syntheses due to these agents are correlated with the changes induced in cell properties. Studies of damage and repair in DNA, combined with studies of damage and repair in functional systems, should lead to the discovery of molecular mechanisms of general applicability. Without such mechanisms, projections of cell and animal data to humans will remain uncertain.
Keywords: COAL INDUSTRY; CHEMICAL EFFLUENTS; IONIZING RADIATIONS; ULTRAVIOLET RADIATION; SYNERGISM; DNA; BIOLOGICAL REPAIR; RADIATION INJURIES; BIOCHEMICAL REACTION KINETICS; LOW DOSE IRRADIATION; BIOLOGICAL FUNCTIONS; ANIMAL CELLS; LETHAL DOSES; HAMSTERS; MAN; LETHAL RADIATION DOSE; CELL KILLING.

80029 Plutonium Behavior in the Miami River Watershed. Edgington, D.N. (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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

80030 Midwest Regional Assessment. Jaroslow, B.N. (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). Div. of Regional Assessments. **Funding:** DOE-$100,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objective is to provide a data book of the midwest region of 12 states encompassing Geographic Regions 5, 7, and North and South Dakota from Region 8 (according to the accompanying map). Our section of the Regional Data Book comprised the sections on Solid Waste Land Use, and Biota. National data sources were used as the primary source material, state and private sources were used where national sources were inadequate. These data will be com-

bined with these obtained by S. Ballou, EES, Project Manager for the Midwest Regional Assessment; and a Midwest Regional Data Book will be produced. In addition to the Data Book, we will complete a study of coal mining in the Midwest Region and assess its impact on agricultural land use. The assessment will be published as a report of the Midwest Regional Assessment.
Keywords: DATA COMPILATION; COAL MINING; AGRICULTURE; LAND USE; REGIONAL ANALYSIS; GREAT LAKES REGION; MIDWEST REGION; ROCKY MOUNTAIN REGION; SOLID WASTES; TERRESTRIAL ECOSYSTEMS; ENERGY SOURCES; ENVIRONMENTAL IMPACTS.

80031 Energy Related Regional Studies Program: Integrated Technology Assessment. Hoover, L.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). Div. of Technology Overview. **Funding:** DOE-$865,000.
Related energy source: all(100). **R and D categories:** Integrated 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 Congressional 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.

80032 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects.

The objectives are to study and parameterize the fundamental mechanisms that control the exchange of heat, moisture, and momentum between heated water surfaces and the atmosphere, in order to develop schemes for predicting the extent and severity of possible adverse environmental effects downwind of cooling ponds; to develop improved numerical simulations of cooling pond systems, capable of assisting in the design of power plants; and to develop methods for assessing the thermal performance of existing installations. Micrometeorological methods of direct flux evaluation are applied over an industrial cooling pond; the data derived allow determination of transfer coefficients appropriate in the special, demanding atmospheric conditions that prevail over heated water surfaces. Remote probing methods and simple predictive models of heat transfer processes and of atmospheric effects (such as fog and rime ice) are developed and evaluated. Methods for assessing the performance of existing cooling ponds have been improved, and simple models for predicting thermal characteristics and the likelihood of fog have been developed.
Keywords: FOG; COOLING PONDS; WASTE HEAT; HEAT TRANSFER; SURFACE WATERS; ENVIRONMENTAL IMPACTS; POWER PLANTS; THERMAL EFFLUENTS; COOLING SYSTEMS; EARTH ATMOSPHERE; METEOROLOGY; MATHEMATICAL MODELS.

80039 Environmental Interactions with the Aging Process. Sacher, G.A. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 001541. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$105,000.
Related energy source: nuclear fission(30); solar(30); all(40). **R and D categories:** Health effects.

This program is concerned with the effects of environmental pollutants on the daily (diel) cycles of energy metabolism, motor activity, and body temperature in small rodents. These processes can be measured accurately and continuously on unrestrained animals. The hypothesis is that they are sensitive indicators of the health status of the animal, including expectation of disease morbidity and survival. We have gone a considerable way toward validating this hypothesis, and are beginning to investigate the effects of specific pollutants. The purpose is, first, to characterize the effects of each pollutant, and second, to determine whether these effects predict the subsequent health history of the animal. Energy-related pollutants currently under examination are ionizing radiations, ingested lead, and high-voltage electric fields. Diel cycles of metabolism, activity, and temperature can be logged continuously and automatically for several individual mice simultaneously for periods up to 2 weeks. The search for indicator variables has thus far been limited to the energy expenditure variable, and has revealed 3 variables that predict the length of life, i.e., resting metabolic rate (negative correlation), ratio of average to resting metabolic rate (positive correlation), and change of metabolic rate from youth to old age (negative correlation). The search must now be extended to the activity and temperature variables, which have become functional only recently. The initial phase of work with pollutants will be focused on radiation variables both ionizing and non-ionizing. The non-ionizing radiations to be examined are 60 Hz electric fields and 2450 MHz microwaves, as produced by the proposed Solar Power Satellite system.
Keywords: AGE DEPENDENCE; DAILY VARIATIONS; METABOLISM; BEHAVIOR; THERMOREGULATION; BODY TEMPERATURE; ENERGY; POLLUTION; HEALTH HAZARDS; RATS; ELECTRIC FIELDS; MICROWAVE RADIATION; SOLAR POWER PLANTS; SATELLITES; LEAD; IONIZING RADIATIONS; CENTRAL NERVOUS SYSTEM.

80042 Molecular Physics and Chemistry Basic to Environmental Research. Inokuti, M. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 001759. **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: fossil fuels(40); coal(20); geothermal(10); solar(10); biomass(5); conservation(5); other advanced(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This activity aims at providing basic molecular data concerning interactions of atmospheric pollutants originating from nonnuclear energy technologies including coal combustion, solar-energy conversion, geothermal energy, and some energy conservation measures. The methods of research are primarily laboratory experiments, and secondarily, theoretical chemical physics. The project will produce diverse data on spectroscopic and reaction-kinetics data on pollutant molecules and related substances. These data are essential to the detailed modeling of the chemical behavior of atmospheric pollutants and to the development of advanced instrumentation for their characterization and monitoring.
Keywords: FOSSIL-FUEL POWER PLANTS; SOLAR ENERGY CONVERSION; GEOTHERMAL ENERGY; AIR POLLUTION; MOLECULES; CHEMICAL REACTION KINETICS; NITROGEN; OZONE; SULFUR; MONITORING.

80043 Development of Improved Monitoring Equipment for On-Line Detection in Characterization of Airborne Plutonium Aerosols. 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 fuels(general)(100). **R and D categories:** Characterization, measurement, and 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. Improved 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.

80044 Surface Mining and Land Reclamation Information System (SUMLARIS). Perry, A.O. (Argonne National Laboratory, Building 8, Argonne, IL, 60439). **Project number:** 002158. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$55,000.
Related energy source: coal(85); oil shales and tar sands(5); nuclear fuels(general)(10). **R and D categories:** Integrated assessment.

The objective of this project is to collect and store in retrievable form data related to the surface mining of coal and reclamation of mined lands. At present, such data are scattered through the files of various state agencies, mostly in the form of raw data. The envisioned data base would permit rapid, easy access to such data and would allow for the calculations of useful statistical measures related to the environmental impacts of mining. Argonne is contacting the pertinent state agencies in order to obtain their cooperation and to determine the nature and scope of the data collection problem. A three state test study is nearing completion. The states are Alabama, Illinois, and Wyoming. With the Tennessee data already in the system, four states will have been computerized by the end of FY 78.
Keywords: COAL MINING; SURFACE MINING; LAND RECLAMATION; INFORMATION SYSTEMS; STATE GOVERNMENT; GROUND WATER; SURFACE WATERS; DATA ACQUISITION SYSTEMS.

80046 Therapy of Poisoning by Radioactive and Non-Radioactive Metals. Lindenbaum, A. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002169. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$210,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is the removal of toxic metals from the body with major emphasis on plutonium-239. This work includes: (1) relationships between physicochemical properties of heavy metal compounds and their deposition sites, duration of retention, and pathological effects; (2) utilization of such information to develop decorporation procedures; (3) development of appropriate methodology to facilitate these objectives. Both in vitro studies of mammalian organs and in vivo studies are carried out in rodents and dogs. Experiments are designed to allow extrapolation of results toward man. Most experiments are short-term (less than 6 months) and utilize sub-microgram quantities of metals. Knowledge of specific deposition sites in tissues of a hazardous metal allows selection of appropriate agents and procedures for decorporation. Potentially useful therapeutic agents are tested in mice or rats. If successful in the rodent, critical metal distribution or decorporation experiments are repeated with dogs. If therapeutic promise is confirmed for both rodent (mainly mice) and dog the substances and/or procedures are then evaluated for clinical use in human patients. The main target organs are the skeleton and liver.
Keywords: METALS; DECONTAMINATION; PLUTONIUM 239; RADIONUCLIDE KINETICS; IN VITRO; IN VIVO; DEPOSITION; PURIFICATION; SKELETON; LIVER; TOXICITY; RATS; DOGS; MAN; METABOLISM; THERAPY; REMOVAL; LEAD.

80049 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

80050 Energy Resources Training and Development Program for American Indians. Cameron, R.E. (Argonne National Laboratory, 9700 S. Cass Avenue, EIS-11A, Argonne, IL, 60439). **Project number:** 002570. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: all(100).

This training program was developed for Native Americans to provide the knowledge and understanding necessary for working on energy development, environmental and reclamation problems on tribal lands. Special attention is given to energy extraction and development with field trips to coal mines on or adjacent to reservation lands to observe mining, environmental impacts, and application of various reclamation technologies. The program consists of a basic and practical six-week educational and training program in energy, resources, conservation, environment, assessment, monitoring, and rehabilitation of disturbed land. The Native Americans are presented lectures, laboratory, and field instruction in geology, energy resources and development, hydrology, soil management, wildlife ecology, data gathering and interpretation, and human factors as related to energy development.
Keywords: AMERICAN INDIANS; EDUCATION; INDIAN RESERVATIONS; ENERGY SOURCE DEVELOPMENT; LAND RECLAMATION; ECOLOGY; GEOLOGY; HYDROLOGY; ENVIRONMENTAL IMPACTS; RESOURCE CONSERVATION.

80054 Radiological Assessment of Contaminated Excess Sites. Wynveen, R.A.; Smith, W.H. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 600098. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$222,000.
Related energy source: nuclear fuels(general)(75); nuclear fission(25). **R and D categories:** Environmental control technology.

Radiological surveys are being conducted to obtain information that is necessary for DOE to determine if, and to what extent, remedial action may be required. The surveys are designed to characterize the radiological environment in and/or around facilities previously owned, leased or utilized by the MED/AEC in such a way that they may have been contaminated with radioactive materials. The surveys will provide data indicating surface contamination levels, ambient radiation exposure levels, soil and air contamination levels and isotopic identification as necessary. An analysis of the survey results will provide a basis for determining the need for remedial action, and will enable evaluation of the efficiency of any remedial action where specified and implemented.
Keywords: NUCLEAR FACILITIES; RADIATION MONITORING; DECONTAMINATION; RADIATION HAZARDS; SOILS; ISOTOPE RATIO.

80055 Technology Assessment, Regional Energy Assessment, and Policy Analysis. 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). Div. of Environmental Impacts. **Funding:** DOE-$80,000.
Related energy source: coal(90); conservation(10). **R and D categories:** Integrated 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.

80056 Development of Material Constitutive Description for Environment and Safety Control Assessments of Energy Materials Shipping Container Systems. Valentin, R.A.; Lin, H.C. (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). Div. of Environmental Control Technology. **Funding:** DOE-$60,000.
Related energy source: nuclear fuels(general)(25); nuclear fission(50); other advanced(25). **R and D categories:** Environmental control technology.

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.

80060 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: all(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective is to develop and validate new techniques for measuring the carcinogenic, mutagenic, and toxic effects of energy-related pollutants on human populations. The new technique of protein gene product (PGP) mapping allows most of the estimated 30,000 to 50,000 PGPs (human cell building blocks) to be seen analytically. Different cells characteristically contain different sets of PGPs. In cancer the PGP population of a cell changes, and PGP mapping raises the possibility of early cancer detection, cancer typing, and assessment of therapy effectiveness. PGP mapping also detects about 1/3 of amino acid substitutions resulting from mutations and makes possible measurement of the background mutation rate in man, the detection of changes in that rate, and the detection of genetic-disease-causing mutations in individuals. Toxic agents cause living cells to leak PGPs and other cell constituents. With PGP mapping, cell type markers may be identified and used as indicators of specific organ damage. Commercially available, clinically useful ISO-DALT mapping system is expected in three years. Commercial sales of systems and products evolved from this program are now over 100 million dollars per year (zonal centrifuges, vaccine centrifuges, centrifugal analyzers, vaccines, reagents, etc.).
Keywords: HUMAN POPULATIONS; CARCINOGENESIS; MUTAGENESIS; TOXICITY; BIOLOGICAL MODELS; PATHOLOGICAL CHANGES; BIOLOGICAL INDICATORS; TECHNOLOGY UTILIZATION; SOCIO-ECONOMIC FACTORS; HEALTH HAZARDS; ENERGY SOURCE DEVELOPMENT; COAL INDUSTRY; POLLUTION; TECHNOLOGY TRANSFER; GENETIC EFFECTS.

80064 Analytical Instrument Development for Organic Environmental Contaminants. Cunningham, P.T. (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: fossil fuels(80); biomass(5); conservation(15). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

80066 Toxicology of Effluents from Advanced Coal Combustion Technologies Including Fluidized Bed Combustion. Norris, W.P. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002563. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$568,000.
Related energy source: fossil fuels(10); coal(90). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

This is a multi-disciplinary program aimed at chemical characterization and toxicological evaluation of the total effluent stream from a PDU (Prototype Development Unit) type, fluidized bed coal combustor (FBC) operated under a variety of conditions. The gases, and accompanying particulate matter, emerging from an existing FBC at Argonne National Laboratory are diluted 20 to 100 times with air. The dilued effluent will be allowed to age in a vessel large enough to provide a mean residence time of 15 minutes. This aging, and accompanying chemical changes, can occur in the presence of simulated sunlight, if desired, to produce photochemical reaction products. The diluted effluent will be chemically analyzed to determine its content of SOx, NOx, CO, metal compounds, and organic species. Suspended particles will be size-classified and analyzed to determine rates of adsorption and amounts of materials absorbed from the gas phase. The presence and rates of growth of condensation nuclei will be determined. Estimates of effluent toxicity will be made using bacterial and mammalian cell tester systems exposed to the total effluent, and to fractions thereof. Mice will also be exposed to the FBC effluent to identify the organs and tissues at risk and the kinds of changes that are produced. Continued assessment of data from FBC will project the dimensions of potential hazards to human populations.
Keywords: COAL; COMBUSTION; FLUIDIZED-BED COMBUSTION; FLUIDIZED-BED COMBUSTORS; PROCESS DEVELOPMENT UNITS; FLUE GAS; PARTICLES; CHEMICAL REACTIONS; CHEMICAL COMPOSITION; SULFUR OXIDES; NITROGEN OXIDES; CARBON MONOXIDE; METALS; ORGANIC COMPOUNDS; FLY ASH; SORPTIVE PROPERTIES; PARTICLE SIZE; TOXICITY; CELL CULTURES; HEALTH HAZARDS; FRACTIONATION; MICE; RISK ASSESSMENT; CHEMICAL EFFLUENTS.

80067 Models and Mechanisms of Dose-Response. Marshall, J.H. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 002490. **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: nuclear fission(100). **R and D categories:** Health effects.

The objective is to formulate a theory of the induction of bone cancer by alpha particle that synthesizes data from cell culture, animals and man within a logical, mechanistic framework that can be tested by experiment. Approaches will include in-vitro study of the properties of human cell tumors and the effects of radiation on cells in tissue culture; study of the viral and immune status of living radium patients; and computer modeling to fit postulates, mechanisms and data in a three-dimensional analysis of tumor rate, dose rate and time. Studies will result in a determination of host factors involved in cancers produced by irradiation; and dose-response curves, based on mechanisms, that fit data for man, animal, and cell cultures on induction of bone cancer by alpha-particle irradiation. These theoretical and mechanistic results are needed for assessment of risk at low levels from radionuclides in nuclear fuel cycles.
Keywords: NUCLEAR INDUSTRY; ENVIRONMENTAL IMPACTS; CHRONIC INTAKE; CARCINOGENESIS; BIOLOGICAL MODELS; ALPHA PARTICLES; BIOLOGICAL RADIATION EFFECTS; DOGS; MAN; BONE TISSUES; DOSE-RESPONSE RELATIONSHIPS; DATA ACQUISITION; CELL CULTURES; COMPUTER CODES; S CODES; HEALTH HAZARDS; RADIOINDUCTION; RISK ASSESSMENT.

80068 Biological Consequences of Chemical Speciation of Heavy Metals in Natural Waters. 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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to determine kinetics and equilibria of metal complexation with inorganic and organic ligands. The approaches include: (1) development of analytical methods for determining

concentrations of metal ligands and complexes in aquatic samples (Cd, Cu, Pd, and Zn); (2) determination of the stoichiometry and stability constants of complexation reactions; (3) measurement of the complexation kinetics; (4) assessment of the effects of complexation on toxicity to algae; (5) spatial and temporal mapping of the concentrations of metals, ligands and complexes in natural waters; (6) assessment of the biological effects of increased input of metals or ligands into natural waters; and (7) characterization of the component fractions of the environmental ligand pool. The results of this research will provide definitive evidence of the relationship between the chemical speciation of heavy metals in the Great Lakes and their potential biological effects on organisms.
Keywords: METALS; BIOLOGICAL EFFECTS; CADMIUM; COPPER; LEAD; ZINC; AQUATIC ECOSYSTEMS; ECOLOGICAL CONCENTRATION; QUANTITATIVE CHEMICAL ANALYSIS; COMPLEXES; CHEMICAL REACTION KINETICS; ALGAE; TOXICITY; AQUATIC ORGANISMS.

80072 Environmental Control Implications of Generating Electric Power 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). Div. of Environmental Control Technology. **Funding:** DOE-$1,100,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

80073 Identification of Refractory Organic Compounds in Treated Refinery Wastewater. Raphaelian, L.A. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** 800058. **Supported by:** Robert S. Kerr Environmental Research Lab., Ada, OK (USA); Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** EPA-$35,000; DOE-$160,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A study is being conducted to assess the efficacy of activated sludge and activated carbon for the removal of problem organic compounds from treated refinery wastewater. ANL is using capillary column gas chromatography/mass spectrometry (GC/MS) to identify refractory organic compounds from the wastewater streams of one Class B refinery that employs an activated sludge system. Three sampling points have been investigated in the Class B refinery's wastewater stream. The first sampling point was after the dissolved air flotation unit, the second after the final clarifier of the activated sludge unit, and the third after the carbon absorption column. Isolation of the organic compounds was accomplished by the US EPA's Robert S. Kerr Environmental Research Laboratory (RSKERL). ANL has identified those consent decree organic compounds present in all the wastewater samples. A total of 304 organic compounds have been characterized. Where possible, approximate concentrations of the organics in all three streams have been calculated. A report showing the efficacy and cost benefit of the use of both powdered and granular activated carbon for the removal of refractory organics will be prepared as the final phase of this project.
Keywords: PETROLEUM REFINERIES; WASTE WATER; WATER POLLUTION; SAMPLING; ORGANIC COMPOUNDS; ADSORPTION; ACTIVATED CARBON; ACTIVATED SLUDGE PROCESS; PURIFICATION.

80074 Environmental Control Technology Survey of Selected 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). Div. of Environmental Control Technology. **Funding:** DOE-$430,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

80075 Chemical Characterization of Aerosols. Cunningham, P.T. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002239. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective of the program is to develop a data base on the distribution and chemical speciation of ambient aerosol pollutants in the greater northeastern U.S. For this purpose, time- and size-classified samples of atmospheric aerosol are being collected at a series of selected sites (4 to 5) in the northeastern U.S. The fine particle fraction (0.3 to 1.0 micrometers) of the aerosol is being analyzed for nitrate, neutral and acidic sulfate, and hydrocarbons using infrared spectroscopy. Work to date has revealed that ambient aerosol is significantly more acidic, both in the frequency of occurrence and in the degree of acidity, in the eastern part of the region (NY, PA, VA) than in the Midwest (IL, IN).
Keywords: AEROSOLS; CHEMICAL COMPOSITION; NITRATES; SULFATES; PH VALUE; HYDROCARBONS; ECOLOGICAL CONCENTRATION; NEW YORK; PENNSYLVANIA; VIRGINIA; ILLINOIS; INDIANA; AIR QUALITY; PARTICLES; QUANTITATIVE CHEMICAL ANALYSIS; QUALITATIVE CHEMICAL ANALYSIS.

80076 Oxygen Isotope Ratio Studies of Atmospheric Sulfates. Cunningham, P.T. (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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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.

80077 Assessment of Once-Through Cooling Water Control Technology. Ditmars, J.D. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** 800190. **Contract:** W-31-109-ENG-38. **Supported by:** Depart-

ment of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

The use of once-through cooling systems (surface and submerged) for power plants is constrained by state water-quality standards and subject to US EPA 316(a) demonstration guidelines. The efficacy of employing once-through cooling systems for environmental control depends, first, on the ability of such discharge systems to perform satisfactorily within the temperature constraints, and second, on the costs of such systems. The proposed research seeks to assess the efficacy of these once-through cooling systems in a variety of receiving-water environments and to assess the potential of statistically based predictions of once-through cooling water discharge performance as a means of evaluating their efficacy. The results of a survey of applicable water quality standards and guidelines will be used with known performance characteristics of surface and submerged discharge systems to assess system efficacy for rivers, lakes, estuaries, and coastal waters. Extensive data on the behavior of discharges of once-through cooling water into the Great Lakes, previously acquired by Argonne, will be used in the study as well as published data for other water bodies.
Keywords: ONCE-THROUGH COOLING SYSTEMS; ELECTRIC POWER; ENVIRONMENTAL EFFECTS; THERMAL EFFLUENTS; STATISTICS; RECOMMENDATIONS; EFFICIENCY; PLUMES; WASTES; WATER.

80078 Oceans--Fate of Nuclear Pollutants--Disposal and Dumping. Edgington, D.N. (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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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 environment. 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.

80079 Research Vessel Support. Edgington, D.N. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002448. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

Field investigations which represent a major portion of the Great Lakes Research Program require the periodic use of research vessels for sampling and other in situ experimental activities. These vessels are required to be equipped for deepwater limnological studies and must be capable of operating in the open lakes. A new fast 58 foot work boat equipped for oceanographic research is under construction and will be operated by ANL on the Great Lakes. In addition, shiptime is leased from other midwestern research groups.
Keywords: RESEARCH PROGRAMS; GREAT LAKES; LIMNOLOGY; SHIPS; CONSTRUCTION.

80082 Support of NEPA Coordination Activities. Gustafson, P.F. (Argonne National Laboratory, 9700 South Cass Avenue (EIS-10), Argonne, IL, 60439). **Project number:** 002756. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of NEPA Coordination. **Funding:** DOE-$50,000.
Related energy source: all(100).

Assistance will be provided to DOE/ASEV Office of NEPA Coordination for preparation of environmental assessments, guidelines and other documents related to DOE environmental impact statement activities. Tasks will be defined by the DOE Office of NEPA Coordination.
Keywords: ENVIRONMENTAL IMPACT STATEMENTS; OPTIMIZATION; RECOMMENDATIONS; COST BENEFIT ANALYSIS.

80083 Cellular Fine Structure as a Sensitive Indicator of Altered Cell Function in Chronic Toxicity Studies. Seed, T.M. (Argonne National Lab., Div. of Biological and Medical Research, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 002759. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$114,000.
Related energy source: fossil fuels(10); oil and gas(10); nuclear fuels(general)(10); nuclear fission(70). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

Research objectives include: (1) the clarification and description of the progressive development of aplastic anemia and leukemia in large, long-lived animals (e.g., dog) following protracted exposure to low daily doses of ionizing radiation or selected chemical toxicants (e.g., benzene); (2) the provision of sensitive and reliable predictors, based on early cellular events, of such pathological responses; and (3) the establishment, for benzene and gamma radiation, of the minimal toxic dose rates and exposure durations for pathological potential in the most sensitive target cells and tissues at risk. The experimental approach is to serially assess, in the exposed animal, phase-related changes in blood forming tissues. Detailed examination is being carried out of the various cellular compartments of the hematopoietic system, with particular reference to the structural and functional properties of stem cells; i.e., suspected cellular targets for these toxicants. To date, four distinct preclinical phases in leukemia induction have been described. Further work promises to elucidate specific cellular events, based on target-stem cell responses to the toxicant, reflective of the extent of pathological progression.
Keywords: BIOLOGICAL RADIATION EFFECTS; BIOLOGICAL INDICATORS; LOW DOSE IRRADIATION; CHRONIC IRRADIATION; BENZENE; BIOLOGICAL EFFECTS; PATHOLOGICAL CHANGES; GAMMA RADIATION; BLOOD FORMATION; LEUKEMIA; ANEMIAS.

80084 Radiation Detector Systems for Trace Radionuclide Measurements. Strauss, M.G. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 002772. **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: coal(10); nuclear fuels(general)(60); nuclear fission(30). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this project is to develop advanced instrumentation and techniques for measuring trace quantities of radionuclides, such as plutonium and uranium, in soil and sediment by x- and gamma-ray spectrometry. These techniques are expected to be simpler, faster, and less costly than the prevailing radiochemical sample analysis methods. By mounting the silicon and germanium crystals on edge rather than on one of the faces (conventional method), a large detection area is realized and therefore the sensitivity is doubled. Background is suppressed by placing these crystals in a shield and sandwiching them between two anticoincidence NaI(Tl) detectors. A prototype x-ray detector has been built and is now being evaluated. Work on 3x3 silicon detector array is planned to start in FY1979. The intensities of the background x-ray lines due to the natural activity in soil that limit the minimum detectable radionuclide trace have been calculated. Accordingly a minimum detectable level of 1 pCi of plutonium or uranium in 1 g of soil is anticipated with the silicon detector array. This is 100 times more sensitive than could be expected from a NaI(Tl) detector system. The ultimate goal of this project is to produce a detector system capable of performing sensitive, inexpensive, routine assaying of trace radionuclides in soil samples from locations such as waste disposal sites and special nuclear material production facilities.
Keywords: RADIATION DETECTORS; PLUTONIUM ISOTOPES; URANIUM ISOTOPES; SOILS; SEDIMENTS; X RADIATION; GAMMA RADIATION; RADIATION MONITORING.

80085 Biomedical and Environmental Effects of Electrical Storage Systems. Lindenbaum, A. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002855. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$117,000.
Related energy source: fossil fuels(20); oil and gas(20); hydroelectric(20); solar(20); wind(20). **R and D categories:** Health effects.

The primary purposes of this program are to: (a) assess the needs for health-effects research in (nonhuman) biological systems, and (b) propose a research plan for resolving public and occupational health-related issues emanating from the battery program. Major

health-related issues will be identified, along with uncertainties and gaps in knowledge. The assessment will be conducted through five tasks: (1) provide information on state-of-the-art, with particular emphasis on toxic substances to be employed in new battery technologies soon to reach commercial applications; (2) evaluate the environmental impact of these substances; (3) review and evaluate existing information on metabolism, toxicity, and medical problems related to chemicals of concern; (4) evaluate occupational and public health hazards and consider regulatory factors that may affect research needs; and (5) identify needs for health-effects research. Based on this assessment, a research plan will be prepared toward resolving special health- and environmental-related problems so identified.
Keywords: HUMAN POPULATIONS; PUBLIC HEALTH; ELECTRIC BATTERIES; HEALTH HAZARDS; LEAD; ANTIMONY; ARSENIC.

80086 Information Coordination Focal Point. Huebner, R.H. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** 002884. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$50,000.
R and D categories: Integrated assessment.

Knowledge and coordination of information resources available to all activities under the Environment Mission is vital to an effective and unified effort. The need to identify and characterize these resources in a systematic way is a prerequisite for establishing an interlaboratory approach to analysis of complex environmental problems. The objective of the Information Coordination Focal Point (ICFP) is to establish an overview of all environmental information resources developed or maintained by ANL research activities. Coordination of this effort with other laboratories and DOE, as well as with diverse research groups within ANL, is the principal function of the ICFP. Other specific approaches of the ICFP include survey of information resources, responses, response to requests for information, analysis of uses and applications of research information, assisting distribution and exchange of encoded environmental data, and information resource evaluation. The principal result is to accomplish a coordinated survey of all information resources (e.g. data base, models, data processing systems and graphical display capabilities) related to environmental research and development at ANL. The survey is accomplished by personal contact and interview and the products are an on-line index of information resources and an annually up-dated report on these resources. The ICFP also provides technical data retrieval and display assistance to environmental assessment activities.
Keywords: ENVIRONMENT; INFORMATION SYSTEMS; DATA ANALYSIS; DATA PROCESSING; INFORMATION RETRIEVAL; AUTOMATION.

80087 Chemical and Physical Characterization of Effluent from Fluidized Bed Combustion (FBC) of Coal. Norris, W.P. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002942. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$113,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The activities in this project support programmatic research (project control number 002563) aimed at toxicological evaluation of the total effluent stream from a PDU type fluidized bed coal combustor at Argonne National Laboratory. The effluent, before and after it has been diluted with air and aged to allow for chemical reactions to proceed, will be chemically analyzed for SOx, NOx, CO, metal compounds, and organic species. An important aspect will be to determine details of reactions whereby metals and hydrocarbons are absorbed onto surfaces of the particles present in the effluent stream. Equipment has been assembled to measure the formation of condensation nuclei. The diluted effluent may be illuminated with light having a spectral composition similar to sunlight. This will allow an assessment of the importance of photochemically induced reactions.
Keywords: COAL; FLUIDIZED-BED COMBUSTION; FLUIDIZED-BED COMBUSTORS; GASEOUS WASTES; CHEMICAL EFFLUENTS; SULFUR OXIDES; NITROGEN OXIDES; CARBON DIOXIDE; ORGANIC COMPOUNDS; METALS; CHEMICAL REACTIONS; ADSORPTION; PARTICLES; FLY ASH; TOXICITY; HEALTH HAZARDS.

80088 Policy Analysis. 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). Div. of Policy Analysis. **Funding:** DOE-$210,000.
Related energy source: coal(90); conservation(5); other advanced(5). **R and D categories:** Integrated 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.

80089 Midwest Regional Assessment. Ballou, S.W. (Argonne National Laboratory, Energy and Environmental Systems Division, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 002963. **Contract:** W-31-109-EnG-38. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$393,000.
Related energy source: fossil fuels(30); nuclear fuels(general)(20); hydroelectric(5); solar(10); biomass(10); wind(10); conservation(15). **R and D categories:** Integrated assessment.

This assessment program comprises: (1) reviewing state energy-related issues and developing a data base for each state; (2) merging state data to achieve a regional view of energy supply and demand, socioeconomic and ecological conditions, and economic goals; (3) evaluating existing and near-term options for energy technologies for each state; (4) evaluating existing and near-term options for conservation technologies in each state; and (5) analyzing the ecological consequences of these options. Program personnel will maintain close liaison with key entities in the 12 midwestern states and in the region as a whole to keep ANL's regional data base current. The program will provide information needed by DOE and other federal agencies on the consequences of various mixes of energy technologies and various supply/demand scenarios in the region; the information will also be useful to state and regional groups for evaluating energy options and for local planning.
Keywords: TECHNOLOGY ASSESSMENT; DATA BASE MANAGEMENT; ENERGY SUPPLIES; ENERGY DEMAND; SOCIO-ECONOMIC FACTORS; ECOLOGY; ECONOMIC IMPACT; ENERGY POLICY; ENERGY CONSERVATION; ENVIRONMENTAL IMPACTS; ENERGY MODELS; MIDWEST REGION.

80090 Decentralized Energy Technologies. Leppert, G. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 003210. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE-$140,000.
Related energy source: coal(10); hydroelectric(10); geothermal(10); solar(25); biomass(10); wind(10); conservation(25). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The objective of this program is to provide DOE with an analysis of the environmental policy implications of alternative energy sources for the United States which differ from present policy in that there is substantially greater emphasis on renewable energy flows; energy supplies are matched to end-use needs in scale, geographic distribution, and thermodynamic quality; and there is greater emphasis on efficiency of energy use, on conservation and natural resources, on ease of use, on user control and understanding, and on diversity. This work is being carried out under subcontract by the Institute for Energy Studies of Stanford University. The primary method being employed consists of a graduate Systems Engineering course being offered by the University to approximately 50 students of widely varying disciplines. In addition to the faculty members teaching the course, numerous members of the University faculty are involved as consultants, as is a distinguished group of energy and environmental experts who comprise the Advisory Board.
Keywords: USA; ENERGY ANALYSIS; ENVIRONMENTAL EFFECTS; SYSTEMS ANALYSIS; ENERGY SOURCES; ENERGY POLICY; ENVIRONMENTAL POLICY; INTERACTIONS; ECONOMICS.

80091 Environmental Assessment of Solar Energy Technologies. Ballou, S.W. (Argonne National Laboratory, Energy and Environmental Systems Division, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 003247. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE-$40,000.
Related energy source: biomass(100). **R and D categories:** Integrated assessment.

The overall objectives of the project are to comprehensively examine the environmental and public health and safety impacts resulting from widespread development and utilization of selected

biomass energy technologies and to examine regional variations which may facilitate the development and utilization of particular combinations of solar technologies. Specifically ANL will identify and determine the magnitude of residuals on a national and on a per QUAD basis, resulting from each technology at the point of end use, and those residuals associated with the entire systems from raw material extraction to end use municipal sludge, feedlot manures, and forestry and agricultural crop residues will be evaluated as fuel resources for several conversion systems, including an aeroline digestion, pyrolysis fermentation, and incineration.
Keywords: SOLAR ENERGY; ENVIRONMENTAL IMPACTS; HEALTH HAZARDS; SAFETY; BIOMASS; TECHNOLOGY UTILIZATION; TECHNOLOGY ASSESSMENT; MUNICIPAL WASTES; MANURES; AGRICULTURAL WASTES; FORESTS; ANAEROBIC DIGESTION; PYROLYSIS; FERMENTATION; CHEMICAL EFFLUENTS; BIOCONVERSION.

80092 Chemical Characterization of Process Streams: High Btu Coal Gasification. Norris, W.P. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 003261. **Contract:** W-31-109-ENG-38. **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:** Characterization, measurement, and monitoring; Health effects.

This work is in support of another program (002942) aimed at toxicological evaluation of process streams and work space air associated with high-Btu gasification of coal. Samples of process streams from scalable portions of an operating pilot plant (HYGAS) are collected under steady-state conditions. The crude samples are fractionated chemically and evaluated for mutagenicity using the Ames test. Guided by the results of biological testing, significant fractions are sub-fractionated further to identify individual toxic and mutagenic components. Significant sub-fractions will be analyzed using infrared spectrometry, gas chromatography--mass spectrometry, and high pressure liquid chromatography.
Keywords: COAL GASIFICATION PLANTS; HIGH BTU GAS; FUEL GAS; GASEOUS WASTES; WASTE WATER; FRACTIONATION; MUTAGENS; MUTAGEN SCREENING; INFRARED SPECTRA; CHROMATOGRAPHY; GAS CHROMATOGRAPHY; MASS SPECTROSCOPY; HYDROCARBONS; ORGANIC COMPOUNDS; SLUDGES; SAMPLING; CHEMICAL EFFLUENTS; HYGAS PROCESS; HEALTH HAZARDS; CHEMICAL ANALYSIS.

80094 Accelerator Decommissioning. Opelka, J.H. (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). Div. of Environmental Control Technology. **Funding:** DOE-$85,000.
Related energy source: nuclear fission(50); nuclear fusion(50). **R and D categories:** Environmental control technology.

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.

80103 Tritium Oxidation and Exchange. Easterly, C.E. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 02610. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The development of fusion reactors to provide a long-term energy source must be accompanied by a prudent program designed to ensure the health and safety of occupational personnel and members of the public. 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 experiment utilizing gas phase reactions of tritium gas at various pressures and atmospheric air will be employed to determine the rate and mechanisms of conversion of HT to HTO.
Keywords: THERMONUCLEAR REACTORS; TRITIUM; ENVIRONMENTAL IMPACTS; RADIATION HAZARDS; OXIDATION.

81003 Early and Late Effects of Radiation of Different Quality and at Different Dose Rates. Baum, J.W.; Rohrig, N. (Brookhaven National Laboratory, Safety and Environmental Protection Division, Upton, NY, 11973). **Project number:** 000008. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$228,000.
Related energy source: nuclear fission(80); nuclear fusion(20). **R and D categories:** Physical and chemical processes and effects; Health effects.

The primary objective of this program is the accumulation of experimental information for the development and evaluation of theoretical models of the mechanisms involved in the induction of biomedical effects by ionizing radiation. Effects under study in eukaryotic cells, tissues, and whole organisms include cell killing, mutation, chromosomal aberration production, transformation, tumor induction, and DNA strand breakage. Quantitative and qualitative variations in biological response as a function of the microscopic distribution of energy deposition provide significant insights into the action of radiation, and often of other physical and chemical agents as well. Irradiation of monolayers of mammalian cells with monoenergetic charged particles provides a minimum spread of radiation quality over a large and interesting range of lineal energy deposition. Response to radiations of such defined quality, dose, and dose rate at different stages in the cell cycle must be accounted for by any theory of the mechanisms of radiation biology. For exposure of large organisms and for more applied purposes (regulatory and cancer considerations) monoenergetic neutrons provide a convenient high LET radiation modality with defined spectra of radiation quality. A dedicated Van de Graaff generator makes possible the production of these radiations over a wide spectrum of energies.
Keywords: EARLY RADIATION EFFECTS; DELAYED RADIATION EFFECTS; BIOLOGICAL RADIATION EFFECTS; ANIMAL CELLS; TISSUES; CHROMOSOMAL ABERRATIONS; DNA; STRAND BREAKS; MUTAGENESIS; RADIOSENSITIVITY; GENETIC RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS; MAN.

81004 Early and Late Effects of Fossil Energy Pollutants on Experimental Animals. 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: fossil fuels(25); coal(25); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Health effects.

This research combines investigation of the acute and chronic effects of inhaled benzene, metabolic products of benzene, and other energy-derived pollutants on immune systems. The industrial use of benzene from fossil energy processes continues to increase; benzene is now being added to gasoline to replace lead as an anti-knock agent. The protection normally conferred on individuals by immunization with antigens and vaccines may be greatly reduced after exposure to benzene. The most dramatic effect of chronic exposure to benzene is depression of the bone marrow with subsequent development of aplastic anemia. The appearance of leukemia in man has long been associated with exposure to benzene. A great void exists in the literature concerning the effects of inhaled benzene on antibody formation and other immune responses. The objectives of this research are directed to the following interdependent areas of immunologic study: (1) effects of benzene upon tetanus antitoxin responses and identification of the subclasses of globulins affected; (2) evaluation of lymphoid cellular elements affected; (3) capacity of benzene to combine with self proteins to elicit autoimmune disease; (4) sensitivity to anaphylaxis; (5) effects of a benzene-antigen mixture to elicit anaphylaxis by inhalation; (6) benzene effects upon susceptibility and immunity to bacterial infections; and (7) benzene effects upon the incidence of lymphocytic and/or myelocytic leukemia in mice.
Keywords: BENZENE; BIOLOGICAL EFFECTS; FOSSIL FUELS; GASOLINE; ADDITIVES; METABOLISM; INHALATION; CHRONIC EXPOSURE; IMMUNOLOGY; BONE MARROW; LEUKEMIA; MICE; BIOLOGICAL STRESS; ANEMIAS; ERYTHROCYTES; CARCINOGENESIS; TOXICITY; IMMUNOGLOBULINS; INHIBITION.

81015 Effect of Energy-Derived Pollutants on Hemopoietic and Other Organs. Cronkite, E.P. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 000024. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$602,000.
Related energy source: fossil fuels(90); nuclear fuels(general)(10). **R and D categories:** Integrated assessment; Health effects; Ecological/biological processes and effects.

Energy-produced chemical pollutants, e.g., benzene and many polycyclic hydrocarbons are capable of producing leukemia, hypoplastic to aplastic bone marrow, and hemopoietic dysplasias frequently preceding the appearance of leukemia. The chemical moieties in pollutants produced by combustion of fossil fuels contain known carcinogens and substances chemically related to materials that have produced hemopoietic dysplasia (HD). The target cells for leukemogenesis and HD are the hemopoietic stem cells. The first

objective is the development of a new method for determining the route of absorption, cellular location, and the concentration of radiolabeled pollutants by freezing cell suspensions and allowing target cells to accumulate radiation injury. The second objective is the development of a system for separating pure stem cells and culturing them either in vitro or in peritoneally implanted diffusion chambers in the presence of candidate leukemogens from pollutants. The leukomogenic, HD, and hypoplastic potential will be tested by transplantation of the treated stem cells into syngeneic mice. The third objective is the description of the cell-to-cell interactions within the bone marrow, definition of the feedback loops controlling differentiation into cell lines, and description of the mechanisms which determine the rates of hemopoietic cell proliferation. This objective will be pursued as required to help understand the effects of pollutants on hemopoiesis. The fourth objective is the study of hemopoiesis in chronic pulmonary disease in collaboration with the Pulmonary group (GK-01-02-01-2-a) and the Lymphopoiesis Group (GK-01-02-01-2-c).

Keywords: BENZENE; POLYCYCLIC AROMATIC HYDROCARBONS; BIOLOGICAL EFFECTS; ANEMIAS; FOSSIL FUELS; LEUKEMOGENESIS; LEUKEMIA; CARCINOGENS; BIOLOGICAL PATHWAYS; RADIONUCLIDE KINETICS; RADIOISOTOPES.

81020 Medical Studies of the People of the Marshall Islands Accidentally Exposed to Fallout. Conard, R.A. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 000032. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$524,000.

Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The primary objective is the determination of the life-time effects of fallout radiation on the Marshallese who were accidentally exposed to radioactive fallout on March 1, 1954. Medical Surveys of these people are conducted at quarterly intervals, and an unexposed Rongelap population is examined for comparison. The surveys, carried out jointly by Brookhaven National Laboratory under the auspices of the Department of Energy, and the Trust Territory of the Pacific Islands, are of great importance in view of the development in this population of growth impairment in some exposed children, thyroid lesions, and one case of acute leukemia.

Keywords: MARSHALL ISLANDS; FALLOUT; HUMAN POPULATIONS; ACCIDENTS; LIFE SPAN; ANIMAL GROWTH; INHIBITION; LEUKEMIA; THYROID; NEOPLASMS; BIOLOGICAL RADIATION EFFECTS; DELAYED RADIATION EFFECTS; JUVENILES; RADIOINDUCTION; MEDICAL SURVEILLANCE; ENDOCRINE DISEASES.

81022 Evaluation of Hazards of By-Products from Nuclear and Non-Nuclear Energy Generation. Carsten, A.L. (Brookhaven National Laboratory, Medical Department, 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-$175,000.

Related energy source: fossil fuels(30); nuclear fission(35); nuclear fusion(35). **R and D categories:** Health effects.

The objectives of this study are to determine what might be the genetic and/or somatic effects of long term exposure to radioactive tritium and/or non-radioactive deuterium, isotopes of hydrogen which are major by-products of power reactors, and to compare these effects with those arising from exposure to non-radioactive energy related pollutants. Second generation mice on tritiated water (1 muCi/ml and 3 muCi/ml) are mated and the pregnant females examined for the frequency of early and late in utero embryoneal deaths. The early deaths are an indication of dominant lethal genetic effects. Mice on tritium throughout their lifetimes will be evaluated for changes in growth, life span, liver chromosome abnormalities and alterations in the bone marrow. Microscopic examination of the regenerating liver following partial hepatectotomy will be used as an indication of somatic genetic effects. Bone marrow will be evaluated for cellularity and content of hematopoietic stem cells. The final results will give an estimate of the relative hazard of exposing a population to long-term effects of radioactive and non-radioactive by-products of nuclear power reactors. Results to date indicate a measureable dominant lethal effect in mice maintained on 1 or 3 muCi/ml of tritiated water. Effects are also seen in the bone marrow as evidenced by a reduction in the number of stem cells. Cytogenetic effects are seen in the regenerating liver following the higher dose exposure. No effects on growth or lifespan have been seen.

Keywords: TRITIUM; DEUTERIUM; MICE; FEMALES; LIFE SPAN; LIVER; CHROMOSOMAL ABERRATIONS; BONE MARROW; HUMAN POPULATIONS; RADIOISOTOPES; POWER PLANTS; MUTAGENESIS; ENERGY; BY-PRODUCTS; HEALTH HAZARDS; NUCLEAR ENERGY; FOSSIL FUELS; RISK ASSESSMENT; COMPARATIVE EVALUATIONS.

81026 Radiological and Chemical Physics. Baum, J.W.; Varma, M.N. (Brookhaven National Laboratory, Safety and Environmental Protection Division, Upton, NY, 11973). **Project number:** 000040. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$86,000.

Related energy source: nuclear fission(70); nuclear fusion(20); all(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

Interaction of radiation with matter and fundamental dosimetry concepts are investigated. Emphasis is placed on studies which improve our knowledge and understanding of the mechanisms and space and time relations of energy deposition and transport in irradiated tissue-like materials. Studies of energy deposition in nanometer sized regions of tissue-like materials are made using a special low pressure ionization chamber and theoretical models. Results from these studies are correlated with available data on biological effects to further our insights into possible basic mechanisms of radiobiological damage.

Keywords: DOSIMETRY; BIOLOGICAL RADIATION EFFECTS; TISSUE-EQUIVALENT MATERIALS; ENERGY ABSORPTION; IONIZATION CHAMBERS; LET; RBE; NEOPLASMS.

81027 Characterization, Measurement and Monitoring 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: geothermal(20); ocean thermal(20); all(60). **R and D categories:** Characterization, measurement, and monitoring.

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 detector systems for charged particles, neutrons, x-rays, and ultraviolet photons. Adequate research and development is carried out on useful ideas to meet the demands of novel applications in Biology, Medicine, Physics, Chemistry, and Environmental Sciences.

Keywords: RADIATION DETECTORS; TECHNOLOGY ASSESSMENT; X RADIATION; CHARGED PARTICLES; NEUTRONS; ULTRAVIOLET RADIATION; PHOTON BEAMS; NEUTRON BEAMS; ALPHA PARTICLES; RESEARCH PROGRAMS.

81029 Cardio-Pulmonary, Behavioral, and Pathophysiological Changes in Response to Environmental Pollutants. Iwai, J. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 000043. **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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The health effects of environmental pollutants, with particular reference to cadmium, are being investigated in an animal model genetically selected for suspectibility or resistance to hypertension. Proposed studies include: (1) the synergistic effects of low levels of polychlorinated biphenyls (PCBs) on cadmium-metallothionin-induced changes in blood pressure, organ and body weights, liver and kidney function, tumor formation and organ morphology; (2) an examination of the behavioral effects of cadmium exposure with associated central and peripheral nervous system functioning (A wide range of dosage levels, ages of initial exposure, and behavioral induces will be employed); and (3) the effects of cadmium and SO2 on the converting enzyme system in the pulmonary endothelium. A related clinical investigation involves the attempt to assess the etiological significance of cadmium in hypertension. Pursuant to this end, the determination of cadmium concentrations in the blood, urine, liver and kidneys of normotensives and hypertensives will be made.

Keywords: CADMIUM; HEALTH HAZARDS; TOXICITY; SYNERGISM; POLYCYCLIC AROMATIC HYDROCARBONS; HYPERTENSION; CARDIOVASCULAR SYSTEM; ORGANIC CHLORINE COMPOUNDS; BEHAVIOR; CENTRAL NERVOUS SYSTEM; ETIOLOGY; METABOLISM.

81031 Effects of Inhalation of Energy-Related Pollutants on Lympho-Hempoietic Cells in the Lung. Chanana, A.D. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 000046. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$785,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives of this project include studies on: (1) direct effects of energy related pollutants on the hemopoietic stem cells and

leukocytes in normal animals and in animals with acute and chronic lung disease; (2) migration and residence time of neutrophils, lymphocytes and monocyte-macrophages in the lungs and the determination of whether these cells terminate in the pulmonary tissues, or return directly to the systemic circulation or via lymphatics; (3) role of enzymes liberated from pulmonary leukocytes in the induction of pulmonary emphysema; and (4) the influence of pollutant exposure on the developmental and functional integrity of the bronchial and gut-associated lymphoid tissues. The major effort during this year was devoted toward the successful development of a model for studies with energy-related inhalation pollutants in fetal, neonatal and adult animals. The sheep model will be further developed in order to permit establishment of normal baseline values of lymphohemopoietic cell fluxes through the lungs and the kinetic and functional studies of broncho-alveolar cells. Studies on B-cells, T-cells, monocytes, granulocytes and stem cells in pulmonary blood and lymph and in vitro mitogenic stimulation of pulmonary blood, lymph and broncho-alveolar cells will be expanded to include animals subjected to inhalant pollutant exposure. Immunological studies on the broncho-alveolar cells of CLL patients will be initiated.
Keywords: STEM CELLS; HEMATOPOIETIC SYSTEM; LUNGS; LYMPHOCYTES; NEUTROPHILS; BRONCHI; INHALATION; SHEEP; BIOLOGICAL MODELS; AIR POLLUTION; BIOLOGICAL EFFECTS; RESPIRATORY SYSTEM; IMMUNOLOGY; PARTICLES; BLOOD; ANIMAL CELLS; HEALTH HAZARDS; CHEMICAL EFFLUENTS.

81036 Atmospheric Diagnostics. Newman, L.; Tanner, R.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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

81037 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

81039 Electron Capture Detector and Glass Capillary Gas Chromatography. Dietz, R.N. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000753. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Four main areas have been under development, including meteorological gas-tracer instrumentation, sampling and concentration procedures, chemical conversion for analytical determinations, and development of pollution calibration standards. Gas tracer instrumentation has been directed at developing and improving electron-capture (EC) detection procedures for the determination of meteorological tracer gases (sulfur hexafluoride and perfluorocarbons) in collected air samples and directly in the field with realtime portable instruments. New laboratory instrumentation techniques based on glass-capillary gas chromatography (GC)2 at ambient and cryogenic temperatures will be applied to extending the detection of tracer compounds, and to the detection of ambient concentrations of many trace constituents such as ammonia, H2S, and SO2. Application will be extended to include detectors in all useful ranges, such as photoionization, flame-photometric, and flame-ionization, as well as electron-capture, detectors. Sample collection and transfer trapping procedures for quantitative transfer of gas-phase constituents onto the head of the capillary column will be developed. Limits of detection, separation numbers, and retention times will be determined for compounds of interest. Potential application to methods of determination of trace organic compounds from coal and oil mining and conversion processes and from treatment systems for combustion effluents will be explored.
Keywords: AIR POLLUTION; SAMPLING; CARBON COMPOUNDS; FLUORINE COMPOUNDS; GAS CHROMATOGRAPHY; TRACE AMOUNTS; TRACER TECHNIQUES; HYDROGEN SULFIDES; SULFUR DIOXIDE; AMMONIA; QUANTITATIVE CHEMICAL ANALYSIS; SEPARATION PROCESSES; MONITORING; ELECTRON CAPTURE; MEASURING INSTRUMENTS; METEOROLOGY; PLUMES.

81040 Assessment of Biomedical and Environmental Costs of Energy Systems. Hamilton, L.D. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 000756. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE-$359,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

This program aims at developing a systematic overview of biomedical and environmental costs of energy production and use. All forms of energy are being considered. Starting with a compilation of residuals from the energy system, the various pathways to man are traced. This task entails definition of transport mechanisms including chemical conversions and various links through the biosphere to man. An evaluation is then made of effects. The initial focus is on biomedical effects and environmental effects on animals, crops, other vegetation, and on land, known to affect man. This evaluation relies on available information; epidemiological data, field and laboratory studies carried out on appropriate animals and vegetation, and basic biomedical research designed to elucidate molecular and cellular mechanisms underlying biological responses to various residuals. By taking account of the magnitude of energy flow through the system and of the population exposed, total effects are calculated. The basic framework of the evaluation is provided by the national energy system models and data base in use and under development by the Brookhaven National Laboratory (BNL) Energy Systems Analysis Group (ESAG). That work provides a significant resource for this program and a means of integrating the results of the program into national energy policy analysis.
Keywords: ENERGY; BIOLOGICAL EFFECTS; ENVIRONMENTAL EFFECTS; HEALTH HAZARDS; BIOLOGICAL PATHWAYS; ENVIRONMENTAL TRANSPORT; FOOD CHAINS; ANIMALS; CROPS; PLANTS; LAND POLLUTION;

MATHEMATICAL MODELS; DATA BASE MANAGEMENT; SYSTEMS ANALYSIS; ENERGY POLICY; DECISION MAKING; ENERGY MODELS; TECHNOLOGY ASSESSMENT.

81041 Coastal Transport and Diffusion. Hopkins, T.S. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 000913. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$450,000.
Related energy source: oil and gas(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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 COBOLT 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 dispersion 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: COASTAL WATERS; DIFFUSION; TEMPERATURE GRADIENTS; SALINITY; AQUATIC ECOSYSTEMS; DATA ACQUISITION; HEAT TRANSFER; ENVIRONMENTAL TRANSPORT; WATER.

81042 Characterization, Measurement and Monitoring Oceanographic and Environmental 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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

81043 National Environmental Research Park. Raynor, G.S. (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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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.

81045 Radiation and Chemical Damage to DNA and Its Repair. 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); nuclear fuels(general)(30); solar(30). **R and D categories:** Health effects.

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.

81047 Food Chain Dynamics. Dagg, M.J. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 001303. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$375,000.
Related energy source: oil and gas(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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. Continental-shelf waters are subject to high daily, weekly, and seasonal stimuli and may be subject to high-amplitude energy-related perturbations in the future, such as offshore nuclear reactors and oil fields. Fish larvae and zooplankton are both components of the coastal ecosystem which are extremely vulnerable to damage by entrainment in heat exchangers, by oil pollution, and by critical limitation of food supply. 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 ichthyoplankton 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; FOOD CHAINS; ENERGY; ENVIRONMENTAL EFFECTS; BIOMASS; TERRESTRIAL

ECOSYSTEMS; COST BENEFIT ANALYSIS; CHEMICAL EFFLUENTS; OCEANOGRAPHY; ECOLOGY; PETROLEUM INDUSTRY; NUCLEAR ENERGY.

81048 Regional Energy Studies. Palmedo, P.F. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001304. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE-$844,000.
Related energy source: all(100). **R and D categories:** Integrated 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.

81049 Acute Effects of Energy-Related Pollutants on Lung Alveolar Macrophages and Type-2 Cells in Culture. Acevedo, J.C. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 001323. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: fossil fuels(20); coal(20); oil and gas(20); oil shales and tar sands(20); solar(20). **R and D categories:** Health effects.

The incidence of chronic pulmonary disease is increasing. Toxic agents in the environment and industrial dusts are suspected as primary causes. Power plants operating on fossil fuel will remain important sources of harmful effluents for a long time. Evaluations of suspected hazards in animal studies are indispensable but time-consuming and can be extremely costly in manpower as well as dollars. Using a tissue culture approach, it is proposed to study acute effects of suspected toxic agents on two likely target cells of the lung: the alveolar macrophage and the type 2 epithelial cell, cultured either as individual populations or in a cocultivation system. Endpoints to be measured are for macrophages: viability, release of hydrolytic lysosomal and non-lysosomal enzymes and endocytosis; and for type 2 cells: structures as observable by light and electron microscopy, especially lamellar inclusion bodies, phospholipid synthesis and cell proliferation (type 2 cells). Heavy metals and specially treated amorphous and crystalline silica with or without cadmium or nickel ions will be studied. The assay systems are planned to be used for screening other types of suspected toxic agents associated with energy production. Some of these agents may be selected for further evaluation in animal studies.
Keywords: LUNGS; RESPIRATORY SYSTEM DISEASES; AEROSOLS; INHALATION; HEALTH HAZARDS; AIR POLLUTION; METALS; SILICA; CADMIUM; NICKEL; MAMMALS; PARTICLES; TOXICITY; ANIMAL CELLS.

81050 Primary Production and Utilization. Falkowski, P.G. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001370. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$430,000.
Related energy source: oil and gas(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The Primary Production and Utilization Program is designed to provide basic quantitative information on the primary producers and their utilization by the 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: COASTAL WATERS; AQUATIC ECOSYSTEMS; PRODUCTIVITY; ENERGY; ENVIRONMENTAL EFFECTS; FOOD CHAINS; BIOMASS; CHEMICAL EFFLUENTS; OCEANOGRAPHY.

81052 Evaluation of Internally Distributed Krypton-85 as a Health Hazard. Cohn, S.H. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 001373. **Contract:** EY-76-C-02-0016. **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:** Health effects.

The emission of krypton-85 (Kr-85) from nuclear reactors constitutes a potential radiation hazard to an exposed population. The hazard is due not only to external radiation but also to internal radiation following exposure to and inhalation of the gas. To evaluate the degree of the internal radiation hazard, it is necessary to know several biological parameters of behavior of Kr-85 in human beings. Estimation of radiation dose requires that the rate of reaching tissue equilibrium concentrations of Kr-85 be determined. The objective of this study is to determine the partition coefficients for Kr-85 into human tissues as well as their saturation and desaturation rates. It is proposed to measure these biological parameters in up to 15 normal healthy subjects after inhalation of tracer amounts of Kr-79. The BNL whole body counter will be used to follow the uptake, distribution and excretion of the inhaled Kr-79. The pharmacokinetics of Kr-79 will be examined by computer analysis based on respiratory parameters of each individual. Dosimetry data were used to better define the radiation hazard from the fission product Kr-85. Since Kr is known to be soluble in body fat, the effect of adiposity on the uptake and retention of Kr-79 was evaluated in subjects representing a wide range of body fat.
Keywords: KRYPTON 85; RADIOECOLOGICAL CONCENTRATION; INHALATION; BIOLOGICAL RADIATION EFFECTS; MAN; RADIONUCLIDE KINETICS; UPTAKE; TISSUE DISTRIBUTION; EXCRETION; ADIPOSE TISSUE.

81053 Larval Fish. Walsh, J.J. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001382. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: oil and gas(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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 management of eventually-harvestable fish stocks be developed to distinguish between natural fluctuations and environmental deterioration.
Keywords: COASTAL WATERS; AQUATIC ECOSYSTEMS; FOOD CHAINS; ENERGY; HYDROCARBONS; BIOLOGICAL EFFECTS; ENVIRONMENTAL EFFECTS; AQUATIC ORGANISMS; BIOMASS; CHEMICAL EFFLUENTS; WATER POLLUTION; OCEANOGRAPHY; ECOLOGY.

81058 Oceanography Ship Charter. Barvenik, F.W. (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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

81059 Penetration Through the Gut and Bioeffects of Particulates from non-Nuclear Energy Production. Joel, D.D. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 001796. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$170,000.
Related energy source: fossil fuels(40); coal(40); conservation(20). **R and D categories:** Health effects.

Particulate pollutants enter the gastrointestinal tract from contaminated food and water and from swallowing particles initially inhaled but cleared from the lung. Consequently, the mucosal surface of the gut is a major site of contact with the environment. The objectives of this project are: (1) to study in animals the uptake, distribution and fate of non-viable particles of various size and surface characteristics administered into the intestine; and (2) to establish the biological effects of particulate pollutants including carcinogens, suspended sulfates, mineral fibers, and carcinogens adsorbed on inert particles. Inert materials such as colloidal carbon, and polystyrene of uniform sizes are used to study the uptake, total body burden, organ distribution and fate of ingested particles. Particulate pollutants will be examined for effects on DNA turnover rates, hematopoieic stem cells, intestinal-associated phagocytic system and immune response, and carcinogenesis following chronic ingestion of particle contaminated water. Uptake, distribution and fate of ingested inert particles have been described. With this background information the biological effects can be systematically studied. By providing an estimate of the hazard to animals, approximation of the hazard to man can be established.
Keywords: GASTROINTESTINAL TRACT; PARTICLES; AEROSOLS; BIOLOGICAL EFFECTS; PATHOLOGICAL CHANGES; INGESTION; IMMUNOLOGY; CARCINOGENESIS; AIR POLLUTION; HEALTH HAZARDS; CARBON; METABOLISM; FOOD; WATER; AIR; SULFATES; MINERALS; FIBERS; CARCINOGENS; CHRONIC EXPOSURE; CHRONIC INTAKE; POLYSTYRENE; TISSUE DISTRIBUTION.

81061 Aerosol Measurements and Microphysics. 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: fossil fuels(70); solar(10); other advanced(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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.

81065 Effects of Acid Rain on Terrestrial Ecosystems. Hendrey, G. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001831. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$250,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

Acid precipitation, a by-product of energy-related activities, stresses ecosystems in the northeastern United States decreasing the pH of stem-flow and through-fall, altering nutrient flux from vegetation to soil, inhibiting growth of bark and leaf-surface organisms and damaging plant tissues. Changes in soil chemistry will result in changes in microbial activities which in turn affect the rates of mineralization, nitrification, and other processes, thus altering nutrient levels in soil and the productivity of plant and animal life. A laboratory program has been established to measure (1) temporal variaion of wet precipitation chemistry within storm events; (2) visual and histological effects of acid precipitation on foliage at acute and protracted dose rates; (3) threshold limits of acid rain and acid aerosols that plants can withstand with no visual or anatomical malfunctions and no growth inhibition; (4) rates of nitrate and sulfate accumulation after exposure to compare with injury responses; (5) effects on leaf surfaces and leaching of elements through increased cell permeability; and (6) effects of acidity on denitrification, N2O production, and nitrogen fixation in soils.
Keywords: ENVIRONMENTAL EFFECTS; PRECIPITATION SCAVENGING; ACID RAIN; NUTRIENTS; PLANTS; SOILS; PLANT GROWTH; SOIL CHEMISTRY; MICROORGANISMS; NITROGEN FIXATION; INHIBITION; NITRATES; SULFATES; PERMEABILITY; AGRICULTURE.

81066 Cytogenetic Effects of Energy-Related Agents. Bender, M.A. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 001845. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$235,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The major objectives of this project are the development of sensitive chromosomal assay systems for the assessment of the mutagenic and carcinogenic potential of energy related environmental agents and elucidation of the molecular mechanisms involved in the production of chromosomal effects by such agents. Human and other vertebrate cells in tissue culture or in vivo are exposed to mutagenic agents at known stages of the cell cycle and the resulting patterns of aberrations and sister chromatid exchanges determined. Agents are selected either to produce known DNA lesions or, as in the case of ozone, because of their practical importance. Cells from persons with genetic diseases causing increased sensitivity to mutagens are studied to elucidate the role of enzymatic DNA repair mechanisms. The expected results are verification of new bioassay systems and information on molecular mechanisms that will allow confident extrapolation to actual human population exposure situations. An in vivo sister chromatid exchange bioassay system is presently being verified for several mutagen carcinogens and several routes of exposure.
Keywords: CHROMOSOMAL ABERRATIONS; MAN; VERTEBRATES; TISSUE CULTURES; IN VIVO; OZONE; BIOASSAY; MUTAGENESIS; DNA; BIOLOGICAL FUNCTIONS; BIOLOGICAL PATHWAYS; BIOLOGICAL REPAIR; IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS; GENETIC RADIATION EFFECTS; RADIOINDUCTION.

81067 Experimental Chemical-Induced and Radiation-Induced Carcinogenesis. Shellabarger, C.J. (Brookhaven National Laboratory, Medical Department, 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: fossil fuels(70); nuclear fission(30). **R and D categories:** Health effects.

Radiation causes cancer. Certain chemicals cause cancer. However, not every individual exposed to radiation or to carcinogenic chemicals develops cancer. Perhaps if the mechanism of carcinogenesis and/or factors that influence carcinogenesis were known, predictions could be made as to which individuals are at especially high risk. The approach is to develop and use a model system of carcinogenesis. This system, mammary carcinogenesis in rats, is studied in regard to radiation, certain model and environmental chemical carcinogens, and the interaction of these physical and chemical carcinogens. Completed studies suggest that radiation and chemical carcinogens are additive. Studies on dose response are in

progress. New studies on the route of ingestion of chemical carcinogens are to be started.
Keywords: CARCINOGENESIS; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; RADIOINDUCTION; FOSSIL FUELS; NUCLEAR ENERGY; BIOLOGICAL MODELS; SYNERGISM; RATS; BIOCHEMICAL REACTION KINETICS; ENDOCRINE GLANDS; HYDROCARBONS; NEOPLASMS; IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS; HEALTH HAZARDS.

81068 Real Time Measurement Systems. 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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

81074 Analysis of Energy and Environmental Policy Considerations. 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). Div. of Technology Overview. **Funding:** DOE-$170,000.
Related energy source: all(100). **R and D categories:** Integrated 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.

81076 Aerosol Chemistry and Dynamics. Tang, I.N. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 002356. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Aerosols are suspensions of particulate matter in a gaseous medium and play an important role in many atmospheric processes. The presence of aerosols in the atmosphere directly influences local visibility, regional climatic changes and, on a larger scale, the total radiation balance of the earth. Because of their high concentration and large surface-to-volume ratio, especially in urban and industrial areas, airborne particles readily serve as a sink for many harmful gaseous pollutants by providing sites for condensation, sorption, or catalytic reactions. Moreover, since the particles themselves are frequently products from pollution sources, their behavior with respect to transport and deposition is of considerable ecological significance. The objective of this research program is to elucidate the chemical and physical processes that govern the dynamic behavior of an aerosol system. Since processes such as condensation, evaporation, dissolution, crystallization, coagulation, and surface reactions directly affect the chemical composition and particle-size distribution of an aerosol, it is necessary to delineate and measure the parameters of these processes under specific conditions. This work is currently underway at Brookhaven National Laboratory (BNL). In addition, research is being initiated to undertake a systematic study of the chemical reactions which are precursory to the formation of atmospheric aerosols. The results of this continuing research program are expected to provide a better understanding of the basic mechanisms of pollutant transformation and transport in the atmosphere. In addition, data on condensational aerosol growth are becoming increasingly important for health-effect evaluation of various hygroscopic aerosols in the environment, as a result of accelerated energy consumption.
Keywords: SURFACE AIR; AEROSOLS; CHEMICAL EFFLUENTS; AERODYNAMICS; ENVIRONMENTAL TRANSPORT; METEOROLOGY; AIR POLLUTION; REACTION KINETICS.

81079 Preliminary Overview of ECT for CO2. Steinberg, M. (Brookhaven National Lab., Upton, NY). **Project number:** 800233. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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. Concerning the FHP, the approach is to conduct laboratory analyses on samples obtained from BNL's experimental FHP unit currently in operation. Based on the experimental data, conceptual flow diagrams will be prepared, including mass and energy balances, of full-scale FHP-chemical and FHP-refinery complexes. The approach to the CO2 study is to survey the literature and consolidate findings on CO2 emissions and atmospheric concentration levels. Conceptual processing schemes for removing and recovering CO2 from the atmosphere and from the industrial source streams will then be prepared.
Keywords: COAL LIQUEFACTION; FLASH HYDROPYROLYSIS PROCESS; CHEMICAL EFFLUENTS; FLOWSHEETS; POLLUTION CONTROL; CARBON DIOXIDE; AIR POLLUTION CONTROL; REMOVAL; RECOVERY.

81080 Assessment of Environmental Factors Involved in (1) the Flash Hydropyrolysis of Coal (FHP) and (2) CO2 Control Technology. Steinberg, M.; Albanese, A.S. (Brookhaven National Lab., Building 526, Upton, NY, 11973). **Project number:** 800264;800233. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

81083 MAP3S Data Management. Benkovitz, C.M. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 002352. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.

Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

A major portion of the MAP3S program is concerned with the collection, evaluation, and codification of both newly-measured and selected historical data that pertain to the distribution and evolution of energy conversion-related pollutants over the Greater Northeast. The initial purpose is to collect sufficient reliable information to assess the extent and severity of the present SO2/sulfate atmospheric burden over the region. These data will provide preliminary objective answers to questions on the spatial and temporal variability of atmospheric-sulfate aerosol, and will supply preliminary estimates of the relative impacts of particular source regions. A continuing purpose is to build a readily-accessible data bank (this to include supporting source inventory and meteorological information) against which submodel parameterization schemes and, eventually, full-parameterized, regional-pollutant transport and transformation simulations can be tested. A longer-range goal will be to provide baseline air-quality data for the Greater Northeast to which future assessments of regional atmospheric environmental impacts attributable to new energy technologies may be referred.

Keywords: SULFUR DIOXIDE; SULFATES; ENVIRONMENTAL IMPACTS; DATA ACQUISITION; AEROSOLS; AIR POLLUTION; INVENTORIES; METEOROLOGY; INFORMATION SYSTEMS; REGIONAL ANALYSIS; PACIFIC NORTHWEST REGION; ECOLOGICAL CONCENTRATION; DATA ANALYSIS; NITROGEN OXIDES; ENVIRONMENTAL TRANSPORT.

81084 Transport and Transformation Experiments (MAP3S). Michael, P.A. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 001812. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$400,000.

Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This program is a part of the Multistate Atmospheric Power Production Pollution Study (MAP3S) of the Department of Energy (DOE), Division of Biomedical and Environmental Research (DBER). The purpose of this study is to develop the ability to assess the effects of the use of fossil fuel upon health and the environment. This ability will require the development of simulation models. The overall effort is interdisciplinary and involves other DOE laboratories, other contractors, and possibly other agencies. This particular effort is aimed at obtaining experimental results to: (1) test hypothesis used in simulation models; (2) develop an understanding of mechanisms so that proper parameterization may be used in models; and (3) provide data for the testing of integrated models. In particular, measurements will be made of the vertical and horizontal distributions of sulfates. Studies of the transformation of sulfur dioxide to sulfate will be made in the atmosphere and there will be participation in large-scale field experiments.

Keywords: EARTH ATMOSPHERE; AIR POLLUTION; HEALTH HAZARDS; ENVIRONMENTAL IMPACTS; FOSSIL FUELS; SIMULATION; MATHEMATICAL MODELS; SULFUR DIOXIDE; NITROGEN OXIDES; SULFATES; FOSSIL-FUEL POWER PLANTS; PLUMES; ENVIRONMENTAL TRANSPORT; OXIDATION.

81085 MAP3S Modeling and Analysis. Meyers, R.E. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 002353. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.

Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This project is designed to perform five critical modeling and analysis functions and one research-coordination function for the Division of Biomedical and Environmental Research (DBER) Multistate Atmospheric Power Production Pollution Study (MAP3S). The modeling and analysis functions consist of development of: (1) an advanced three-dimensional Eulerian-grid pollution model treating nonlinear chemistry, long-distance transport and diffusion of sulfur compounds, NOx, O3, and related chemicals on the regional scale; (2) a variational diagnostic three-dimensional meteorological analysis model capable of objectively resolving inversions and fronts on the regional and subregional scale; (3) advanced plume laboratory reaction models incorporating lumped chemistry and the major effects of turbulent mixing upon chemical reactions; (4) a computer link from Brookhaven National Laboratory (BNL) to the National Weather Service at Suitland, MD, to supply MAP3S with timely meteorological data for experiments and modeling; and (5) the design of field experiments, including establishment of aircraft data requirements and quality assurance such as calibration flights and intercomparison programs, to test and further develop the models. In addition, R.E. Meyers will provide the MAP3S Numerical Modeling Working Group coordinating functions, consisting of chairmanship of the MAP3S Modeling Working Group and related duties.

Keywords: FUNCTIONAL MODELS; ENERGY SOURCES; EMISSION; DIFFUSION; DISTRIBUTION; SULFUR DIOXIDE; SULFUR COMPOUNDS; ENVIRONMENTAL TRANSPORT; AIR POLLUTION; OZONE; MATHEMATICAL MODELS; THREE-DIMENSIONAL CALCULATIONS; REGIONAL ANALYSIS; SULFATES.

81086 Aircraft Operations. Garber, R.W. (Brookhaven National Lab., Upton, NY, 11973). **Project number:** 002355. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$185,000.

Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

A twin-engine aircraft has been leased for exclusive use to carry out research projects which are part of the Atmospheric Sciences programs at Brookhaven National Laboratory (BNL). The aircraft is used for atmospheric sampling and analysis experiments. Routine observation of the horizontal and vertical distribution of pollutants which are conducted for the MAP3S program require about one-half of its scheduled flight time. Plume studies which are part of the MAP3S program require about one-quarter of the scheduled flight time. The remaining scheduled flight time is used principally for cooperative atmospheric studies with observation teams from other organizations which are part of the MAP3S program. Other BNL Atmospheric Sciences programs may obtain flight time on this aircraft on a cost-recoverable basis. For certain studies which are conducted for the MAP3S program and for other Atmospheric Sciences programs, utilization of a second small aircraft is necessary. Additional aircraft will be obtained on a short-term rental basis and outfitted with easily-installed equipment for the purposes of the specific study. As part of Aircraft Operations, a program of equipment testing, calibration, and modification is required to maintain an effective atmospheric sampling and analysis system for the aircraft.

Keywords: AIRCRAFT; RESEARCH PROGRAMS; AIR POLLUTION; BNL; AERIAL MONITORING; ECONOMICS; PLUMES.

81087 Northeast Oceanography Coordination. Manowitz, B. (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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

81088 Mass Spectrometric Determination of Environmental Pollutants. Friedman, L. (Brookhaven National Lab., Department of Chemistry, Upton, NY, 11973). **Project number:** 004027. **Contract:** EY-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: fossil fuels(15); coal(75); oil and gas(10). **R and D categories:** Characterization, measurement, and monitoring.

The investigation designed to develop mass spectrometric techniques for the assay of environmental pollutants has progressed to the point where the first data have been accumulated on the characterization of black anthracotic particulate matter in tracheobronchial lymph nodes. This pigmented material contains an integrated sample of particulate air pollutants that have penetrated the bronchial tree and are sequestered in the tracheobronchial lymph nodes. Techniques have been developed for the isolation of this particulate matter from body tissue, lipids, etc. so that determination of the relative quantity of carbon and non-combustible ash can be determined. Precise 13C/12C determinations have been made on carbon from samples obtained from unselected autopsies and these ratios are compared with body tissue 13C/12C ratios in carbon isolated from atmospheric air. This technique will be pursued to determine the utility of 13C/12C ratios in the identification of sources of carbon in the particulate matter. Spark source mass spectrometric analysis of the non-combustible ash will provide further bases of identification of sources of ingested particulate matter.
Keywords: MAN; INHALATION; CARBON; RESPIRATORY SYSTEM; TISSUE DISTRIBUTION; PARTICLE SIZE; MEASURING METHODS; ISOTOPE RATIO; CARBON 12; CARBON 13; TISSUES; SAMPLING; HEALTH HAZARDS; MASS SPECTROSCOPY; INGESTION; AIR POLLUTION; ENVIRONMENT.

81090 Detrimental Biological Effects of Magnetic Fields. Baum, J.W. (Brookhaven National Laboratory, Safety and Environmental Protection Division, Upton, NY, 11973). **Project number:** 001375. **Contract:** A093 6000. **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:** Health effects.

Controlled thermonuclear reactors will require the use of exceptionally large magnets of very high field intensity. The fields near these magnets will vary from approximately 100,000 Oersted inside the shields to possibly 10 Oersted at a few hundred meters. Many biological effects have been reported for such magnetic fields; however, their validity is open to question. A careful study of somatic, genetic and developmental effects is planned using Tradescantia as the test organism for somatic mutations and using Drosophila as the test organism for genetic and developmental effects. Tradescantia cuttings and Drosophila in various stages of development will be exposed for periods from 1 to 10 days in fields of intensity from 1 to 40,000 Oersted. Tradescantia will be scored for stamen hair mutations, pollen abortion and formation of micronuclei. Drosophila will be examined for recessive lethal mutations and possible developmental defects.
Keywords: MAGNETIC FIELDS; THERMONUCLEAR REACTORS; BIOLOGICAL EFFECTS; GENETIC EFFECTS; DROSOPHILA; TRADESCANTIA; MUTANTS; MUTAGENESIS; ENVIRONMENTAL IMPACTS.

81091 Interaction Between Energy-Related Pollutants and Oncogenic Viruses in Carcinogenesis. Pavlova, M.T. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 002350. **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: fossil fuels(30); coal(70). **R and D categories:** Health effects.

The purpose of this research is to evaluate interactions of mammalian cells, chemicals and viruses and to determine whether energy-related pollutants, such as metals and metallic compounds, nitrogen and sulfur oxides, ozone and polycyclic hydrocarbons enhance viral transformation of cells in vitro and enhance viral tumor formation in vivo. If so, quantitative information directly applicable to estimation of health risks from these pollutants will be obtained. The objectives are to develop reliable methods for rapid in vitro screening for carcinogenic and mutagenic potential of chemical agents associated with all facets of fossil energy technologies. A sensitive, quantitative technique is employed using enhancement of viral transformation frequency as the endpoint. Treatment of hamster embryo cells with cadmium, cobaltous, chromium and arsenic salts, and with carcinogenic polycyclic hydrocarbons [benzo(a)pyrene, dibenz(a,h)anthracene, 7,12-dimethylbenz(a)anthracene and 3-methylcholanthrene] resulted in an enhancement of viral transformation up to 100-fold. This adenovirus-hamster embryo transformation assay offers a reliable system for identifying potential environmental carcinogens and mutagens, and will provide information about the molecular mechanisms of carcinogenesis and mutagenesis.
Keywords: ONCOGENIC VIRUSES; CARCINOGENESIS; BIOLOGICAL MODELS; AIR POLLUTION; SYNERGISM; BIOCHEMICAL REACTION KINETICS; ANIMAL CELLS; CHEMICAL EFFLUENTS; METALS; INORGANIC COMPOUNDS; NITROGEN OXIDES; SULFUR OXIDES; OZONE; POLYCYCLIC AROMATIC HYDROCARBONS; HEALTH HAZARDS; SENSITIVITY; IN VITRO; IN VIVO; FOSSIL FUELS; MUTAGENESIS; HAMSTERS; BIOASSAY; WATER POLLUTION.

81095 Health Effects of Atmospheric Pollutants Resulting from Energy Generation and Utilization. Drew, R.T. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 002198. **Contract:** Ey-76-C-02-0016. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE-$736,000.
Related energy source: coal(60); oil and gas(30); solar(10). **R and D categories:** Health effects.

The objective is to assess health effects of airborne energy-related pollutants by integrating results of in vitro studies, in vivo animal inhalation studies and clinical studies of human pulmonary disease. Research is aimed at understanding how airborne pollutants react with normal lung to produce disease; assessing effects of exposure to various combinations of pollutants; developing well characterized models of disease and determining how these diseased models interact with common energy derived air pollutants; and developing more sensitive indices of altered cardiopulmonary function, quantitative morphometric techniques and close correlation of the two. Current projects include: exposure of rats to sulfur dioxide to determine whether SO2 alters the hypertensive response in rats which are susceptible to salt-induced hypertension; development of facilities for safely exposing rodents to carcinogenic compounds; and developing animal models of pulmonary fibrosis using bleomycin. Several collaborative projects are underway: immunological aspects of both SO2 + benzene; mutagenic effects of SO2, O2, O3, and benzene; effects of SO2 on a dominant lethal assay and the effect of route of exposure on the ability of DMBA to produce breast tumors.
Keywords: AIR POLLUTION; HEALTH HAZARDS; MAN; PATIENTS; IN VIVO; IN VITRO; INHALATION; SULFUR DIOXIDE; RATS; BIOLOGICAL EFFECTS; HYPERTENSION; CARDIOVASCULAR SYSTEM; BENZENE; MUTAGENESIS; OXYGEN; OZONE; SYNERGISM; AROMATICS; HYDROCARBONS; CARCINOGENESIS.

81100 Environment-Mediated Teratogenesis: Molecular Etiology and Assessment of Risk. Slater, D.W. (Brookhaven National Laboratory, Medical Department, 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: fossil fuels(100). **R and D categories:** Health effects.

The objective of the proposed research is to establish the molecular etiology of teratologic effects resulting from environmental insult using embryonic material possessing a propensity for extrapolation to other embryonic forms, including human. Environment-mediated teratogenesis is viewed as the misprogramming of genetic expression due to the derangement of cellular surveillance mechanisms normally operative during differentiation. Given its pivotal role in cell metabolism, RNA is considered to be the molecular species of choice for use as a diagnostic probe to assess the etiology of such aberrant developmental programming. This interfacing of molecular and developmental biology is specifically aimed at providing information and methodologies prerequisite to reducing environment-mediated teratogenesis, including those developmental malfunctions induced by chemicals generated from energy-related technologies, to a preventable pathology.
Keywords: TERATOGENESIS; EMBRYOS; ANIMAL CELLS; RNA; BIOLOGICAL INDICATORS; CHEMICAL EFFLUENTS; GENETIC EFFECTS; PATHOLOGICAL CHANGES; MAMMALS; MAN.

81103 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: fossil fuels(100). **R and D categories:** Health effects.

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.

81109 Dose Reassessment for Populations on Rongelap and Utirik Following Exposure to Fallout from the Bravo Incident (March 1, 1954). Naidu, J.R.; Greenhouse, N.A. (Brookhaven National Laboratory, Safety and Environmental Protection Division, Building 535, Upton, NY, 11973). **Project number:** 3010. **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: nuclear fission(100). **R and D categories:** Health effects.

Incidences of thyroid nodules, benign and malignant, in the exposed populations of Utirik and Rongelap have indicated critical differences in correspondence between nodule incidence and thyroid dose for the two populations. The estimated external dose received from the time fallout began to the time of evacuation shows that the Rongelap population received an external dose (175 rads) which was about thirteen times that for the Utirik population (14 rads), and the thyroid dose was about ten times larger, whereas the incidence of thyroid nodules in the two populations were not significantly different. A preliminary study has indicated that the critical area of investigation that could shed light is the period during fallout and evacuation for both the islands. In addition, the fact that the Utirik population returned within 120 days following evacuation, whereas the Rongelap population returned only after three years, requires that we look closely at the Utirik population in terms of a longer period, both internal and external. Further studies would, therefore, have to concentrate on the re-examination of all available data in reports issued by various agencies during that period, consultations with uncertainty, and using appropriate computer programs to analyze the data. The end result will enable us to look for correlations between the incidence of thyroid nodules and the reassessed dose estimates.
Keywords: HUMAN POPULATIONS; THYROID; NEOPLASMS; FALLOUT; NUCLEAR EXPLOSIONS; BIOLOGICAL RADIATION EFFECTS; AIR POLLUTION; HEALTH HAZARDS; CARCINOGENESIS; MATHEMATICAL MODELS; BIOLOGICAL MODELS.

81111 Production and Selection of Duckweed (Lemnaceae) Strains for the Removal of Water Pollutants Resulting from Energy Production and Energy-Intensive Agriculture. 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 Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: fossil fuels(80); nuclear fuels(general)(20).

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.

81879 Intermediary Metabolism of Mutagens. Russel, L.B. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 002375. **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:** Health effects.

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 (new) project will explore the intermediate metabolism of these potential mutagens. Specifically, it will be investigated whether the initial compound or some other metabolite reaches the target cells, whether a mutagen is inactivated, whether induction occurs, and if so by what mechanism(s). Such information is needed to interpret the mutagenesis data in the mouse, and to facilitate informed extrapolation of these data from mouse to man for the purpose of formulating risk estimates. 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; MICE; GENETICS; RISK ASSESSMENT; MUTAGENESIS; CELL CULTURES; CHEMICAL EFFLUENTS.

82001 Cell-Membrane Biophysics/Environmental Agents. 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: fossil fuels(90); nuclear fuels(general)(10). **R and D categories:** Health effects.

The objectives are (1) to advance fundamental knowledge of cell-membrane systems and to apply this knowledge in studies on cellular development, differentiation, and actions of selected chemical and physical agents significant to health, with emphasis on blood cells; and (2) to develop original methods for detecting small quantities of agents and their modes of action, evaluating means for modifying undesired agent action, characterizing agent-altered and pathological cells, and large scale testing of cells from human populations. Results indicate methods are sensitive to heavy metals, drugs, aging agents acting at the whole-cell or cell-membrane level. Future work is aimed at extending sensitivity of measurement of agent-mediated, naturally pathological and normal cell osmotic sensitivity, membrane recovery/repair processes, cell size, form and deformability responses; at elucidating mechanisms of action at the cell-membrane level; and at assessing specific kinds of health hazards from exposure to mercury, lead, radiation, and physical stress. Several new kinds of methodology have emerged from this project including resistive pulse spectroscopy and Staflo cell separation methods. Further advances may be expected.
Keywords: BIOPHYSICS; CELL MEMBRANES; POLLUTION; MEASURING INSTRUMENTS; ANIMAL CELLS; ERYTHROPOIESIS; PATHOLOGY; BIOLOGICAL EFFECTS; BLOOD; HUMAN POPULATIONS; MERCURY; LEAD; IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS.

82007 Fly Ash Particle Chemistry. Hayes, T.L. (University of California, 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:** Characterization, measurement, and monitoring.

The chemistry of fly ash particles produced by coal burning power plants has usually been characterized from data obtained from multi-particle bulk analyses. While such averaged values are very

useful in determining quantity and overall composition, the distribution of the chemical elements among individual fly ash particles is not revealed by these bulk analysis techniques and can only be evaluated by the application of individual particle analysis methods. Scanning electron microscopy with x-ray elemental analysis can provide the required localization and particle identification for determining individual particle matrix chemistry. The results to date indicate substantial segregation of matrix elements among the particles. This non-uniform distribution of matrix elements can alter the distribution of many of the trace elements found in fly ash since it has been shown that sorptive behavior of the trace elements is associated with specific matrix composition of the particles. Trace element concentrations will be elevated in these particles above that estimated from multi-particle analysis. The existence of high concentration particles plays a significant role in the biological effects of fly ash exposure.
Keywords: ELECTRON MICROSCOPY; PARTICLES; ELEMENTS; SPECTROSCOPY; PARTICLE SIZE; AEROSOLS; TOXICITY; AIR POLLUTION; FOSSIL-FUEL POWER PLANTS; FLY ASH; TRACE AMOUNTS; DISTRIBUTION; CHEMISTRY; INHALATION.

82011 Effects of Pollutants on Central Nervous System. Gaffey, C.T. (University of California, Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 304. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: fossil fuels(50); nuclear fission(30); solar(10); other advanced(10). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

Functional damage to the central nervous system (CNS) by potentially harmful agents is measured in vivo with electrophysiological recording techniques. Mammals are exposed to known concentrations of environmental pollutants (e.g., ozone, CO, hydrocarbons, heavy metals) and local applications of focused laser and/or heavy-ion beams. Alterations in neural function to exposures of environmental pollutants are monitored with electrodes monitoring the EEG (electroencephalogram), ERG (electroretinogram), and ECR (evoked cortical response). Quantitative assessment of these bioelectric signals will characterize the extent and, possibly, the mechanisms of any toxic effects. Cerebellum explants from newborn rats can be maintained in vitro. These nerve cell cultures demonstrate neuronal differentiation, i.e., development of neuritic processes (dendrites and axons), arborization of dendrites, myelination of axons, and cell-to-cell communication as confirmed by the presence of synaptic potentials. These in vitro studies allow the investigator to check the developing neonatal nervous system for damage due to exposure to potentially toxic chemicals such as ozone, hydrocarbons and carbon monoxide as well as to laser and heavy-ion radiation.
Keywords: RATS; CENTRAL NERVOUS SYSTEM; OZONE; CARBON MONOXIDE; IIYDROCARBONS; TOXICITY; BIOLOGICAL EFFECTS; LASERS; HEAVY IONS; EYES.

82012 Molecular Mechanisms of Cellular Effect. Tobias, C.A. (Lawrence Berkeley Laboratory, Building 10, Room 202, Berkeley, CA, 94720). **Project number:** 00305. **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 fuels(general)(100). **R and D categories:** Health effects.

The major goal of this program is to quantify the responses of cultured mammalian cells to accelerated heavy ions, and to understand the molecular processes that lead to lethality, cell transformation, and mutation. Cell survival kinetics, including modifying effects of oxygen, are determined for cells of different DNA content as a function of kinetic energy of carbon, neon, and argon particles. The nature of DNA strand breaks produced by heavy ions and the rate of their repair will be measured. The enhancement by high-LET radiation of cell transformation by oncogenic viral and chemical agents is being determined and correlated with the characteristics of radiolesions introduced into the cellular DNA. The results of molecular and cellular studies are being analyzed in terms of charged-particle track structure; a repair-misrepair model that describes the dose-effect dependence of cell survival and the time kinetics of radiation repair is currently under development. The properties of some mammalian cell mutants are under study. The interest extends to cellular repair following exposure to heavy ions, and mixed heavy ions and x irradiation; to cell-cycle variations in heavy-ion radiosensitivity; and to the effects of radioprotectors (hydroxyl radical scavngers) and to hypoxic cell radiosensitizers. The work is relevant to ıe carcinogenic action of alpha-particle emitters, the safety of space ıight, the biological actions of space radiation, and the development of heavy-ion cancer therapy.
Keywords: ARGON IONS; CARBON IONS; NEON IONS; IRRADIATION; CELL CULTURES; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; DNA; STRAND BREAKS; RADIOINDUCTION; BIOLOGICAL REPAIR; MUTATIONS; CELL KILLING; MOLECULAR BIOLOGY; MUTAGENESIS; CARCINOGENESIS; OXYGEN; RADIOSENSITIVITY EFFECTS; KINETIC ENERGY; ONCOGENIC VIRUSES; CARCINOGENS; PARTICLE TRACKS; DOSE-RESPONSE RELATIONSHIPS; RADIOSENSITIVITY; X RADIATION; CELL CYCLE; HYDROXYL RADICALS; SCAVENGING; RADIOPROTECTIVE SUBSTANCES; RADIOSENSITIZERS.

82014 Macromolecules and Pollutant Damage. Lindgren, F.T. (Lawrence Berkeley Laboratory, 108 Donner Laboratory, Berkeley, CA, 94720). **Project number:** 000308. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$136,000.
Related energy source: all(100). **R and D categories:** Health effects.

The objective and goal of this project is to obtain new information and insights on: (1) the mechanism of pollutant transport in the bloodstream via lipoprotein and apoproteins; (2) the initiation and membrane and cellular damage by pollutants; and (3) correlation of degree of pollutant damage with concentrations of serum lipoproteins and/or proteins. Pollutants resulting from energy production may have significant genetic and metabolic effects of man and experimental animals. To detect, measure and characterize these potential effects, we are developing an automatic quantitative micro lipoprotein and protein screening test for humans and experimental animals. We intend to apply all methodology and instrumentation developed to both animals and man. Application will be with experimental animals and humans accidentally exposed to these agents. Where appropriate, detailed biochemistry as well as the morphology and ultrastructure by electron microscopy will be determined on the abnormal tissues and macromolecules.
Keywords: BIOLOGICAL PATHWAYS; METABOLISM; PROTEINS; LIPOPROTEINS; CELL MEMBRANES; TOXICITY; CHEMICAL EFFLUENTS; POLLUTION; GENETIC EFFECTS; MAN; ANIMALS; BIOSYNTHESIS; OZONE; MORPHOLOGICAL CHANGES.

82015 Ecosystem Stability. Harte, J. (University of California, Lawrence Berkeley Lab., Energy and Environment Division, Berkeley, CA, 94720). **Project number:** 000310. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to better understand the stability properties of perturbed ecosystems and to develop practical stability indicators for use in predicting the responses of ecosystems to perturbations caused by energy-related activities. The approach employed consists of: (1) theoretical analysis of model ecosystems; (2) development of a microcosm facility consisting of replicate freshwater lake laboratory systems; (3) testing of hypothetical stability indicators in microcosms; and (4) field applications of stability indicators (however funding has not permitted field stage of project to commence). To date, a thorough assessment has been carried out of the optimum design, initiation, and operation procedures for microcosm use in environmental impact assessment. Theoretical candidates for stability indicators have been identified and preliminary testing of them in the microcosm facility has taken place. Unexpected cancellation of project by DOE forecloses future results.
Keywords: ECOSYSTEMS; STABILITY; ENERGY SOURCES; ENVIRONMENTAL EFFECTS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; METALS; HYDROCARBONS; SULFUR COMPOUNDS; BIOLOGICAL INDICATORS; ENVIRONMENTAL EFFECTS; WATER POLLUTION; PLANTS.

82016 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 fuels(general)(100). **R and D categories:** Health effects.

The objective of this project is to describe quantitatively in monkeys the circulatory transport, gross and microscopic distributions in tissues and bones, and temporal changes of those distributions for some biologically important and potentially hazardous radionuclides, Sr-90, Pu-238, and Am-241. Subjects are Macaques of known age (M. mulatta, M. fasicularis, M. arctoides). Single doses of radionuclides are given parenterally as soluble citrate complexes to mimic behavior after absorption into the body. Dosages (5 to 14 muCi/kg of Sr-90 or about 0.3 muCi/kg of actinides) avoid acute injury but allow accurate radioanalysis. Studies and methods include metabolic balance using radiochemical analysis; kinetics using in vivo whole- and partial-body counting and scanning; and microdistribution and morphology using auto- and microradiography. Radionu-

clide exposure limits (used to design and operate safe nuclear facilities) are met by limiting intakes, and these must be calculated from element-specific metabolic models. Human metabolic data for 90-Sr, 241-Am, and 238-Pu are scarce or incomplete, and this project will develop models for them in Macaca (Old World Monkeys), a laboratory animal phylogenetically close to man. Complete simian models of actinide metabolism will (a) aid in establishing safe, realistic exposure limits, (b) increase reliability of the bioassay system (urinalysis) used to monitor implementation of intake limits, and (c) provide a framework for interpreting the human tissue data being collected by the U.S. Transuranium Registry and by environmental sampling programs.
Keywords: AMERICIUM 241; PLUTONIUM 238; STRONTIUM 90; AMERICIUM COMPLEXES; PLUTONIUM COMPLEXES; STRONTIUM COMPLEXES; CITRATES; ORAL ADMINISTRATION; MACACUS; METABOLISM; TISSUE DISTRIBUTION; RADIONUCLIDE KINETICS; SINGLE INTAKE; RADIOCHEMICAL ANALYSIS; WHOLE-BODY COUNTING; SCINTISCANNING; AUTORADIOGRAPHY; BIOLOGICAL MODELS; MAN; RISK ASSESSMENT.

82024 Long Term Effects of High-LET Radiation. Alpen, E.L. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 000475. **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: solar(100). **R and D categories:** Health effects.

The major goals of this project are to assess the potential adverse late effects of ionizing radiations of high linear energy transfer in normal animal tissues. In particular we are concerned with tumorogenesis and delayed functional effects. We will utilize rat skin, hamster lung and rat spinal cord as model systems. As required by the systems being studied, skin, spinal cord, or thorax will be irradiated with accelerated beams of neon, argon or carbon ions. Some exposures will be made with oxygen ions. At appropriate times after irradiation the animals will be either sacrificed or subjected to appropriate functional tests.
Keywords: TISSUES; LET; BIOLOGICAL RADIATION EFFECTS; RATS; HAMSTERS; LUNGS; SPINAL CORD; BIOLOGICAL MODELS; NEON IONS; ARGON IONS; CARBON IONS; OXYGEN IONS; COSMIC RADIATION; CARCINOGENESIS; MUTAGENESIS.

82025 Radiological Physics. Chatterjee, A. (Lawrence Berkeley Laboratory, Building 29, Room 216, Berkeley, CA, 94720). **Project number:** 000705. **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: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring.

There are two main objectives: (1) to understand the microscopic and submicroscopic details of energy deposition by energetic charged particles, correlate this energy deposition to biochemical change, and then analyze and evaluate the biological effects; and (2) to understand the extent and effect of break-up of the projectile particles. Energy deposition studies are primarily theoretical in nature, but the chemical analyses are being approached experimentally. The second part of the objective is studied by the time-of-flight technique. The physical process of energy deposition is quite well understood and chemical stage results are well within control. We expect to understand the damage to biological cells including repair mechanism.
Keywords: ENERGY ABSORPTION; CHARGED PARTICLES; BIOLOGICAL RADIATION EFFECTS; BREAKUP REACTIONS; BIOLOGICAL REPAIR; ANIMAL CELLS; BIOCHEMICAL REACTION KINETICS.

82027 Instrument Techniques for Environmental Monitoring. Goulding, F.S.; Haller, E.E. (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 fuels(general)(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring.

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.

82033 Instrumentation Technology for Energy-Related Contaminants. Goulding, F.S. (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: fossil fuels(20); coal(40); oil and gas(40). **R and D categories:** Characterization, measurement, and monitoring.

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.

82034 Physical Methods of Measuring Environmental Contaminants. Goulding, F.S.; 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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

82035 Tritium in Mammalian Cells. Hurki, 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: fossil fuels(40); nuclear fission(40); solar(20). **R and D categories:** Health effects.

The objective of the project is to provide a quantitative framework for evaluation of the health effects and hazards of tritium (and other DNA damaging mutagens) in mammalian cells. The research approach includes the following: (1) test system--mammalian cells (human, Chinese hamster, and mouse), normal and malignant, from various organs, including lung, kidney, ovary, testis, and skin; (2) exposure conditions--tritium, I-125, IUdR, BudR, visible light (fluorescent), uv, ionizing radiation, nitrosoguanidine, and other carcinogens and mutagens; (3) route of administration--incorporation into DNA and other macromolecules; (4) dose and duration--acut 37 degrees C, chronic exposures at 4 degrees C and -196 degrees C and (5) endpoints to be assessed--reproductive death, cell cycle kinetics, mutagenesis, chromosome changes, transformation, recovery, and molecular repair processes. Tritium mutagenesis and cell killing are similar to those expected from external low-LET radiation ionizing radiation. I-125 is like high-LET radiation. Synchro-

nous mammalian cells will be expected to be a valuable system for assaying effects of energy production related environmental mutagens.
Keywords: SYNCHRONOUS CULTURES; ANIMAL CELLS; MAN; HAMSTERS; MICE; ACUTE EXPOSURE; CHRONIC EXPOSURE; TRITIUM; IODINE 125; ULTRAVIOLET RADIATION; IONIZING RADIATIONS; VISIBLE RADIATION; BUDR; IODODEOXYURIDINE; NITROSO COMPOUNDS; GUANIDINES; CARCINOGENS; MUTAGENS; BIOLOGICAL RADIATION EFFECTS; GENETIC RADIATION EFFECTS; MUTAGENESIS; BIOLOGICAL EFFECTS; GENETIC EFFECTS; MUTATIONS; CHROMOSOMAL ABERRATIONS; CELL KILLING; REPRODUCTION; BIOLOGICAL RECOVERY; BIOLOGICAL REPAIR; CELL CYCLE; MEDIUM TEMPERATURE; LOW TEMPERATURE; COMPARATIVE EVALUATIONS.

82037 Regional Issues Identification and Assessment. Wiu, S. (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: all(100). **R and D categories:** Integrated 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.

82038 Survey of Instrumentation for Environmental Monitoring. 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: all(100). **R and D categories:** Characterization, measurement, and monitoring.

Concurrent with our need to develop new energy technologies and optimize existing conversion processes has been the understanding 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.

82039 Aerosol Chemistry. Novakov, T. (Lawrence Berkeley Lab, Univ. of California, Berkeley, CA, 94720). **Project number:** 001599. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$215,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Experimental field and laboratory study of formation of secondary aerosol species (sulfate, nitrate, amines, and organics) by heterogeneous gas-particle reactions is in progress. Emphasis is on reactions in liquid droplets that contain primary combustion-produced soot particles which serve as catalysts for the oxidation of dissolved sulfur dioxide to sulfate and nitrogen oxides to nitrate and other nitrogenous species. Significant emphasis is also placed on ways to determine experimentally the relative amount of primary and secondary carbonaceous particulate matter. The principal research tools are photoelectron spectroscopy (ESCA), Fourier transform infrared spectroscopy, Raman spectroscopy, and optical attenuation methods. Reactions are studied in a laboratory fog chamber supplemented by field measurements with a mobile instrumented van.
Keywords: AEROSOLS; SULFATES; NITRATES; AMINES; PARTICLES; ORGANIC COMPOUNDS; GASES; PHOTOELECTRON SPECTROSCOPY; SYNTHESIS; OXIDATION.

82041 Endocrine Parameters Pollutants. Garcia, J.F. (University of California, Lawrence Berkeley Laboratory, Division of Biology and Medicine, Berkeley, CA, 94720). **Project number:** 001851. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$151,000.
Related energy source: fossil fuels(25); coal(25); oil and gas(50). **R and D categories:** Health effects.

The effects of non-nuclear energy pollutants on the production, secretion and metabolism of hormones in rats are studied. Specifically, the effects of gaseous and metal pollutants are investigated. In vivo studies involve both acute and chronic administration of the pollutants. Following exposure, the rats are sacrificed and serum, the anterior pituitary, and the target endocrine glands saved for hormone assay and/or in vitro studies. The neuroendocrine response of pituitary function and hormone metabolism studies are under investigation. Short-term zone exposures (8 hr x 1 ppM) depress significantly the pituitary-thyroid axis for all parameters tested. Changes in pituitary function are also indicated by higher circulating prolactin levels and pituitary prolactin content. Presently, we are trying to determine whether the effect of ozone acts peripherally or is mediated through the central nervous system, and thus the neuroendocrine system. Chronic administration of nine metal pollutants at low levels in drinking water for six months altered pituitary and some target gland function with most metals tested.
Keywords: METABOLISM; HORMONES; OZONE; AIR POLLUTION; RATS; POLLUTION; ENERGY FACILITIES; HEALTH HAZARDS; PITUITARY HORMONES; PITUITARY GLAND; METALS; WATER POLLUTION.

82042 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

A new assay system will be developed for testing mutagenic, carcinogenic, and possibly teratogenic effects of environmental pollutants on animal cells and human cells grown in tissue culture. Animal and human cells will be grown on the surface of plastic or solid agar under extremely tightly controlled and reproducible conditions so that the morphology of the growing colonies of cells is accurately measurable and reproducible. A television camera will examine time-lapse photographs of the growing colonies and report the results to an on-line moderate sized computer.
Keywords: AIR POLLUTION; WATER POLLUTION; CARCINOGENESIS; MUTAGENESIS; TERATOGENESIS; BIOASSAY; MAMMALS; SOMATIC CELLS; CELL CULTURES; TELEVISION CAMERAS; MORPHOLOGICAL CHANGES; IMAGES; ON-LINE SYSTEMS; COMPUTERS.

82043 National Geothermal Information Resource. Phillips, S.L. (University of California, Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 002159. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: coal(25); geothermal(75). **R and D categories:** Integrated assessment.

The project objective is to collect and disseminate information relevant to environmental aspects of geothermal energy, including the following main parameters: hydrogen sulfide; subsidence; induced seismicity; monitoring; toxic trace metals; and noise. Information is collected from various sources (e.g., published literature), organized into appropriate categories, stored on computer tapes, evaluated, and disseminated (e.g., Federal, State, local government agencies, the private sector) on a worldwide basis.
Keywords: GEOTHERMAL ENERGY; ENVIRONMENTAL IMPACTS; INFORMATION RETRIEVAL; NOISE; TRACE AMOUNTS; TOXIC MATERIALS; GROUND SUBSIDENCE; STATE GOVERNMENT; LOCAL GOVERNMENT; HYDROGEN SULFIDES; SEISMIC EFFECTS; INFORMATION CENTERS.

82044 LBL Socio-Economic-Environment-Demographic Information System. Quong, C.; Austin, D.M.; Holmes, H.; Merrill, D. (University of California, Lawrence Berkeley Lab., CSAM, Bldg. 50B, Room 3238, Berkeley, CA, 94720). **Project number:** 002160. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts; Employment and Training Administration, Washington, DC (USA). **Funding:** DOE-$115,000; DOL-$355,000.
R and D categories: Integrated assessment.

The objective of the SEEDIS project is to establish a coherent, comprehensive, computer-based information system for energy policy analysis, environmental impact studies, and other socio-economc analysis applications. The system contains a variety of large data bases, such as the 1970 Census, air quality data, geographic base files, and land use data, accessible through online retrieval systems over the ARPA network, dial-up terminals, and remote batch stations. A comprehensive set of user-oriented retrieval, analysis, and graphical display modules provides tables, charts, and maps, both on interactive terminals and on high-quality hardcopy output. Computer science techniques involved include very large data bases, distributed data management, computer networks, image processing, and computer graphics. Work has begun on interfacing the system to a distributed mini-computer network, as well as the ARPA network; and on implementation techniques for installing and distributing summary data from the 1980 Census. SEEDIS is an operational system used extensively by personnel in DOE, DOL, other federal and state agencies. Research and development will include enhancement of the user interface, development of distributed data management techniques, improvements and refinements of analytical/display techniques and addition of new data sources.
Keywords: SOCIO-ECONOMIC FACTORS; POPULATION DYNAMICS; ENVIRONMENTAL IMPACTS; INFORMATION SYSTEMS; ENERGY; ENVIRONMENT; S CODES; COMPUTER CODES; ENVIRONMENTAL POLICY; DATA BASE MANAGEMENT.

82049 Metabolic Brain Disorders. Sargent, T. III. (Lawrence Berkeley Lab., Donner Lab., Berkeley, CA, 94720). **Project number:** 002419. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$112,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The objective of this program is to determine what metabolic factors influence the development of mental disorders in humans, and how these factors may be influenced or produced by the environment. Metabolic intermediates or other organic compounds suspected of being involved in mental diseases are labelled with radioisotopes, including 11C, 14C, 13N, 123I, and 77Br. These are injected into experimental animals or human subjects and the dynamics of their movement in the organism are studied by measurement of the emitted radiation. With 14C, the 14CO2 in the expired breath is measured; with the gamma-emitting isotopes, the location within the body is measured as a function of time, using quantitative nuclear imaging devices developed at this laboratory: the Auger scintillation camera, the Mark II whole-body scanner, a whole-body counter, and the newly-devised ECAT-Positron-Ring Camera. To date we have demonstrated abnormalities in methionine metabolism in patients with schizophrenia, developed new radiopharmaceuticals for imaging human brain in vivo, and devised a method for measuring the effects of drugs and noxious agents on catecholamine metabolism in the rat brain. When baseline levels are established we will be able to study the effects of environmental pollutants such as ozone, pesticides, and other complex organic materials on the etiology of mental disorders.
Keywords: MAN; MENTAL DISORDERS; ETIOLOGY; METABOLIC DISEASES; OZONE; PESTICIDES; ORGANIC COMPOUNDS; METABOLITES; CARBON 11; CARBON 14 COMPOUNDS; NITROGEN 13; IODINE 123; BROMINE 77; LABELLED COMPOUNDS; BRAIN; SCINTISCANNING; CAT SCANNING; WHOLE-BODY COUNTING; METHIONINE; CATECHOLAMINES; METABOLISM; PATHOLOGICAL CHANGES; BIOLOGICAL EFFECTS; PSYCHOTROPIC DRUGS; PHARMACOLOGY; BIOCHEMISTRY.

82051 Guide for Seismic Safety. Eagling, D.G. (Lawrence Berkeley Laboratory, Berkeley, CA, 94526). **Project number:** 600063. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Operational and Environmental Safety. **Funding:** DOE-$40,000.
R and D categories: Operational safety.

The objective of this project is to provide managers of DOE facilities with a practical guide for administering a comprehensive earthquake safety program. Each section of the Guide is written by a professional with solid design and field experience in his subject. Comment and advice from the Operator-Managers' point of view is provided in each section (based upon LBL's experience) to bridge the gap between earthquake engineering and operational realities. A reference document will be published which will describe and provide practical guidelines for simplifying and speeding up the application of seismic safety to DOE facilities.
Keywords: EARTHQUAKES; SEISMIC EFFECTS; RECOMMENDATIONS; ENERGY FACILITIES; SAFETY; SAFETY ENGINEERING.

82052 Steroid Metabolism Energy Pollutants. Connell, G.M. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 001852. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$156,000.
Related energy source: fossil fuels(25); coal(25); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Health effects.

The objective is to determine the effects of a variety of metal and gaseous pollutants of energy producing technologies on endocrine physiology and especially those biochemical processes which are either controlled or in part influenced by steroid hormones. Laboratory animals will be exposed to gaseous pollutants (ozone, oxides of nitrogen and sulfur and certain hydrocarbons) in controlled exposure chambers. Effects of heavy metals such as mercury, cobalt, manganese, cadmium, nickel, lead, arsenic (and organic salts of mercury and cadmium) will be studied after administration to laboratory animals in drinking water. Alterations in endocrine end-points (i.e., steroid binding to receptors, steroid synthesis and metabolism, target organ response to tropic hormones, reproduction, fecundity and mortality) will be assessed by analytical methods which include highly sensitive and specific radioimmunoassay and radioreceptor techniques, metabolic and enzyme studies and mating experiments. Chronic low level exposures to ozone (1 ppM) has served as a model for our gaseous pollutants studies. Investigations with mice reveal a sex dependent survival phenomenon. Female rodents survive this oxidant atmosphere significanty better than male rodents. The relationships of male and female sex steroids to this response is being studied.
Keywords: STEROIDS; METABOLISM; HORMONES; ENDOCRINE GLANDS; PHYSIOLOGY; OZONE; NITROGEN OXIDES; SULFUR DIOXIDE; HYDROCARBONS; MERCURY; COBALT; MANGANESE; CADMIUM; NICKEL; LEAD; ARSENIC; DRINKING WATER; BIOSYNTHESIS; BIOASSAY; ENZYMES; REPRODUCTION; MICE; RODENTS.

82053 *Pollutants in Tissue Metabolism.* Dixon, J.S. (Lawrence Berkeley Laboratory, Division of Biology and Medicine, Berkeley, CA, 94720). **Project number:** 001849. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$96,000.
Related energy source: fossil fuels(25); coal(25); oil and gas(50). **R and D categories:** Health effects.

The objective is to establish a rational biochemical basis for quantitating early damage measurable by changes in the blood sera or other test tissues derivable from mammals by relatively non-invasive procedures following exposure to environmental pollutants. Rodents and rabbits will be exposed to a variety of inhaled pollutants such as enriched oxygen, ozone, oxides of nitrogen, sulfur and carbon, aromatic hydrocarbons and hydrogen sulfide or ingestible heavy metal pollutants such as lead, cadmium, zinc, selenium, and mercury. Detailed investigations of affected organs, notably the lung, kidney or liver, will be conducted in animal model systems to provide information indicating useful parameters measurable in the blood. These studies will indicate a number of biochemical or physical changes in animals resulting from exposure to pollutants associated with energy production from fossil fuels that can indicate the early onset of damage to humans, either by direct extrapolation or by indicating non-invasive measurements that can be carried out on relatively large segments of the human population. Results to date indicate that in rats the adverse effects of exposure to ozone are sex related; exposure to air containing a few ppM of nitric oxide or nitrogen dioxide gives rise to significant accumulations of both nitroxyhemoglobin and methemoglobin in the blood with the latter being the major product.
Keywords: MAMMALS; POLLUTION; METABOLISM; METALS; LEAD; CADMIUM; ZINC; NITROGEN OXIDES; SULFUR OXIDES; OZONE; CARBON MONOXIDE; HYDROCARBONS; HYDROGEN SULFIDES; SELENIUM; MERCURY; LUNGS; KIDNEYS; LIVER; HEALTH HAZARDS; RODENTS; RABBITS; TISSUES.

82054 Indoor Air Pollution Epidemiology Study. Hollowel' C.D. (University of California, Lawrence Berkeley Laboratory, Cyclotron Road, Berkeley, CA, 94720). **Project number:** 00186 **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: conservation(100). **R and D categories:** Health effects.

The broad goals of this project are: (1) to characterize indoor air pollution; (2) to identify the important sources, abundance, and fate of indoor air pollutants; (3) to study the abatement of indoor air pollutants; (4) to characterize exposures of the occupants to the important air pollutants; (5) to study the health and welfare effects; and (6) to assess the impact of various energy-conservation strategies on indoor air quality. The epidemiological work will concentrate on the nitrogen oxides, with careful attention being paid to all other air pollutant species which can be characterized. Results of the study indicate that levels of gaseous and respirable particulate air pollutants in the indoor environment frequently exceed the levels commonly found in the outdoor urban air. Levels of CO and NO/sub 2/ were found to exceed existing and recommended ambient air quality standards. Such findings indicate a potential impact of combustion-generated indoor air pollution on human health, and if borne out by further work they may ultimately have a large impact on energy conservation strategies for buildings, on the future design of epidemiological studies, and on the need for more stringent control of air pollution from indoor combustion sources.
Keywords: AIR POLLUTION; PERSONNEL; BUILDINGS; AIR QUALITY; NITROGEN OXIDES; CARBON MONOXIDE; HEALTH HAZARDS; EPIDEMIOLOGY; OCCUPANTS.

82055 Biological Effects of High Magnetic Fields. Tenforde, T.S. (Lawrence Berkeley Laboratory, 1 Cyclotron Road, Building 74, Room 344, Berkeley, CA, 94720). **Project number:** 02189. **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:** Ecological/biological processes and effects.

Biomagnetic effects are being investigated with the objective of providing quantitative baseline data for the establishment of exposure guidelines for workers in energy-related technologies that utilize stationary and pulsed dc fields. Magnetic field effects are being evaluated from physiological measurements in small mammals, including body temperature, cardiac activity, respiration, blood and urine composition, hormones, hematopoiesis, tissue pathology, and neurobehavioral parameters. Biomagnetic effects in potentially sensitive neural and visual tissues are being assessed by electrophysiological techniques. Development of organisms in strong fields is being studied with model insect and plant systems. After fabrication of a suitable large-volume magnet, functional studies will be carried out on the visual, cardiovascular, respiratory, and nervous systems of exposed individuals. These studies will provide a comprehensive assessment under well-controlled experimental conditions of biomagnetic effects in mammalian systems. This data will be directly relevant to the establishment of occupational exposure guidelines at fusion reactor facilities, magnetohydrodynamic systems, magnetic energy storage systems, isotope separation facilities, cyclotrons and bubble chambers, and technologies that involve induction-type devices such as induction welding.
Keywords: HVDC SYSTEMS; MAGNETIC FIELDS; BIOLOGICAL EFFECTS; MAMMALS; BODY TEMPERATURE; CARDIOVASCULAR SYSTEM; RESPIRATORY SYSTEM; ENDOCRINE GLANDS; HEMATOPOIETIC SYSTEM; NERVOUS SYSTEM; BLOOD; URINE; TISSUES; VISION; BEHAVIOR; PATHOLOGICAL CHANGES; INSECTS; PLANTS; ONTOGENESIS; DYNAMIC FUNCTION STUDIES; CHEMICAL COMPOSITION.

82056 Epidemiology of Magnetic Effects on Humans. Budinger, T.F. (University of California, Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 2688. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: all(100). **R and D categories:** Health effects.

The objective of the project is to determine the effects, if any, of the stationary and alternating magnetic and electric fields produced by controlled thermonuclear reactors, high-voltage transmission lines, magnetic energy storage systems and magnetohydrodynamic systems. This is an epidemiological study of 2000 scientists and technicians who have been exposed to high fields for substantial cumulative exposures.
Keywords: MAGNETIC FIELDS; ELECTRIC FIELDS; THERMONUCLEAR REACTORS; MHD GENERATORS; MAGNETIC ENERGY STORAGE; EPIDEMIOLOGY; PERSONNEL; ENVIRONMENTAL EFFECTS; ELECTRIC POWER; POWER TRANSMISSION LINES; HEALTH HAZARDS; MAN; BIOLOGICAL EFFECTS.

82057 Health Effects in the Petroleum Industry. Alpen, E.L. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 002692. **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: oil and gas(100). **R and D categories:** Health effects.

There exists a large population of individuals who are routinely exposed to low levels of volatile hydrocarbons during their occupationally related activities in the petroleum industry. Although it has been known for many years that some of these compounds are carcinogenic, and that they may also cause other unrelated injury to organ systems, there has been little or no specific attention to analysis of disease rates among these workers. There are, as yet, poorly defined reports that there is an elevated cancer mortality rate in Contra Costa County in California, a major refining center. We are proposing to study the epidemiology of a number of disorders, concentrating at first on cancer, cardiovascular, and respiratory disorders among refinery workers. The study would be based at the start on the Contra Costa population.
Keywords: PETROLEUM INDUSTRY; CHEMICAL EFFLUENTS; HEALTH HAZARDS; PERSONNEL; HYDROCARBONS; BIOLOGICAL EFFECTS; CARCINOGENESIS; NEOPLASMS; RESPIRATORY SYSTEM DISEASES; CARDIOVASCULAR DISEASES; EPIDEMIOLOGY; OCCUPATIONAL DISEASES; INDUSTRIAL MEDICINE.

82058 Field Studies--Participation in MAP3S. Novakov, T. (Lawrence Berkeley Lab., Univ. of California, Bldg. 73, Rm. 101, Berkeley, CA, 94720). **Project number:** 002701. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of the project are to perform chemical analyses and characterize the physical properties of particulates collected in the MAP3S region by the methods available at LBL. The emphasis is on speciation of sulfur- and nitrogen-containing species and on carbonaceous particulate matter. The goal of the research is to establish regional differences in the chemical composition of particulates. Our approach is the extensive use of size-segregated sampling for optical attenuation measurements, determination of total particulate carbon, and elemental analysis.
Keywords: AIR POLLUTION; REGIONAL ANALYSIS; SULFUR COMPOUNDS; NITROGEN COMPOUNDS; SAMPLING; CHEMICAL ANALYSIS; PARTICLES; CARBONACEOUS MATERIALS; CHEMICAL COMPOSITION; SPECTROSCOPY.

82059 Magnetic Field Dosimetry. Amer, N.M. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 2935. **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:** Characterization, measurement, and monitoring.

The development of a sensitive (approximately 1 Gauss) liquid crystal magnetic dosimeter for dosimetry purpose in nuclear fusion plants is discussed. We utilize the coupling between the anisotropy of mechanical properties of a liquid crystal-magnetic needle with external magnetic fields to optically measure the field intensity.
Keywords: THERMONUCLEAR POWER PLANTS; NEUTRON DOSIMETRY; NEUTRON DETECTION; MAGNETIC FIELDS; MEASURING METHODS.

82060 Laser Optoacoustic Spectrometer. 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 shales and tar sands(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Development of an ultrasensitive, multiparameter molecular detector for the characterization of trace contaminants at the parts per billion levels is described. To insure high selectivity and sensitivity, the use of three concepts is combined in one technique: (1) use of lasers; (2) optoacoustic detection; and (3) use of resonance absorption whenever feasible.
Keywords: EARTH ATMOSPHERE; AIR POLLUTION; PARTICLES; TRACE AMOUNTS; MONITORING; LASER SPECTROSCOPY; PHOTOACOUSTIC SPECTROMETERS; RESONANCE ABSORPTION; AIR POLLUTION MONITORS; SENSITIVITY; DESIGN.

82064 National Coal Utilization Assessment. 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). Div. of Technology Overview. **Funding:** DOE-$215,000.
Related energy source: coal(100). **R and D categories:** Integrated 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.

82066 Integrated Assessment of Environmental Impacts: Pursuing the Search for Comparability. Holdren, J.P. (Lawrence Berkeley Laboratory, 100 T-4, Berkeley, CA, 94720). **Project number:** 3212. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Integrated 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.

82067 Pollutants and the Immune System. Goodman, J.W. (Lawrence Berkeley Laboratory, Division of Biology and Medicine, Berkeley, CA, 94720). **Project number:** 3250. **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: fossil fuels(25); coal(25); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Health effects.

The objective is to determine the effects of non-nuclear energy pollutants (specifically gaseous and metal pollutants) on the immune system. Experimental animals (mice) are exposed acutely or chronically to pollutants. Their lymphoid tissues (spleen, lymph nodes, thymus) are tested for ability to perform normal immunologic functions in vivo and in vitro. In vivo experiments involve transplantation of marrow and lymphoid cells from exposed mice into heavily irradiated recipients in order to assess proliferation and functional capacities of those tissues. In vitro tests include 3-H thymidine-uptake measurements in response to T or B cell specific mitogens such as PHA, ConA, LPS.
Keywords: POLLUTION; METALS; LEAD; CADMIUM; IMMUNOLOGY; MICE; OZONE; SPLEEN; THYMUS; LYMPH NODES; HEALTH HAZARDS.

82068 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). Div. of Environmental Control Technology. **Funding:** DOE-$25,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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: (a) making the retort largely impermeable to groundwater flow by partial or complete filling with a cementitious material; (b) making the retort largely impermeable by using polymers or other agents to plug fissures in retort walls and to form localized plugs; (c) chemically immobilizing the leachables without hydraulically sealing off the retort; (d) deliberate leaching with groundwater or an organic solvent which would be captured, treated and reused, and (e) 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: IN-SITU RETORTING; GROUND WATER; WATER QUALITY; OIL SHALES; WATER POLLUTION CONTROL; ENVIRONMENTAL EFFECTS; LEACHING.

82069 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). Div. of Environmental Control Technology. **Funding:** DOE-$50,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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.

82070 Assessment of Environmental Controls for Mercury Emissions during Oil Shale Retorting. 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). Div. of Environmental Control Technology. **Funding:** DOE-$30,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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.

83002 Radiosensitivity of Oocytes and Other Mammalian Cells During Development. Dobson, R.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-252. **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 fission(30); nuclear fusion(70). **R and D categories:** Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are: (1) using the intact mammal (mouse and monkey), to identify effects induced by low exposures to tritium, other important radionuclides, and external radiation during the sensitive pre- and postnatal stages of development; and (2) to quantify these at the cell-population level, thus obtaining data necessary for critical comparisons at low exposures where hazard evaluation is most urgently needed. The approach is to chronically expose animals in utero and postnatally, then to evaluate selected cell populations by residual cell numbers and function. Emphasis is on oocytes because of high radiosensitivity and numbers set by birth. For protracted low-level exposure during the most vulnerable portion of the mammalian life cycle, we are obtaining the quantitative dose-response data required for reliable safety standards and exposure guides. Tritium administered to mice in maternal drinking water is found to cause remarkable oocyte destruction in offspring, measurable at tritium concentrations comparable to permissible occupational exposure levels. In monkeys destruction is even greater. With this sensitive system, comparisons between tritium and gamma rays show that the controversial tritium RBE (relative biological effectiveness) is greater than unity and that it increases at low exposure, reaching approximately 3.

Keywords: TRITIUM; OOCYTES; RADIOSENSITIVITY; RADIATION HAZARDS; MICE; GERM CELLS; DOSE-RESPONSE RELATIONSHIPS; TERATOGENESIS.

83003 Sperm as Indicators of Hazard. Gledhill, B.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-254. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: fossil fuels(80); nuclear fuels(general)(10); geothermal(10). **R and D categories:** Health effects.

The objective is to develop sensitive bioassay methods using mammalian spermatogenesis and particularly mature sperm as indicators of genetic, teratologic and general toxicity. The project uses optical, automated, high-speed, and content-oriented methods to measure the morphology, the variability in DNA content, and the nuclear protein composition of sperm and testis cells. Effects of chemical and physical mutagens are measured by conventional cytologic methods and by advanced flow techniques. Application of data and methods from laboratory animals is being applied to monitoring of humans. Base-line data on human sperm are being collected.
Keywords: SPERMATOZOA; BIOLOGICAL INDICATORS; SPERMATOGENESIS; BIOASSAY; ANIMAL CELLS; GENETICS; TOXICITY; TERATOGENESIS; CELL FLOW SYSTEMS; DNA; TESTES; MORPHOLOGY; HYDROCARBONS.

83005 Flow Systems Applications. Gray, J.W. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-257. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
Related energy source: fossil fuels(75); nuclear fuels(general)(10); geothermal(15). **R and D categories:** Health effects.

This project is concerned with general biological applications of the flow system facilities of the division. Several projects will be supported. These include: (1) the analysis and sorting of individual human chromosomes for biological and biochemical experiments involving the effect of clastogens on chromosomes; (2) the analysis of sperm populations to reveal the presence of aberrant sperm; (3) the identification and characterization of cell mutants; (4) the development of new techniques for cell cycle analysis; (5) the development of methods for the recognition of carcinogenesis and mutagenesis; and (6) the recognition of abnormal exfoliated cervical-vaginal cells. Support is provided to scientists interested in utilizing flow-systems in the study of a particular problem. This support includes flow systems operation, maintenance of permanent data-storage facilities, routine computer analysis of user generated data, help in incorporating flow-system technology into experimental design and in interpreting the resulting data, and the provision of suitable biological materials and information necessary for the development and testing of biologically useful flow systems. In addition our own investigations are initiated in areas where flow-systems technology might be useful.
Keywords: CELL FLOW SYSTEMS; CHROMOSOMES; SPERMATOZOA; ANIMAL CELLS; CELL CYCLE; CARCINOGENESIS; COMPUTERS; COMPUTER CODES; DATA; CARCINOGENS; GENETICS; REPRODUCTION; BIOASSAY; BIOLOGICAL MODELS; MUTANTS.

83013 Cytogenetics and Chromosome Aberrations. Carrano, A.V. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-273. **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: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

This program will investigate chromosome aberrations, including mechanisms of production, specificity of induction, persistence in cell populations in vivo and in vitro, and their functional significance. The ultimate goal of this study is to identify cytogenetic lesions formed in response to chronic exposure to pollutants and to establish a rapid quantitative measure of the lesions for monitoring exposed human populations for both somatic and genetic damage. Both in vivo (rodents, blood, bone marrow, testes) and in vitro (human diploid cells, various animal cells) test systems will be utilized. Known mutagens/clastogens (alkyating agents or radiation) will serve as a positive control for experiments. Unknown mutagens/clastogens (heavy metals, hydrocarbons) will be evaluated for their activity following acute or protracted administration. This evaluation includes flow systems analysis of chromosomal DNA content, formation and persistence of sister chromatid exchanges and direct chromosome breakage. An aerosol delivery system is also proposed. Automated clastogen test systems will be evaluated as they can be applied to quantitation or characterization of damage. Pilot studies are currently being conducted to evaluate sister chromatid exchange induction in occupationally exposed individuals.
Keywords: CYTOLOGY; CHROMOSOMAL ABERRATIONS; GENETICS; POLLUTION; HUMAN POPULATIONS; MONITORING; CHRONIC EXPOSURE; RODENTS; RABBITS; BLOOD; BONE MARROW; TESTES; CELL CULTURES; MUTAGENESIS; IONIZING RADIATIONS; DNA; STRAND BREAKS; METALS; CHEMICAL EFFLUENTS.

83014 Development of Instrumentation for Characterizing Pollutants and Their Behavior in the Environment. Kirby, J.A. (Lawrence Livermore Lab., P.O. Box 5507, L-524, Livermore, CA, 94550). **Project number:** RPIS-277. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: nuclear fuels(general)(30); nuclear fission(50); nuclear fusion(20). **R and D categories:** Characterization, measurement, and monitoring.

The objective is the design and development of an instrument for measuring in-situ americium and plutonium contamination, especially in soil. The instrument is to be portable and capable of operation by one person in a field situation. Based upon previous experience with high purity germanium detectors, a full-scale detector system is being developed.
Keywords: SPECIFICATIONS; GAMMA RADIATION; X RADIATION; SOILS; PLUTONIUM; AMERICIUM; RADIATION DETECTORS; DESIGN; RADIATION MONITORING.

83015 Continuing Enewetak Atoll Dose Assessment. Robison, W.L. (Lawrence Livermore Lab., P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-278. **Contract:** W-7405-ENG-48. **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:** Integrated assessment; Health effects.

This program will supply continuing assessment of radiological problems associated with resettlement of Enewetak Atoll. There are significant assessments which must be continuously followed up. Major problems which require continued evaluation include: (1) potential use of the northern half of Enewetak Atoll (this is critically important at Enewetak, because half of the people live in the northern half of the atoll and own land rights there); (2) evaluation of alternate living patterns which are being suggested at the atoll; (3) evaluation of diet changes as a result of alternate crop species or as a result of changes in location or practice of subsistence agriculture; (4) evaluation of potential remedial measures designed to reduce the dose to returning populations; (5) evaluation of maximum individual annual doses as well as population dose commitments; and (6) refinement of dose predictions for the atoll as new data and time dependent data become available. The assessments are continually updated as new data become available from our research programs.
Keywords: RADIOISOTOPES; POWER GENERATION; HUMAN POPULATIONS; NUCLEAR POWER PLANTS; EMISSION; COST; RADIATION DOSES; CONTAMINATION; MARSHALL ISLANDS; NUCLEAR EXPLOSIONS; URANIUM; DATA ACQUISITION; MATHEMATICAL MODELS; ENVIRONMENTAL EFFECTS; AGRICULTURE; TERRESTRIAL ECOSYSTEMS; RADIOACTIVE EFFLUENTS; RADIONUCLIDE MIGRATION.

83017 Effects of Air Pollution on Western Plant Ecosystems. Shinn, J.H. (Lawrence Livermore Laboratory, P.O. Box 5507, L-524, Livermore, CA, 94550). **Project number:** RPIS-699. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$390,000.

Related energy source: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

The objectives are to assess and to predict the impact of phyto-toxic air pollution on photosynthesis (primary productivity) of plant stands; and to apply the method at the San Bernardino National Forest and other sites in the economically important Western yellow pine complex (ponderosa pine dominant) where air pollution causes considerable losses. A portable, temperature-controlled, null-balance leaf diffusion porometer was developed for extensive measurements on diverse leaf types where both photosynthesis (14-CO2 methods) and transpiration are measured simultaneously. A larger, less-portable cuvette system for intensive, controlled fumigations was also developed and is used in the field. Sites are chosen in cooperation with U.S. Forest Service. The seasonal course of photosynthesis and stomatal response was examined in 1977, for various oxidant damage classes and water stress categories of ponderosa pine in California.

Keywords: PHOTOSYNTHESIS; PLANTS; TOXICITY; PINES; AIR POLLUTION; BIOLOGICAL MODELS; TRACER TECHNIQUES; CARBON 14; CARBON DIOXIDE; FORESTRY; OZONE; ENVIRONMENTAL EFFECTS; ENVIRONMENTAL IMPACTS; TOXICITY.

83018 Transuranic Radionuclides in Oceanic Water Columns. Noshkin, V.E. (Lawrence Livermore Lab., P.O. Box 808, L-233, Livermore, CA, 94550). **Project number:** RPIS-934. **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 fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

This study investigates the distribution of Sr-90, Cs-137, Pu-238, Pu-239, Pu-240 and Am-241 in geosecs oceanic water columns to provide baseline data on the concentrations, distributions and removal rates of these long-lived radiotoxic pollutants in the world oceans. Large volume water samples are analyzed for specific radionuclides using low-level radiochemical techniques.

Keywords: TRANSURANIUM ELEMENTS; SEAWATER; RADIOISOTOPES; STRONTIUM 90; CESIUM 137; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM 240; AMERICIUM 241; RADIONUCLIDE MIGRATION; CONTAMINATION; RADIOCHEMICAL ANALYSIS; MATHEMATICAL MODELS; DISTRIBUTION; ENVIRONMENTAL EFFECTS; BASELINE ECOLOGY; RADIOECOLOGICAL CONCENTRATION.

83019 Emissions from Advanced Combustion and Alternative Pollution Control Systems. Ondov, J.M. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-937. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

83021 Regional Atmospheric Systems: Formulation of Numerical Analytical Models. Dickerson, M.H. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-939. **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: fossil fuels(60); nuclear fuels(general)(40). **R and D categories:** Physical and chemical processes and effects.

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.

83022 Atmospheric Release Advisory Capability. Dickerson, M.H. (Lawrence Livermore Lab., P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-940. **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 fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated 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.

83023 Environmental Behavior of Radionuclides in the Coastal Environment. Noshkin, V.E. (Lawrence Livermore Lab., P.O. Box 808, L-233, Livermore, CA, 94550). **Project number:** RPIS-1309. **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: fossil fuels(20); nuclear fuels(general)(80). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

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.

83026 Biogeochemical Cycling of the Transuranics and other Radionuclides in the Marshall Islands. Noshkin, V.E. (Lawrence Livermore Lab., P.O. Box 808, L-233, Livermore, CA, 94550). **Project number:** RPIS-1508. **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 fuels(general)(70); biomass(30). **R and D categories:** Physical and chemical processes and effects.

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.

83027 Distribution and Effects of Pollutants in Power Plant Effluents in Marine Ecosystems. Harrison, F.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-1511. **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: all(100). **R and D categories:** Ecological/biological processes and effects.

In this research project, we are concerned with the distribution and effects of pollutants released from power plants into marine and freshwater ecosystems. Two tasks are defined: (1) the assessment of the impact of corrosion products that are produced in cooling systems and leached by circulating cooling waters, and (2) the assessment of the impact of fly ash that is released into the stack and deposited directly onto aquatic ecosystems and the fly ash that is collected by emission control devices and disposed of directly or indirectly into the aquatic ecosystems. Both field and laboratory studies are performed. In the field, we determine the kinds and quantities of the pollutants or their derivatives in the abiotic and biotic compartments; in the laboratory, we determine their deleterious effects on the biota and the chemical and physical factors affecting their availability to the biota. The data obtained will be used to evaluate the relative impact on aquatic ecosystems of corrosion products in liquid effluents and combustion products in atmospheric effluents.
Keywords: AQUATIC ECOSYSTEMS; SEAS; FRESH WATER; DISTRIBUTION; POWER PLANTS; ENVIRONMENTAL EFFECTS; CORROSION PRODUCTS; COOLING SYSTEMS; FLY ASH; WATER POLLUTION; CONTAMINATION.

83029 Intercalibration of Detectors for Measuring Plutonium and Other Transuranium Elements in Man. Dean, P.N. (Lawrence Livermore Lab., P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-1533. **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: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this project are to develop methods of improving the sensitivity of detection methods used in assaying transuranium elements in the lung, to identify and resolve current weaknesses in calibration techniques, and to execute a program to intercalibrate the detector systems in use at DOE supported laboratories. This program will be carried out with the guidance of an Intercalibration Committee, chaired by the principal investigator, and will involve the use of anthropomorphic phantoms, accidentally exposed personnel, and human calibration studies.
Keywords: TRANSURANIUM ELEMENTS; PLUTONIUM ISOTOPES; LUNGS; CALIBRATION; RADIATION DETECTORS; PHANTOMS; PERSONNEL; DATA; BIOLOGICAL RADIATION EFFECTS; RADIATION HAZARDS; INHALATION; RADIONUCLIDE MIGRATION; IN VIVO.

83031 Personal Plutonium Resuspension Studies. Robison, W.L. (Lawrence Livermore Lab., P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-1644. **Contract:** W-7405-ENG-48. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to evaluate the effects of an individual's occupational and recreational activities in altering his exposure to resuspended plutonium aerosols. While performing simulated recreational and occupational activities, an individual's exposure to resuspended plutonium aerosols is measured using small battery-powered air samplers. Comparison is made to a reference concentration measured by a routine high-volume air sampler. Samples of clothing will also be assayed for plutonium contamination from the soil surface. These measurements have been made in conjunction with other experiments at spill sites. Although there are still problems weighing the filters, some mass loading data has been accumulated. Some identification of elements collected on the filters has been done also.
Keywords: PLUTONIUM ISOTOPES; RADIOACTIVE AEROSOLS; OCCUPATIONS; SUSPENSIONS; AIR SAMPLERS; CONTAMINATION; SOILS; CLOTHING; DIFFUSION; INHALATION; SOILS; ENVIRONMENTAL EXPOSURE PATHWAY; BIOLOGICAL ACCUMULATION.

83032 Marshall Island Radioecology Studies for Dose Evaluation. Robison, W.L. (Lawrence Livermore Lab., P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-1676. **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:** Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Objectives are 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 in order to improve predicted dose assessments to the returning population; and to develop further understanding of the terrestrial foodchains so as to derive quidelines for agricultural practices and for agricultural development such that population exposure via terrestrial foods will be minimized. Test plantings and radionuclide recycling will be utilized. Test plots of coconut, pandanus fruit, breadfruit, squash, papaya, banana, watermelon, lime, and sweet potato have been established. The food products will be analyzed as they become available for direct estimates of radionuclide concentrations that potentially reach a resident population. Soil and soil-water nuclide concentration data will also be taken, and leaf samples will be analyzed for radionuclide content. All of these data will be used to improve predictive models to assess a potential dose commitment before a food product is readily available for consumption.
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.

83034 IVEP Geothermal-Water Quality. Pimentel, K.D. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-1944. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$310,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The project objectives are to: accumulate baseline data on water quality in Imperial Valley, California; detect and evaluate any impacts of geothermal development on water quality; participate in evaluation of alternate heat sinks for geothermal power; participate in regional water resource analysis; and explore ways that geothermal resources could be used to improve water quality in Imperial Valley. These objectives will be accomplished by accumulating water quality data already available from many federal, California, and local agencies, collecting additional data specific to our needs, and integrating these data into an overall assessment. Water quality sampling networks were established to monitor baseline chemistry in surface waters and groundwaters.
Keywords: IMPERIAL VALLEY; WATER QUALITY; GEOTHERMAL ENERGY; ENERGY SOURCE DEVELOPMENT; CALIFORNIA; REGIONAL ANALYSIS; DATA ACQUISITION; GROUND WATER; ENVIRONMENTAL IMPACTS.

83038 IVEP Geothermal-Ecosystem Quality. Shinn, J.H. (Lawrence Livermore Lab., P.O. Box 5507, L-524, Livermore, CA, 94550). **Project number:** RPIS-2342. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$400,000.
Related energy source: geothermal(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objective is to provide baseline data and to exmaine the potential long-term effects of geothermal development in Imperial Valley on shoreline habitats, aquatics, agriculture, desert ecosystems, consumptive water-use, air pollution effects, and site-specific problems. The goal is to collect and preserve inorganic and organic materials for baseline reference data and to identify existing or potential stresses on ecosystems. Seven research teams were organized to follow the above areas of focus to collect data and identify potential ecosystem stresses. Two developers of geothermal energy production sites and 10 outside agencies (universities, colleges, and government agencies) are collaborating in the field programs. All field studies have been completed, and collaborators' reports have been received. Analyses of data and synthesis of results into a final summary volume are underway.
Keywords: IMPERIAL VALLEY; GEOTHERMAL INDUSTRY; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS;

AIR POLLUTION; BASELINE ECOLOGY; ENVIRONMENTAL IMPACTS.

83040 Multistate Atmospheric Power Production Pollution Study. MacCracken, M.C. (Lawrence Livermore Lab., P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-2343. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$139,000.
Related energy source: coal(75); oil and gas(25). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This project provides funding support for the project leadership of the MAP3S program. The MAP3S goal over the next few years is to improve the understanding of temporal and spatial relationships between ambient levels and emissions from utilities in order to develop the capability to simulate more accurately the changes in pollutant concentration and nature, precipitation chemistry, and atmospheric behavior relevant to understanding and evaluating human health and ecological effects which could result from alternative strategies of generating power with fossil fuel in the northeastern United States. The project director is to provide program leadership that will integrate the individual efforts of the DOE National Laboratories and other contractors into a cohesive program.
Keywords: FOSSIL FUELS; POWER GENERATION; AIR POLLUTION; USA; SIMULATION; HEALTH HAZARDS; EVALUATION; ENVIRONMENTAL IMPACTS.

83041 Air Quality Impacts of Geothermal Development in California. Gudiksen, P. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-2347. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives of this project are to conduct air quality impact studies of present and future geothermal development within The Geysers Region; perform air quality assessments within the Long Valley, California KGRA; and complete the IVEP air quality assessment of geothermal development in the Imperial Valley and support the Imperial Valley Transition Project.
Keywords: AIR QUALITY; IMPERIAL VALLEY; LONG VALLEY; GEYSERS GEOTHERMAL FIELD; KGRA; CALIFORNIA; ENVIRONMENTAL IMPACTS; GEOTHERMAL ENERGY; ENERGY SOURCE DEVELOPMENT.

83043 IVEP Geothermal Integrated Assessment. Layton, D.W. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-2349. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE-$70,000.
Related energy source: geothermal(100). **R and D categories:** Integrated assessment.

The primary purpose of this project is to perform an integrated assessment of the impacts of large scale geothermal energy development in the Imperial Valley of California. Secondary objectives are to manage data collected by survey elements of the Imperial Valley Environmental Project (IVEP) (e.g., air quality, subsidence and seismicity, water quality, and ecosystem quality) and to transfer research results, baseline data, and other assessment information to public and private users. To carry out the project objectives, potential levels of geothermal energy development have been defined, and now impact assessments of future development are being made. Models are used to analyze air quality changes caused by H/sub 2/S emissions from power plants, the effects of H/sub 2/S on sugar beets, water supply impacts, and economic impacts. Data collected by the IVEP survey elements are entered into a computerized data base and are available for analysis or transfer to interested users. Preliminary analyses indicate that geothermal energy development will not have major environmental and socioeconomic impacts. However, large withdrawals of waste water for cooling will increase the Salton Sea's salinity and decrease its surface elevation.
Keywords: IMPERIAL VALLEY; AIR QUALITY; GROUND SUBSIDENCE; WATER QUALITY; ENVIRONMENTAL IMPACTS; HYDROGEN SULFIDES; ECONOMIC IMPACT; SUGAR BEETS; ENERGY SOURCE DEVELOPMENT; SOCIAL IMPACT; SEISMIC EVENTS; MATHEMATICAL MODELS; GEOTHERMAL POWER PLANTS; SALTON SEA; WASTE WATER; SALINITY; GEOTHERMAL ENERGY.

83045 Ground Water Quality Changes and Subsidence Effects Associated with In Situ Coal Gasification: Environmental Control Implications. Mead, S.W. (Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA, 94550). **Project number:** RPIS-800155. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$185,000; EPA-$250,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

83046 IVEP Geothermal Subsidence and Seismicity. Crow, N.B. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-2341. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$358,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects.

This project has the objectives of documenting the naturally occurring levels of subsidence and seismicity in the Imperial Valley of California and of identifying any increase in these processes due to the development of geothermal resources. Included are development of criteria for distinguishing natural subsidence from induced movement, and natural seismic activity from induced activity. A geological model of the Imperial Valley will be developed as well as a predictive model of potential subsidence due to geothermal production activity. Subsidence detection is based upon precise leveling networks, surveyed to first- or second-order standards. Repeated surveys at intervals of one or two years will show any changes in elevation of points on the network, thus measuring land-surface elevation changes. A regional seismographic network and microseismic network will be utilized to determine baseline seismic activity in the Valley.
Keywords: IMPERIAL VALLEY; SEISMIC EVENTS; GROUND SUBSIDENCE; GEOLOGIC MODELS; GEOTHERMAL ENERGY; GEOTHERMAL RESOURCES; ENERGY SOURCE DEVELOPMENT; MICROEARTHQUAKES; SEISMOGRAPHS.

83047 Environmental Policy Analysis. Craig, P.P. (Lawrence Livermore Lab., P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-2226. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Policy Analysis. **Funding:** DOE-$100,000.
Related energy source: coal(5); oil and gas(10); solar(50); biomass(10); wind(5); conservation(20). **R and D categories:** Integrated assessment.

The objectives of the project are to provide DOE with analyses of the relationships among technical, environmental, health, economic and societal factors as they affect environmental regulation, energy and environmental RD and D policy or the commercialization of developing energy systems. The approach will include conducting specific studies to examine social costs and potential inequities that are associated with potential future energy systems for California employing small scale dispersed energy technologies.
Keywords: ENERGY SOURCE DEVELOPMENT; CALIFORNIA; HEALTH HAZARDS; SOCIO-ECONOMIC FACTORS; ENVIRONMENTAL IMPACTS; COMPARATIVE EVALUATIONS; LAND USE; COST BENEFIT ANALYSIS.

83049 Integrated Assessment to Support High Priority Geothermal Development Areas. Ermak, D.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-2626. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE-$607,000.
Related energy source: geothermal(100). **R and D categories:** Integrated 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 character-

ize 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.

83051 High Efficiency Filter Fire Research. Alvares, N.J. (Lawrence Livermore Laboratory, Box 808, Livermore, CA, 94550). **Project number:** RPIS-600007. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Operational and Environmental Safety. **Funding:** DOE-$200,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

This project is directed towards devising efficient means for protecting HEPA (high-efficiency pariticulate 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.

83052 Natural Phenomena Hazards for Department of Energy Critical Facilities. Murray, R. (Lawrence Livermore Laboratory, P.O. Box 808, L-90, Livermore, CA, 94550). **Project number:** RPIS-600022. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Operational and Environmental Safety. **Funding:** DOE-$100,000.
Related energy source: all(100). **R and D categories:** Operational safety.

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.

83056 IVEP: Health Effects. Anspaugh, L.R. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-2336. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: geothermal(100). **R and D categories:** Health effects.

The objective is to determine potential health effects associated with the development of geothermal resources, with emphasis on the Imperial Valley. Work will be carried out through a subcontract with the California Department of Health to (1) examine available effluent data and health effects data to determine relevant damage functions or to specify needed effects research; (2) establish a system for the rapid reporting of mortality and morbidity in Imperial County; (3) review occupational health programs and provide recommendations; and (4) conduct special surveys to determine the public's perception of odor annoyance and health problems. The results expected are: (1) predictive assessment of health effects from geothermal resource development; (2) early warning system to detect actual health effects should they occur; and (3) quantitative surveys of odor annoyance due to hydrogen sulfide.
Keywords: ODOR; HEALTH HAZARDS; GEOTHERMAL ENERGY; BIOLOGICAL STRESS; INFORMATION SYSTEMS; HUMAN POPULATIONS; POPULATION DYNAMICS; MORTALITY; OCCUPATIONAL SAFETY; PUBLIC RELATIONS; HYDROGEN SULFIDES; ECOLOGICAL CONCENTRATION.

83057 Project Indalo, A Study of Plutonium in the Environment. Dean, P.N. (Lawrence Livermore Lab., P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2335. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$33,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objective is to provide assistance and technical advice, including information and specialized equipment, to Spanish investigators studying the physiological and ecological behavior of plutonium oxide in a contaminated rural environment.
Keywords: PLUTONIUM; ENVIRONMENTAL TRANSPORT; PLUTONIUM OXIDES; TERRESTRIAL ECOSYSTEMS; RADIONUCLIDE MIGRATION; RADIONUCLIDE KINETICS; PLANTS; ROOT ABSORPTION; SOILS.

83058 Preliminary Assessment and Planning for Geothermal KGRAs. Phelps, P.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-2650. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Assessments. **Funding:** DOE-$425,000.
Related energy source: geothermal(100). **R and D categories:** Integrated assessment.

The project objective is to identify environmental issues and information needs associated with the development of high-priority known geothermal resources areas so that environmental research and assessment plans can be established. Methods are to compile and assess currently available information; set up workshops to bring together representatives of local, state, and federal government agencies, resource developers, power companies, etc.; and establish what is known and what is needed (formulate plans such that duplication of effort is eliminated).
Keywords: INFORMATION NEEDS; GEOTHERMAL RESOURCES; ENVIRONMENTAL IMPACTS; ELECTRIC UTILITIES; LOCAL GOVERNMENT; STATE GOVERNMENT; GEOTHERMAL ENERGY; KGRA; ENERGY SOURCE DEVELOPMENT.

83061 Geothermal Loan Guaranty Program: Assessment of Environmental Control. Phelps, P.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-800180. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$40,000.
Related energy source: geothermal(100). **R and D categories:** Environmental control technology.

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.

83062 Liquefied Natural Gas Spill Effects Program. Hogan, W.J. (Lawrence Livermore Laboratory, Box 808 L-49, Livermore, CA, 94550). **Project number:** RPIS-800230. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$1,156,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

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.

83063 Imperial Valley Environmental Project: Assessment of Environmental Control. Phelps, P.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:**

RPIS-800181. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$100,000.
Related energy source: geothermal(100). **R and D categories:** Environmental control technology.

The project objectives are: to provide identification and assessment of the efficacy and practicability of control measures to be employed by Government-sponsored geothermal energy programs in the Imperial Valley; and to provide a description of the IVEP control technologies for use in preparation of ERDA ER/EIS's for geothermal energy development in the Imperial Valley. A further objective is to confirm performance criteria of control technologies in the Imperial Valley. The approach is to: (a) search literature to avoid overlap with prior and ongoing assessments of environmental control technologies; (b) identify various environmental control technologies which were used, such as water quality, air quality, subsidence/seismicity; and integrated assessment; and (c) assess environmental control technologies for engineering efficacy and practicability.
Keywords: GEOTHERMAL ENERGY; IMPERIAL VALLEY; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; WATER QUALITY; AIR QUALITY; GROUND SUBSIDENCE; SEISMIC EVENTS; CONTROL; GOVERNMENT POLICIES; PERFORMANCE; ENVIRONMENTAL ENGINEERING; GEOTHERMAL RESOURCES.

83065 ***High Sensitivity Stack and Ambient Monitor for Measuring Transuranic Aerosols.*** Kordas, J.F. (Lawrence Livermore Laboratory, P.O. Box 5507, L-524, Livermore, CA, 94550). **Project number:** RPIS-4046. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Pollutant Characterization and Safety Research. **Funding:** DOE-$140,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

A highly sensitive transuranic aerosol measurement system (TAMS) with pseudo real-time response for measuring transuranic aerosols in stack and in ambient air for the nuclear fuel cycle is described. The system utilizes high flow rate air sampling, alpha particle detection by a large surface area solid state detector array enclosed in an evacuated detection chamber which is isolated from the corrosive collection streams; special gating logic; and a decay analysis scheme to differentiate natural alpha emitting radon daughters from transuranic alpha emitters. The monitor has two windows, one for 238Pu, 239Pu, 240Pu, 241Am and 243Am and the other for 242Cm and 244Cm.
Keywords: TRANSURANIUM ELEMENTS; RADIOACTIVE AEROSOLS; RADIOACTIVITY; RADIATION MONITORING; SURFACE AIR; STACKS; SURFACE CONTAMINATION MONITORS; RADIATION MONITORS; DESIGN; AIR SAMPLERS; RADON; DAUGHTER PRODUCTS; FUEL FABRICATION PLANTS; RADIOACTIVE EFFLUENTS; GASEOUS WASTES; ALPHA DETECTION; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM 240; AMERICIUM 241; AMERICIUM 243; CURIUM 242; CURIUM 244.

83066 **Atmospheric Characterization of Geothermal Sites: Gases, Particles and Meteorology.** Gudiksen, P. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-2643. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$35,000.
Related energy source: geothermal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this project are: (1) the development of a mobile air quality laboratory; and (2) utilization of this laboratory for air quality and meteorological measurements in support of the Imperial Valley Environmental Project. The capabilities of the laboratory will include the measurement of wind velocity, temperature, relative humidity and solar radiation as well as the concentrations of H2S, SO2, O3, NOx, CO2, and particulates. Measurements of these parameters are currently in progress in support of geothermal development in the Imperial Valley.
Keywords: AIR QUALITY; IMPERIAL VALLEY; ENVIRONMENTAL IMPACTS; WIND; AMBIENT TEMPERATURE; HYDROGEN SULFIDES; OZONE; NITROGEN OXIDES; CARBON DIOXIDE; SULFUR DIOXIDE; GEOTHERMAL RESOURCES; RESOURCE DEVELOPMENT; TEST FACILITIES.

83067 ***Development of Advanced Air Quality Instrumentation.*** Gudiksen, P. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-2832. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This project involves the development of an advanced air quality and meteorological monitoring system that can be utilized for baseline measurements in support of most DOE supported energy development technologies. It will consist of a series of meteorological and air quality sensors controlled by a central microprocessor for automatic calibration, data processing, and recording. The system is based on state-of-the-art CMOS microprocessor technology to perform these functions. The integrated system is not available in today's market place, but does utilize commercially available instrumentation whenever possible.
Keywords: AIR QUALITY; MONITORING; BASELINE ECOLOGY; METEOROLOGY; MICROPROCESSORS; EARTH ATMOSPHERE; AIR POLLUTION MONITORS; PERFORMANCE TESTING.

83073 **Heavy Metal Methylation Biochemistry and Mutagenesis.** Taylor, R.T. (Lawrence Livermore Laboratory, P.O. Box 5507 L-452, Livermore, CA, 94550). **Project number:** RPIS-1952. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$145,000.
Related energy source: coal(60); oil and gas(10); oil shales and tar sands(10); geothermal(10); conservation(10). **R and D categories:** Health effects.

The major purpose of this project is to determine the cytotoxicities and mutagenecities of six representative energy-related metals (As, Cr, Hg, Pt, Sn, and Tl), comparing the inorganic metal ions with their methylated forms. A secondary goal is to determine whether combinations of metal complexes and their methyl-derivatives have synergistic mutagenic effects. Reactivity with methyl B-12 yielding a water soluble, stable methyl-metal product is the criterion being used to assess which methylated metals should be tested as individual compounds. It is important to evaluate the influence of chemical form (valence state and alkylation) on the genetic toxicity of select metals. Cultured Chinese hamster ovary (CHO) cells are being used for these toxicity and mutagenesis studies because metal mutation data is needed for mammalian systems. Quantitative mutagenesis assays include metal compound induced resistances to 8-azaguanine (HGPRT locus) and ouabain (membrane ATPase locus). We have demonstrated that three Pt compounds (one a methylation product) increase the frequency of HGPRT variants in a dose-dependent manner. They also induce auxotrophic reversions in another CHO line. A similar approach with Cr will begin in FY 1979.
Keywords: ARSENIC; CHROMIUM; MERCURY; TIN; THALLIUM; PALLADIUM; METHYLATION; SYNERGISM; MUTAGENESIS; BIOLOGICAL MODELS; BIOASSAY; TOXICITY; HAMSTERS; METABOLISM.

83074 **Quantitative Urinary Cytology of Fossil Fuel Workers.** Mayall, B.H. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2627. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$63,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective is to develop and apply quantitative methods for the cytological evaluation of uroepithelial cells exfoliated into the urine of workers in high-risk fossil fuel extraction, conversion, and utilization industries. Image analysis will measure the amount, localization, and spatial distribution of cytochemical probes and will be used to detect differences between normal and abnormal uroepithelial cells. Quantitative cytochemical probes will reflect cellular properties such as enzymatic activity, membrane structure, and chromatin condensation. Measurements will be correlated with conventional cytomorphologic identification to evaluate the diagnostic potential of the various probes. The project should result in the reliable and early detection of cancerous changes in the uroepithelium. For the individual, the lesion will be detected at an early, treatable and perhaps reversible stage. For society, a hazardous situation will be identified so that early remedial action can be taken.
Keywords: FOSSIL FUELS; CYTOLOGY; HEALTH HAZARDS; URINE; EPITHELIUM; COAL INDUSTRY; ANIMAL CELLS; DIAGNOSIS; CARCINOGENESIS; NEOPLASMS; PERSONNEL.

83075 **Serum and Urine Enzyme Profiles of Individuals Exposed to Energy-Related Pollutants.** Smith, R.E. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2628. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$67,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The proect is directed toward evaluating the potential health effects of energy-related pollutants. By quantifying the activity of specific proteinases found in the serum and urine from persons chronically exposed to suspicious toxic agents, we are attempting to

recognize those chemical effluents which have blood or tissue damaging effect. Using fluorogenic substrates of a special new design to measure enzyme activities by fluorometric assay, we are studying several proteinases relevant to blood coagulation and tissue damage. The intentions are to develop a battery of tests (new and existing) that will provide an enzyme profile identifying the functional state of the major body organs and blood factors.
Keywords: MAN; METABOLISM; BLOOD SERUM; URINE; ENZYMES; HEALTH HAZARDS; FOSSIL FUELS.

83076 Health Effects of Fossil Fuel Processes. Mayall, B.H. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2629. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$48,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective of this program is to 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 of 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 chromatid exchange rates; incidence of red cells with mutant hemoglobin; enzyme and apolipo-protein profiles of serum; mutagenicity, enzyme profile and cytological abnormalities in urine; and frequency of abnormal sperm. All these tests are designed to detect precancerous lesions and genetic damage in man. This project will: identify tests that measure significant genetic and carcinogenic effects induced by exposure to fossil fuel pollutants; validate the dose response of the tests and their epidemiological value; apply the tests to monitor exposure of workers for potential health effects caused by fossil fuel pollutants; and allow detection of hazardous situations early enough to take remedial action to safeguard the health of the individual and society.
Keywords: FOSSIL FUELS; HEALTH HAZARDS; CARCINOGENS; MUTAGENS; AIR POLLUTION; EPIDEMIOLOGY; SAFETY; INDUSTRIAL MEDICINE; WORKING CONDITIONS; MONITORING; CHROMOSOMAL ABERRATIONS; BLOOD; URINE; GENETIC EFFECTS.

83077 Cytochemical Markers for Cell Transformation and Carcinogenesis. Vanderlaan, M. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2630. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Health effects.

The objective of this proposal is to develop cell-oriented assay procedures to identify potentially neoplastic cells early in the course of tumor develoment. Markers characteristic of neoplasia will be identified in cultured cells and in cells from the livers of rats that have been exposed to carcinogens. Markers will include changes in DNA content, enzyme levels, and membrane properties. By measuring intact cells, we will be able to recognize potentially important differences between cells and thus detect clones of aberrant cells early in the disease process. Ultimately, these studies may provide sensitive and inexpensive assays for both complete carcinogens and promoting agents, a cytochemical basis for identifying tumor cells in diagnostic cytology, thereby improving the monitoring of high-tumor-risk human populations, and insight into the mechanism of carcinogenesis and tumor promotion.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; CYTOCHEMISTRY; BIOCHEMISTRY; TUMOR CELLS; BIOASSAY; NEOPLASMS; RISK ASSESSMENT; HUMAN POPULATIONS; HYDROCARBONS.

83078 Toxicology of Effluents from In Situ Coal Gasification. Hatch, F.T. (Lawrence Livermore Laboratory, Biomedical Sciences Division, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2631. **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.

The objectives of this project are to measure the release and transport of genetically toxic materials into ground water surrounding in-situ coal gasification experiments; to provide guidance regarding potential health hazards to technology development and environmental control technology; and to contribute to integrated assessment of health effects of developing coal conversion technology. Ground water will be sampled in geometric and time profiles surrounding in situ coal gasification experiments. Preliminary fractionation will be into polar and apolar, acidic, neutral and basic fractions of organic constituents. Inorganic and organometallic pollutants will be isolated. A battery of tests for genetic damage will be used. Mutagenesis in bacterial and mammalian cells, sister chromatid exchange, injury to developing sperm and oocytes will be studied. Genetic tests results will be related to chemical analyses of fractions. Preliminary results indicate several genetic tests are capable of detecting genetically toxic agents in nonpolar basic and neutral fractions and cell toxicity in acidic fraction. Inorganic sulfur precipitation produces artifacts in the isolation of organic fractions. Future results will produce time and space profiles of genetically toxic agents, evaluate self-absorption in coal, and help to guide environmental control technology.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; GROUND WATER; WATER POLLUTION; TOXIC MATERIALS; ENVIRONMENTAL TRANSPORT; HEALTH HAZARDS; SAMPLING; FRACTIONATION; MUTAGEN SCREENING; CELL CULTURES; COAL; SORPTIVE PROPERTIES; ENVIRONMENTAL EFFECTS; POLLUTION CONTROL; HYDROCARBONS; ORGANIC COMPOUNDS.

83079 Automatic Cytologic Methods for Monitoring Genetic Injury in Humans. Branscomb, E.W. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** RPIS-2632. **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: all(100). **R and D categories:** Health effects.

This project seeks to develop and apply methods for monitoring the level of somatic mutations in humans by measuring, in samples of peripheral blood, the frequency of erythrocytes that contain certain mutant forms of hemoglobin. Antisera are being developed which will recognize the mutant hemoglobins and, when fluorescently labelled, allow cells containing the variant hemoglobins to be detected and enumerated by fluorescence microscopy and flow microfluorometry. We propose that polyvalent antisera, capable of recognizing a number of different mutant hemoglobins arising in one mammalian species will be produced by immunizing that species with hemoglobin from another species. The point mutations so detected will be among those that define the evolutionary divergence between the two species. Efforts to test this proposal in rabbits immunized with human hemoglobin have so far failed because of our inability to produce sera of sufficient titer. Methods of increasing the immunogenicity of hemoglobin are now being investigated.
Keywords: GENETIC EFFECTS; MUTATIONS; HUMAN POPULATIONS; BLOOD; BIOASSAY.

83080 Collaborative Project for Inter-Laboratory Information Exchange. Ries, D.R. (Lawrence Livermore Laboratory, P.O. Box 808, L-316, Livermore, CA, 94550). **Project number:** RPIS-2833. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$25,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The Interlaboratory Working Group for Data Exchange (IWGDE) was set up to facilitate the sharing and exchange of relevant energy and environmental data among DOE laboratories and other investigators. The committee's approach has been to define and implement data exchange standards for magnetic tape and to establish a set of reference data bases required by relevant projects at each of the laboratories. A standard has been defined and accepted by the IWGDE Committee. It is now being considered by the American National Standards Institute for the Tape Standard for data base exchange. Three levels of computer software to implement the standard have been defined. Level one software has been implemented at seven cooperating laboratories. Level two implementations should be completed by February 1979. Specific needs and problem areas in data exchange have been addressed. Specific data exchanges have been recorded, a standard primer for interchanging geo-coded or spatial data has been developed, and potential future reference data bases are currently being cataloged.
Keywords: ENERGY; ENVIRONMENTAL EFFECTS; ENVIRONMENTAL IMPACTS; DATA ACQUISITION; INFORMATION SYSTEMS; STANDARDS; COMPUTERS; MAGNETIC TAPES.

83082 Modeling Climatic Effects of CO2 Increase. Knox, J.B. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** RPIS-3028. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

84001 Life-Shortening Effects as a Function of Dose Rate Dose and Age at Exposure. Spalding, J.F. (Los Alamos Scientific Lab., P.O. Box 1663, LASL H-4, MS 880, Los Alamos, NM, 87544). **Project number:** 000119. **Contract:** F601. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

To determine the biological effects of ionizing radiation from the combinations of total dose, dose rate, age at exposure, and genetic sensitivity to neoplastic transformation, animals in 4 age groups (new born, 2 month, 6, and 15 months old) were exposed to five doses (20, 60, 180, 540, and 1620 rad) at six dose rates (0.7, 2.1, 6.3, 18.9, and 56.7 rad/day, and 25 rad/min). A mouse strain insensitive to neoplastic transformation was used. Life span and cause of death are end points of consideration. Because of the complexity of the project and number of animals used, it is being done in two replications. Data from the 15 month age group are complete (both replications) and show no significant effect of any dose given at any dose rate on life span and/or incidence of neoplastic disease. All project data will be available for analysis and publication by October 1, 1979.
Keywords: IONIZING RADIATIONS; CHRONIC IRRADIATION; LOW DOSE IRRADIATION; WHOLE-BODY IRRADIATION; GAMMA RADIATION; MICE; DOSE RATES; AGE DEPENDENCE; BIOLOGICAL RADIATION EFFECTS; CHROMOSOMAL ABERRATIONS; RADIOINDUCTION; HISTOLOGY; PATHOLOGICAL CHANGES; LIFE SPAN; DOSE-RESPONSE RELATIONSHIPS; AGING; ANIMALS; GAMMA RADIATION; PATHOGENESIS; TISSUES.

84002 Tumorigenesis in the Lung. Thomas, R.G. (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 fuels(general)(100). **R and D categories:** Health effects.

The objective is to evaluate the carcinogenic potential of various forms of radionuclides in the lung. Primary interest has been on the tumorigenicity of plutonium isotopes (238, 239) as sources of alpha particle radiation. Earlier research dealt with the lodging of ceramic particles containing radioactivity of various source strengths into Syrian hamster lungs, by injection via the jugular vein. This form of exposure has changed almost completely to the inhalation route, giving a diffuse irradiation of the lung, as opposed to the discrete hot particle situation after injection. It has become obvious that diffuse radiation to the lung is much more tumorigenic than when the same source strength is in discrete particles.
Keywords: PLUTONIUM; MICROSPHERES; BIOLOGICAL RADIATION EFFECTS; LUNGS; MAXIMUM PERMISSIBLE EXPOSURE; LABORATORY ANIMALS; CARCINOGENESIS; DOSE-RESPONSE RELATIONSHIPS; AEROSOLS; PARTICLES.

84003 Absorption, Retention, and Excretion of Energy-Related Hazardous Materials. Thomas, R.G. (Los Alamos Scientific Lab., MS 880, Los Alamos, NM, 87544). **Project number:** F-613. **Contract:** W-7405-ENG-36. **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:** Health effects.

The objective is to determine quantitatively the metabolic parameters of certain inorganic substances upon which information is lacking for establishing or revising health protection guidelines and standards. Multiple species (mice, rats, dogs, and monkeys) are administered radionuclides by various routes. Organ distribution patterns and whole-body retention are quantitated for extrapolation to humans. Radioactive tracers are used not only to follow potential radioactive contaminants but also elements that may prove hazardous in nonradioactive form.
Keywords: MICE; RATS; DOGS; MONKEYS; RADIOISOTOPES; UPTAKE; RETENTION; TISSUE DISTRIBUTION; EXCRETION; ANIMALS; INGESTION; INHALATION; METABOLISM.

84010 Photo-Adducts of Carcinogens with Model DNA. Hoard, D.E. (Los Alamos Scientific Laboratory, Group H-9, MS 886, Los Alamos, NM, 87545). **Project number:** F501. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project's objectives are to synthesize, purify, and characterize chemically covalent adducts of polycyclic aromatic hydrocarbons and DNA formed under the influence of near-ultraviolet light (wavelength 300 nm). Reactions of benzo(a)pyrene are being investigated initially; benzo(a)pyrene is reported to form covalent adducts with DNA after such irradiation in an in vitro system. Homogeneous solutions of synthetic polydeoxynucleotides (model DNA's) and labeled benzo(a)pyrene are irradiated with the output of a mercury-vapor lamp filtered to remove radiation at wavelengths below 300 nm. After reisolation, the DNA is degraded by enzymic digestion; the digest is then fractionated by chromatography on Sephadex LH-20. Analysis of isolated nucleoside-hydrocarbon adducts will be attempted by gas chromatography--mass spectrometry. When model DNA and 14C-labeled benzo(a)pyrene were irradiated with 6 x 10/ sup 8/ ergs of near-ultraviolet light between 0.05 and 0.06 umole of hydrocarbon per umole of nucleotide they appeared bound to the DNA. Isolation of hydrocarbon adducts from digests of such material is currently in progress.
Keywords: DNA; POLYCYCLIC AROMATIC HYDROCARBONS; ULTRAVIOLET RADIATION; BENZOPYRENE; BIOSYNTHESIS; PURIFICATION; BIOCHEMICAL REACTION KINETICS; CARBON 14 COMPOUNDS; PHOTOCHEMICAL OXIDANTS; CARCINOGENESIS; SHALE OIL; GAS CHROMATOGRAPHY; MASS SPECTROSCOPY; HYDROCARBONS.

84012 Repair of Chemically Damaged Chromatin. Strniste, G.F. (Los Alamos Scientific Laboratory, Cellular and Molecular Biology, MS 886, Los Alamos, NM, 87545). **Project number:** 000134. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: fossil fuels(25); oil shales and tar sands(50); solar(25). **R and D categories:** Health effects.

The objectives of this program are to: (1) study the mechanism of light activation of polycyclic aromatic hydrocarbons (PAH); (2) define the type and frequency of various lesions induced in chromatin by light-activated PAH; and (3) determine the repair potential in cells for specific classes of lesions induced in DNA by light-activated PAH. To gain insight into the dynamics of the light-activation of PAH in eucaryotic cells at the molecular level, it is mandatory to utilize a substrate in in vitro tests which will mimic the in vivo situation. To this end, we are using reconstituted complexes of histone protein and DNA which approximate the native substructure of chromatin as it exists in vivo. Naked DNA and protein-DNA complexes are being used as substrates in order to determine frequency and type of lesions induced by various light-activated PAH. The reparation of these lesions will be studied using extracts from various procaryotic and eucaryotic sources. These data along with studies concerning cytotoxic and mutagenic effects of light-activated PAH in cultured human fibroblasts should provide a better understanding of mechanisms involved in order to evaluate the potential impact of increasing abundance of PAH in the environment.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; PHOTOCHEMICAL REACTIONS; CHEMICAL ACTIVATION; ANIMAL CELLS; DNA; CHROMATIN; BIOLOGICAL REPAIR.

84016 Chromosome Structure and Function. Deaven, L.L. (Los Alamos Scientific Laboratory, Cellular and Molecular Biology, H-9, MS 886, Los Alamos, NM, 87545). **Project number:** 000219. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$102,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The transition of normal cells into the malignant state is frequently accompanied by increased variability in chromosome number and structure. Treatment of in vitro cell cultures with clastogenic agents can also result in clonal populations with altered karyotypes. Whether karyotype instability is a cause or an effect of malignant transformation its general association with transformed phenotypes makes it a relevant end point for energy-related toxicants. We are examining energy-related pollutants of the shale oil industry for their clastogenic properties and for their potential to transform cells into clonal populations with altered karyotypes. Initial studies utilize known components of oil shale applied to in vitro Chinese hamster cells (line CHO). These results are then related to complex mixtures of materials generated by oil shale

extraction. Materials with clastogenic potential, as determined by the CHO studies, will then be applied to human lymphocytes and/or fibroblasts in vitro. Materials which are clastogenic or which induce elevated levels of sister chromatid exchange at relatively high concentration will then be tested at expected environmental and/or physiological levels. Eventually, when available, selected individuals with known exposures will be examined for chromosome damage in peripheral lymphocytes.
Keywords: CHROMOSOMAL ABERRATIONS; BIOLOGICAL FUNCTIONS; CHROMOSOMES; NEOPLASMS; OIL SHALE INDUSTRY; HEALTH HAZARDS; CHEMICAL EFFLUENTS; HAMSTERS; ANIMAL CELLS; MAN.

84018 Metal and DNA Fidelity. Smith, D.A. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** 000221. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$81,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.

The primary objective of this work is to evaluate and improve the in-vitro DNA polymerase assay which was recently proposed as a screen for the detection of potential metal mutagens or carcinogens. If validated, this test will be used to determine the presence of potentially mutagenic metals in the process water and other effluents from the various approaches to production of oil from shale. Another objective is to investigate the possibility that some activated mutagens might exert their effects by reacting with DNA polymerase so as to cause these enzymes to make mistakes at a higher frequency. The effects of covalent addition to DNA of other pollutants from oil shale processing, including polycyclic aromatic hydrocarbons, on the template functions of DNA will also be investigated, as well as an evaluation of polymerase assays as a tool to measure the kinetics and extent of repair of DNA or chromatin function following exposure of cells or animals to mutagenic substances. The experimental approach used in this work is generally to incubate the purified polymerase with a simple, synthetic DNA with its correct substrates, as well as a noncomplementary deoxyribonucleotide triphosphate, and to determine the amount of incorrect substrate incorporated into acid-insoluble material and how this is influenced by the presence of exogenous agents such as metal ions or adducts on the DNA template. Experiments to date have concentrated on the effects of metal ions on RNA polymerase fidelity. A large number of metal ions have been tested. Although many of them are inhibitory, only lanthanum has definitely been shown to cause a higher error frequency. Aqueous extracts of oil shale but not spent shale are inhibitory to RNA polymerase. Preliminary experiments have been done with DNA polymerase from calf thymus. This enzyme has an exceedingly low background error frequency.
Keywords: METALS; TOXICITY; DNA; IN VITRO; MUTAGEN SCREENING; POLYCYCLIC AROMATIC HYDROCARBONS; RNA; POLYMERASES; BIOCHEMICAL REACTION KINETICS.

84023 Determination of Plutonium in Man. McInroy, J.F. (Los Alamos Scientific Lab., P.O. Box 1663, MS 486, Los Alamos, NM, 87545). **Project number:** 000380. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$297,000.
Related energy source: nuclear fuels(general)(20); nuclear fission(40); nuclear fusion(40). **R and D categories:** Health effects.

This project will establish statistically significant measurements of the base-line concentrations of environmental plutonium in the general population of geographic areas of interest to the DOE, monitor those areas where the base line has been established to determine if changes have occurred, measure the tissue distributions of plutonium in occupationally exposed workers, determine the particle size distribution of plutonium oxide aerosols in tissues of occupationally exposed workers, and evaluate the histological effects of deposited plutonium on the tissues of exposed workers. Methods utilized include collecting organs of interest from autopsies; recording pertinent epidemiological information; analyzing quantitatively for plutonium and normalizing the results to a concentration value; and statistically evaluating the distributions.
Keywords: PLUTONIUM; TISSUE DISTRIBUTION; PERSONNEL; MAN; RADIOACTIVITY; RADIATION MONITORING; AUTOPSY; EPIDEMIOLOGY; PARTICLE SIZE; INHALATION; LUNGS; PLUTONIUM; TISSUES.

84024 Ecological Investigation of Materials in Waste Discharge Areas at Los Alamos. 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: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects.

The goal of this research is to characterize distributions of some radioactive (cesium and plutonium) and stable waste (mercury) contaminants in soils, plants, and animals from intermittent streams at Los Alamos and from the fallout zone at Trinity Site in New Mexico, and to quantify the processes which govern their transport. The experimental approach was to evaluate distributions by sampling of major ecosystem components and to evaluate transfers based upon ecological variables and focused field experiments. Relatively high concentrations of radionuclides in native vegetation and in pelt and gastro-intestinal tract samples from rodents at both study locations suggest that physical and/or biological processes (rather than chemical processes) dominate in the transport of these elements to biota. In the future, this research will emphasize environmental transport processes in intermittent streams at Los Alamos because of the potential application of this information to waste management problems associated with numerous developing energy technologies throughout the southwest. We are particularly interested in any identifiable relationships between rainfall, runoff, and suspended sediment loads that might lead to a predictive capability for contaminant transport.
Keywords: RADIOACTIVE MATERIALS; LIQUID WASTES; WASTE DISPOSAL; DISTRIBUTION; PLUTONIUM ISOTOPES; AMERICIUM ISOTOPES; SOILS; PLANTS; ANIMALS; NUCLEAR ENERGY; ENVIRONMENTAL EFFECTS; RADIOECOLOGICAL CONCENTRATION; CONTAMINATION; ENVIRONMENTAL TRANSPORT; RADIONUCLIDE MIGRATION.

84025 Fine Particle Studies Related to Health and Air Cleaning. Tillery, M.I. (Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 000712. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$216,000.
Related energy source: fossil fuels(40); oil shales and tar sands(40); nuclear fuels(general)(10); conservation(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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.

84028 Analysis of the Human Health and Ecological Consequences of Plutonium and Other Transuranics. Healy, J.W. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** 000899. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Integrated assessment.

As a fuel for breeder reactors, plutonium promises to extend the uranium resources by many times and could be important in the coming energy shortage. However, public concern over its carcinogenicity has caused difficulties in such use and, in some cases, questions have been raised which were difficult to answer because the data available had not been collated and made available in a useful form. This project provides analysis of existing information to give summaries of the present data important to a given objective. It is anticipated that eventually these reviews and conclusions will be incorporated into an analysis of the total health hazards from the use of plutonium. A second objective is to provide a body of trained people to answer DOE problems involving the health effects of plutonium. A critical review of available data revealed the importance of differing experimental techniques and an increased uptake of these elements compared to plutonium. A detailed review of the first draft of an EPA standard on plutonium in soils was made at the request of DOE which revealed many technical and sociological difficulties that were discussed with EPA personnel, as well as transmitted to DOE in letters. A limit for shallow earth burial of materials contaminated with transuranic elements is being derived currently.
Keywords: HUMAN POPULATIONS; HEALTH HAZARDS; BIOLOGICAL EFFECTS; ENVIRONMENTAL EFFECTS; RADIONUCLIDE MIGRATION; RADIONUCLIDE KINETICS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; PLUTONIUM; TRANSURANIUM ELEMENTS; NEPTUNIUM; PLANTS; SOILS; UPTAKE.

84029 Ecological Investigation of Rehabilitation of Uranium Mill Tailings of the Southwestern United States. Dreesen, 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 fuels(general)(100). **R and D categories:** Ecological/biological processes and effects.

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.

84030 Los Alamos National 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: all(100). **R and D categories:** Ecological/biological processes and effects.

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.

84031 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: fossil fuels(35); nuclear fission(35); geothermal(10); solar(10); biomass(10). **R and D categories:** Physical and chemical processes and effects.

The objective is to document the major effects of terrain irregularies 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.

84034 Ecological Investigation of Alaskan North Slope Oil Field Development. Hanson, W.C. (Los Alamos Scientific Laboratory, Environmental Science Group, MS-490, Los Alamos, NM, 87545). **Project number:** 001272. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$314,000.
Related energy source: oil and gas(90); nuclear fission(10). **R and D categories:** Ecological/biological processes and effects.

The objectives are to monitor and evaluate the ecological consequences of the extraction and transportation of Alaskan North Slope petroleum resources by studying specific tundra ecosystem components; and to monitor, measure and model worldwide fallout radionuclides in the lichen--caribou--Eskimo food chain. Methods employed are (1) basic biological studies of arctic tundra nesting birds, small mammals, moose, caribou, and carnivores in the vicinity of petroleum development installations on Alaska's North Slope; and (2) measurement of 90-Sr, 137-Cs, and 238,239,240-Pu in selected ecosystem compartments of the soil--lichen--herbivore--carnivore food webs of northern Alaska.
Keywords: ALASKA; OIL FIELDS; TUNDRA; ECOSYSTEMS; FOOD CHAINS; RADIONUCLIDE KINETICS; STRONTIUM 90; CESIUM 137; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM 240; SOILS; ENVIRONMENTAL TRANSPORT; LICHENS; DEER; ESKIMOS; ANIMALS; PETROLEUM; ENVIRONMENTAL EFFECTS.

84037 Technology Assessments and EDP's. Lohrding, R. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** 001536. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$498,000.
Related energy source: all(100). **R and D categories:** Integrated 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.

84043 Mutagenesis: Shale Oil. Barnhart, B.J. (Los Alamos Scientific Laboratory, Cellular and Molecular Biology Group, MS 886, Los Alamos, NM, 87545). **Project number:** 001877. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$175,000.
Related energy source: fossil fuels(25); oil shales and tar sands(75). **R and D categories:** Health effects.

The objective of this project is to evaluate the mutagenicity of shale oil samples with in vitro test systems in order to assess potential health and environmental effects of the test materials. Samples will be obtained from the SOHIO refinery run of Paraho crude shale oil and tested as received and after fractionation by a Stedman-type method to provide acids, bases, neutrals, insoluble residues and residue aqueous solutes. These materials will initially be tested in the Ames bacterial/liver microsome system. Subsequent mutagenicity assays will be performed using Chinese hamster cells, line CHO, in culture. Mutation frequencies at the HGPRTase locus, measured as 6-thioguanine resistant clones, are quantitated in cultures incorporating a liver microsome activation system or near ultraviolet light (NUV) activation of the promutagen to active mutagen. The latter system which simulates sunlight suggests a potential synergism between the polyaromatic hydrocarbons and sunlight in producing somatic cell mutations on the skin of man.
Keywords: MUTAGENESIS; OIL SHALE INDUSTRY; CHEMICAL EFFLUENTS; SHALE OIL; HEALTH HAZARDS; RISK ASSESSMENT; ENVIRONMENTAL IMPACTS; PETROLEUM REFINERIES; HAMSTERS; SYNERGISM; POLYCYCLIC AROMATIC HYDROCARBONS; MAN; MUTAGEN SCREENING; CARCINOGENS; PHOTOCHEMISTRY; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; TOXICITY; BENZOPYRENE.

84045 Epidemiologic Study of Plutonium Workers. Stebbings, J.H. Jr. (Health Research Division Office, Los Alamos Scientific Lab., Los Alamos, NM, 87545). **Project number:** 001879. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$405,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

Past and present plutonium workers from major United States nuclear installations will be followed to determine age-specific mortality rates from all major causes of death, with special emphasis upon cancer. Dose-response relationships will be estimated using systemic body burden data from urine tests. The study population,

approximately 20,000 individuals, will include all workers with estimated body burdens above one nanocurie, random samples of exposed workers with lesser or no body burdens, and random samples of non-exposed workers from the same installations. A subset of 8000 workers will be actively followed and questionnaire studies of personal risk factors and of morbidity from cancer, cardiovascular, chronic respiratory, and other chronic diseases will be carried out. Related studies in progress include a clinical study of 26 Manhattan District Project workers, studies of cancer incidence and mortality in residents of Los Alamos, New Mexico, and a preliminary follow-up study of mortality in the most highly burdened plutonium workers.
Keywords: PLUTONIUM; DELAYED RADIATION EFFECTS; EPIDEMIOLOGY; PERSONNEL; BODY BURDEN; MAN; BIOLOGICAL EFFECTS.

84046 Lower Statospheric (Airstream) Technical Operations and Field Support. Guthals, P.R. (Los Alamos Scientific Lab., Chemistry-Nuclear Chemistry Group 11, MS-514, Los Alamos, NM, 87545). **Project number:** 001883. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$38,000.
Related energy source: nuclear fission(25); nuclear fusion(25); other advanced(50). **R and D categories:** Physical and chemical processes and effects.

Project Airstream objectives include stratospheric constituent measurement and observation for the study of atmospheric motion, transport and diffusion particulate and whole air samples are analyzed from collections made in the lower stratosphere and troposphere. This analysis involves measurement of both radioactive and stable elements and compounds. Resultant data are applied in a variety of model testing techniques by a number of investigators. Triannual field collections provide samples for eventual analysis at several laboratories.
Keywords: STRATOSPHERE; AIR POLLUTION; AEROSOL MONITORING; EARTH ATMOSPHERE; RADIONUCLIDE MIGRATION; ENVIRONMENTAL TRANSPORT; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; WEATHER; RADIOISOTOPES; TRACER TECHNIQUES; SAMPLING; DIFFUSION.

84047 Ecological Investigation of Dry Geothermal Energy Demonstration. Rea, K.H. (Los Alamos Scientific Laboratory, Environmental Research Group (MS 490), P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 002153. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$147,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects.

The project research is to (1) develop an environmental resource data base at the site, (2) determine differences in composition and quantity of ecosystem components near the facility and at adjacent control sites, and (3) identify in effluent waste water solid chemical constituents and other materials that might degrade the water quality of the area. Permanent sampling stations will be set up to follow both the biotic and abiotic components of the ecosystem through time. Eventually it should be possible to compare the environmental consequences of hot dry rock utilization to other forms of geothermal energy (i.e., hydrothermal and geopressured).
Keywords: HOT-DRY-ROCK SYSTEMS; ENVIRONMENTAL IMPACTS; ENERGY SOURCE DEVELOPMENT; WATER QUALITY; ECOSYSTEMS; WASTE WATER; DATA ACQUISITION.

84050 Water Issue in the West. Roach, J.F. (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). Div. of Regional Assessments. **Funding:** DOE-$362,000.
Related energy source: fossil fuels(100).

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.

84052 Assessment of Teratogenic and Toxic Properties of Products and By-Products of Oil Shale Technologies. Swartzendruber, D.E. (Los Alamos Scientific Laboratory, P.O. Box 1663, H-10, MS 888, Los Alamos, NM, 87545). **Project number:** 002682. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The objective of this project is to provide a simple diagnostic system using totipotential cells for screening and evaluating energy-related products and by-products for their toxic and/or teratogenic effects on embryonic development. Intrauterine embryonic cells are not practical for large-scale screening of potentially hazardous agents since such systems are hampered by complex, lengthy, and costly techniques and by a paucity of embryonic material. As an alternative to embryos, totipotential stem cells derived from a murine teratocarcinoma (which is analogous to cells of the early mouse embryo) will be used to screen for toxic and/or teratogenic agents. Flow cytometry will be used to quantitate parameters of the in vitro differentiation of teratocarcinoma cells and to detect disruption of these parameters by various agents. Initial characterization of this system by flow cytometry is presently being pursued.
Keywords: OIL SHALE INDUSTRY; HEALTH HAZARDS; TERATOGENESIS; GENETIC EFFECTS; SULFUR OXIDES; NITROGEN OXIDES; EMBRYOS; TOXICITY; MICE; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PARTICLES; AEROSOLS; METALS.

84053 New Source Performance Standards. Ford, F.A. (Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM, 87545). **Project number:** 002972. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Policy Analysis. **Funding:** DOE-$41,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The objective of this project was to assess the probable financial impact on proposed changes in new source performance standards on the U.S. electric utility industry. Under the direction of our monitor from the DOE and with supervision from a team leader from the Argonne National Laboratory, we organized the analysis in three steps. First, we specified three sets of standards on Particulate Matter, Sulfur Oxides, and Nitrogen Oxides. Next, we estimated the additional pollution control costs to satisfy these three sets of possible standards. And third, we exercised the Baughman/Joskow simulation model to determine the financial impacts of the different levels of pollution control costs.
Keywords: POLLUTION REGULATIONS; STANDARDS; AIR QUALITY; ECONOMIC IMPACT; AEROSOLS; PARTICLES; SULFUR DIOXIDE; NITROGEN OXIDES; AIR POLLUTION CONTROL; POLLUTION CONTROL EQUIPMENT; PUBLIC UTILITIES; POWER PLANTS.

84061 Respirator Research and Development. Davis, T.O. (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). Div. of Operational and Environmental Safety. **Funding:** DOE-$120,000.
Related energy source: all(100). **R and D categories:** Operational safety.

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.

84062 Aerosol Sampling and Characterization for Hazard Evaluation, 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). Div. of Operational and Environmental Safety. **Funding:** DOE-$115,000.
Related energy source: fossil fuels(75); oil shales and tar sands(25). **R and D categories:** Operational safety.

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.

84063 Ventilation Systems Analysis under Explosion Conditions. 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). Div. of Operational and Environmental Safety. **Funding:** DOE-$140,000.
Related energy source: fossil fuels(20); nuclear fuels(general)(60); nuclear fission(20). **R and D categories:** Operational safety.

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.

84066 Recommendation for Safety Limits. 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). Div. of Operational and Environmental Safety. **Funding:** DOE-$75,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

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.

84068 Mutagenesis: Plutonium. Barnhart, B.J. (University of California, 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The original goal was to provide information on the mutagenic effects of plutonium on a mammalian cell system. The second goal is to determine whether or not alpha-particle induced mutagenic lesions can be repaired. Third, we plan to pursue a cytogenic analysis of alpha irradiated mammalian cells. Our laboratory is utilizing a quantitative petri plate approach to mutation frequency using the Chinese hamster cell line CHO to measure mutations to 6-thioguanine resistance (HGPRTase locus) under conditions of strict cell accountability with respect to survival, plating efficiencies and karyologic perturbations. The availability of a simple, clean and easy to use source of high LET radiation permits irradiation of large numbers of cells in culture with alpha particles from a stabilized 238-Pu source. Semilog plots of cell survival as a function of dose for 250-kVP x rays describe the well documented shouldered curve with an exponential component at higher doses and a D/sub 0/ of 170 rads. The survival curve for the 100-kV/mu-m alpha particles emitted by 238-Pu is a straight line exponential with a D/sub 0/ of 70 rads. Arithmetic plots of mutations describe cumulative curves which reveal nonthreshold responses. The initial portions of both alpha and x-ray induced mutagenesis are linear with slopes of 4.5 x 10/sup -7/ and 1.1 x 10/sup -7/ mutations per viable cell per rad, respectively. The relative mutagenicity of these radiations, however, is quite different when the cytotoxic effects of each are considered. At all levels of survival from 0.80 to 0.10 the relative biological effectiveness (RBE) for cell survival is greater than for mutagenesis by factors of from 1.3 to 2.4. It should be emphasized that these experiments on single cells do not address the requirement for an additional understanding of genetic expression and an appreciation for modulating effects which may occur in the intact animal.
Keywords: PLUTONIUM; MUTAGENESIS; ANIMAL CELLS; ALPHA PARTICLES; X RADIATION; GENETIC RADIATION EFFECTS; PLUTONIUM 238; RADIATION PROTECTION; HAMSTERS; BIOLOGICAL MODELS; RADIOINDUCTION; SURVIVAL CURVES; RADIONUCLIDE KINETICS.

84070 Development of Structural and Thermal Analysis Methods for Environmental and Safety Control Assessments of Energy Material Shipping Container Systems. Butler, T.A. (Los Alamos Scientific Laboratory, P.O. Box 1663, Group WX-8, MS 928, Los Alamos, NM, 87545). **Project number:** 800044. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$260,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

In assessing the adequacy of the environmental and safety controls provided by energy material shipping containers, their response to a wide range of accident conditions must be determined. The prohibitive expense of prototype and exact scale-model tests makes analytical tools, substantiated by a few carefully designed experiments, the logical procedure for evaluating the environmental and safety control provided by a given container system. The purpose of the project is to develop analytical computer codes that will predict shipping container response to a wide range of accident conditions including fire, impact, and puncture. We have developed computer codes that predict container response to end-on and oblique impact. Another code predicts railcar-container system response for cases where the railcar strikes a train during coupling operations. Current and future efforts will improve and generalize these codes and develop additional codes that will predict container response to other accident conditions. We intend to substantiate experimentally all of the computer programs using data obtained from simplified test specimens and from tests of more complex specimens performed at other laboratories.
Keywords: COMPUTER CODES; CASKS; CONTAINERS; SPENT FUEL CASKS; RADIOACTIVE MATERIALS; TRANSPORT; MATHEMATICAL MODELS; IMPACT STRENGTH; SAFETY; COMPUTER CALCULATIONS; C CODES.

84071 Trace Element Characterization and Removal/Recovery from Coal and Coal Wastes. Wewerka, E.M. (Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM, 87544). **Project number:** 800059. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology; Environmental Protection Agency, Washington, DC (USA). **Funding:** DOE-$325,000; EPA-$100,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

This program involves both field and laboratory investigations to assess the nature and magnitude of the trace contaminants in the drainage from stored coal and coal waste dumps, to identify the trace elements and organic components of greatest environmental concern, and to define suitable environmental control technology where needed to prevent or reduce these forms of environmental pollution.
Keywords: COAL PREPARATION; ELEMENTS; TRACE AMOUNTS; REMOVAL; COAL; CHEMICAL COMPOSITION; ASHES; LEACHING; RUNOFF; ENVIRONMENTAL EFFECTS; SULFATES; METALS; ORGANIC COMPOUNDS; MINERAL WASTES; POLLUTION CONTROL; FEASIBILITY STUDIES; GROUND WATER; SURFACE WATERS; STOCKPILES.

84074 Toxicity of Oil Shale. 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 Health and Environmental Research. **Funding:** DOE-$180,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.

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.

84075 Critical Review and Assessment of Environmental and Safety Implications of Hydrogen Energy Systems. 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). Div. of Environmental Control Technology. **Funding:** DOE-$156,000.
Related energy source: all(100). **R and D categories:** Environmental control technology.

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.

84076 Environmental Control Technology Implications of Magnetic Fields. Hassenzahl, W.V. (Los Alamos Scientific Laboratory, P.O. Box 1663, MS 764, Los Alamos, NM, 87545). **Project number:** 800191. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$30,000.
Related energy source: nuclear fusion(30); other advanced(70). **R and D categories:** Environmental control technology.

Several advanced technologies are under development as alternatives to existing energy system components. Among these technologies are nuclear fusion using magnetic confinement, magnetohydrodynamics (MHD) for power generation, and superconducting magnets for energy storage (SMES). The magnets associated with these technologies are unshielded and, for the superconducting types, fields up to 10 T can be generated (1 T = 10,000 G). This program has assessed ways of controlling or limiting the magnetic fields beyond the site boundaries. We have calculated magnetic field levels as a function of distance from various energy related devices, including SMES magnets, MHD power sources, and seven designs for fusion reactors. We have determined types of control technologies for limiting fields to three exposure levels: 200 G (interim exposure limit at research institutions), 10 G (field reported to affect pacemakers), and 0.3 G (average value of earth's field). The control technologies include shield coils, ferromagnetic materials, and fence placement.
Keywords: THERMONUCLEAR REACTORS; MHD GENERATORS; SUPERCONDUCTING MAGNETS; MAGNETIC ENERGY STORAGE; MAGNETIC FIELDS; SHIELDING; CONTROL; FERROMAGNETIC MATERIALS; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS; MAN; MAXIMUM PERMISSIBLE EXPOSURE.

85002 Fission Neutrons and Gamma Rays. 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 fuels(general)(100). **R and D categories:** Health effects.

The purpose of this project is to define the dose response relationships, the RBE-dose relationships and dose rate relationships for tumor induction after neutron exposure in a number of murine tumors. In addition to defining the relationships, research is also directed toward the understanding of the mechanistic basis for these relationships. In these studies, primary emphasis has been placed on the induction of alveolar cell lung adenocarcinomas, mammary adenocarcinomas and ovarian tumors in the BALB/c mouse. For the studies on the mechanistic basis of dose and dose rate effects emphasis is being placed on the role of repair, recovery, and cell killing in carcinogenesis as they relate to both initiating and promoting events after neutron irradiation. Recent research findings on carcinogenesis and life shortening, suggesting very high RBE values and convex shaped dose response curves, have made it apparent that dose response relationships and RBE-dose relationships for neutrons are not adequately defined, particularly in the low to intermediate dose range. In addition, because of recent data suggesting unexpected dose rate effects, particularly the possibility of enhanced effects with protraction, studies examining the dose rate relationships for neutron carcinogenesis are also needed. These experiments will provide information which is necessary for the establishment of risks and permissable exposure levels for ionizing radiation.
Keywords: FRACTIONATED IRRADIATION; DOSE-RESPONSE RELATIONSHIPS; NEUTRONS; GAMMA RADIATION; RADIOINDUCTION; LUNGS; NEOPLASMS; BIOLOGICAL RADIATION EFFECTS; MICE; BIOLOGICAL REPAIR; RISK ASSESSMENT.

85003 RNA Tumor Virus--Environmental Carcinogenesis Oncology. Tennant, R.W. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000145. **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: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Health effects.

RNA tumor viruses are transmitted genetically to progeny (they are endogenous) in many mammalian species. Evidence indicates that expression of one or more viral genes, or spread of virus to target cells is required for tumor induction. Therefore, the identification of agents which induce virus expression, and the mechanism of induction are important to the ultimate control of tumorigenesis. Our studies have focused on a model system of AKR mouse embryo cells which have relatively high sensitivity for virus induction. Hydroxyurea (HU) induces virus in AKR cells at low frequency (approximately 1 x 10/sup -5/), and DNA synthesis is required soon after treatment (i.e., no stable induction intermediate is formed). HU induction can be enhanced by simultaneous treatment with halogenated pyrimidines and a stable intermediate is produced. Since HU inhibits semiconservative replication and since BruUrd is incorporated predominantly by repair synthesis under these conditions, the analog appears to be inserted during repair of HU-induced lesions in DNA.
Keywords: ONCOGENIC VIRUSES; RNA; ENVIRONMENT; CARCINOGENESIS; EMBRYOS; TERATOGENESIS; MICE; BIOLOGICAL REPAIR; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL MODELS; PYRIMIDINES; HYDROXYUREA; BIOLOGICAL EFFECTS; BIOLOGICAL RADIATION EFFECTS; IONIZING RADIATIONS; BIOASSAY.

85004 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: fossil fuels(100). **R and D categories:** Health effects.

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.

85005 Pathology--Physiology, General. Ullrich, R.L. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000147. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$480,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective of this project is to examine the contribution of various environmental and physiological factors to the carcinogene-

sis. Work on the project includes studies of the effects of carcinogens on physiological factors which may be involved in the carcinogenic process such as hormonal response and promoting events, the role of these factors in observed dose response and dose rate relationships, and related studies on co-carcinogenesis. Since these physiological factors can influence the sensitivity or resistance of an individual to a carcinogen, it is essential to understand these factors in our model systems if we are to reliably evaluate risk for human exposure on the basis of experimental models.
Keywords: PATHOLOGY; PHYSIOLOGY; ENVIRONMENTAL EFFECTS; CARCINOGENS; HEALTH HAZARDS; HUMAN POPULATIONS; BIOLOGICAL MODELS.

85006 Medium Low Level Long Term Effects. Ullrich, R.L. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000148. **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: nuclear fuels(general)(100). **R and D categories:** Health effects.

The purpose of this project is to examine the tumorigenic effects of low dose rate gamma ray exposures in several murine tissues which are sensitive to tumor induction with radiation and whose tumorigenic response to acute gamma rays is well defined. The experiments are comparing the effects of high (40 rad/min) and low (1 rad/day) dose rate gamma ray exposure on the induction of lung adenocarcinomas, mammary adenocarcinomas, and ovarian tumors in the BALB/c mouse. The lack of adequate information on dose rate effects of low LET radiation remains a serious problem when assessing the risks of environmental radiation exposures. This is true for the assessment of carcinogenic risks from exposure to low LET radiation and for the assessment of the relative biological effectiveness of high LET radiation. Since similar studies are being conducted in our laboratory examining neutron effects using these endpoints, this study will provide information on the low dose rate effects of gamma rays, and will provide information necessary to evaluate the relative biological effectiveness of neutrons. In addition, such a comparison will provide new information on the relative degree of recovery from carcinogenic injury which can occur after gamma and neutron irradiation.
Keywords: CHRONIC IRRADIATION; LOW DOSE IRRADIATION; LUNGS; MAMMARY GLANDS; OVARIES; NEOPLASMS; MICE; RADIOINDUCTION; DOSE RATES; RISK ASSESSMENT; GENETIC RADIATION EFFECTS; BIOLOGICAL RADIATION EFFECTS; AGE DEPENDENCE; LET; RBE; NEUTRONS; GAMMA RADIATION.

85008 Developmental Biochemistry. Pfuderer, A.P. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 000154. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective is to isolate, identify and study the mode of action of organic neurotoxins involved in energy production. The toxins will be fractionated by liquid chromatography, single molecular species separated by gas chromatography, and then assayed by a sensitive acute toxicity test. The species will then be identified by GC-MS, and their mode of action studied. The ether soluble weak acid fraction of synthoil contained neurotoxic phenol and its homologues. Phenol could reverse the action of epenephrine and nonepenephrine in our model system. Therefore, it is possible phenol is functioning as an adrenergic blocking agent. Since phenol deadens the sense of taste and smell, fish will not avoid it, making it a dangerous pollutant. The ether soluble basic fractions of shale oil and synthoil contain a series of compounds tentatively identified as C7 to C13 pyridines. Their mode of action is similar to an anaesthetic, death being caused by respiratory failure. Since shale oil may be recovered by processes using water, these water soluble toxins need to be further characterized.
Keywords: BIOCHEMISTRY; FOSSIL FUELS; PHENOLS; BIOLOGICAL MODELS; HEALTH HAZARDS; BIOLOGICAL EFFECTS; SHALE OIL; TOXICITY; SYNTHETIC PETROLEUM; COAL GASIFICATION; CENTRAL NERVOUS SYSTEM; FISHES.

85011 Biostatistics and Biomathematics. Gardiner, D.A. (Union Carbide Corporation, Nuclear Division, Oak Ridge, TN, 37830). **Project number:** 159. **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: all(100). **R and D categories:** Health effects.

The objectives are to improve research programs in the Biology, Environmental Sciences, and Health Physics Divisions of ORNL through collaboration with our statisticians and mathematicians; and to conduct research in statistics and mathematics on basic principles and on problems arising in our collaboration. Life Scientists are given assistance in planning, conducting, analyzing and interpreting their investigations. This is accomplished by the application of a broad spectrum of statisticl and mathematical methods and theory to their experiments and surveys. The research is accomplished through the independent and joint efforts of our professional staff to improve existing methodology and to discover new methods and principles. We colloborate with investigators who conduct applied and basic research on energy related projects. The use of appropriate statistical principles in design and planning will result in the completion of investigations in the life sciences with a maximum of valid information at a minimum cost of labor, materials and facilities. Statistical and mathematical analyses will result in extracting and quantifying information from investigations. The statistical and mathematical research will continue to produce publications and applications. Much of this research is on energy problems which are motivated by the collaborative projects.
Keywords: BIOLOGY; RESEARCH PROGRAMS; STATISTICS; ENVIRONMENT; HEALTH HAZARDS; DATA ANALYSIS; DATA COMPILATION; STATISTICAL MODELS; MATHEMATICAL MODELS; ENERGY; ECOLOGY.

85019 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.
R and D categories: Health effects.

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: ENZYMES; METABOLISM; CATALYSIS; MUTATIONS; X RADIATION; BIOLOGICAL RADIATION EFFECTS; MUTAGENS; BIOLOGICAL EFFECTS; DROSOPHILA; RNA; MICE; HEMOGLOBIN; ALBUMINS; CARCINOGENESIS; GENES; RADIOINDUCTION; NEOPLASMS; GENETICS; BIOCHEMISTRY; BIOLOGICAL EFFECTS; POWER PLANTS; COAL; PETROLEUM.

85021 Mammalian Biochemical Genetics. Popp, R.A. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, 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: fossil fuels(70); nuclear fuels(general)(30). **R and D categories:** Health effects.

Our program's principal aim is to evaluate human hazards of chemical and nuclear by-products of energy production. DNA base substitution is the most common mutation accepted in the genome, yet methods have not been adequately developed to detect and to compare this kind of mutation in vivo in germinal and somatic cells of mammals. Quantitative chemical analyses and isotopic tracer methods are being used to show that the wrong amino acids, i.e., ones not normally coded for in a specific protein but for which the code may occur by DNA base substitutions, are incorporated at a frequency of 10/sup -5/ into hemoglobin, vesicular gland proteins and serum lipoproteins. A spectrofluorometric method using fluorescence mercurie acetate, is being developed to detect the substitution of cysteine for other amino acids at a frequency as low as 10/sup -9/. About one-fourth of the Marshallese and most experimental animals including mice, rabbits, rats, and cattle, exposed to more than 100 R of irradiation or mutagenic doses of chemicals show a 2- to 4-fold elevation in the frequency of incorporation of noncoded amino acids into proteins. These tests are being adapted to analyze proteins in the serum and body fluids of humans, who during their normal occupations are exposed to potential chemical hazards, such as pesticides.

Keywords: MAMMALS; BIOCHEMISTRY; GENETICS; CARCINOGENESIS; MUTAGENESIS; PROTEINS; IONIZING RADIATIONS.

85022 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: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Health effects.

This is a large-scale, multi-faceted whole-animal project to provide fundamental information needed for the estimation of the genetic hazards of exposure of human beings to ionizing radiation and chemical mutagens. Questions asked for each type of genetic lesion are: what are its heterozygous or homozygous effects; what factors influence induction (e.g., cell stage, dose distribution); and what is the basic nature of the lesions. Qualitative and quantitative mutational information was obtained by use of the following approaches: (1) skeletal analyses to detect mutations affecting first-generation offspring; (2) exploration of in-vivo nondisjunction as a measure of induced chromosomal damage; (3) specific-locus experiments, with tritiated water and with very low dose-rate gamma irradiation; (4) characterization of mutants for the purpose of relating circumstances of the mutagenic treatment to the nature of the mutations produced; (5) induction of mutations at the hemoglobin loci, and determination of the nature of such mutations; (6) studies of the effects of mutations in heterozygous condition; and (7) use of X-autosome translocations to study gene action.
Keywords: GAMMA RADIATION; BIOLOGICAL RADIATION EFFECTS; IN VIVO; TRITIUM; MUTATIONS; GENETIC RADIATION EFFECTS; RADIOINDUCTION; MICE; HYBRIDIZATION; CHEMICAL EFFLUENTS.

85027 Mammalian Cytogenetics. Brewen, J.G. (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: fossil fuels(40); nuclear fuels(general)(60). **R and D categories:** Health effects.

The objectives of the project are: to measure chromosome aberration frequencies induced by acute or chronic radiation exposure and by chemical mutagens in somatic cells and male and female germ cells; to use these data to make assessments of human genetic risk; and to study the mechanisms of chromosome aberration induction following radiation or chemical treatment. Chromosome aberrations in peripheral lymphocytes of several species following irradiation will be analyzed in order to better understand interspecific differences in radiosensitivity. Reciprocal translocations are being analyzed in spermatocytes of mice and marmosets following chronic gamma-ray exposure. Chromosome aberrations are being analyzed at metaphase 7 and first cleavage division following radiation or chemical treatment of mature or maturing oocytes. DNA repair and chromosome aberrations are being studied in human cells following similar chemical or radiation treatments to try and understand the role of DNA repair in aberration induction. From measurements of reciprocal translocations induced in spermatogonial stem cells at low dose rates, it is clear that at very low dose rates the frequency of translocations per cell per R is considerably less than for acute exposures. The possible involvement of the repair of base damage induced by x rays in the production of chromosome aberrations has been shown.
Keywords: X RADIATION; GAMMA RADIATION; ACUTE IRRADIATION; CHRONIC IRRADIATION; LABORATORY ANIMALS; BIOLOGICAL RADIATION EFFECTS; SOMATIC CELLS; GERM CELLS; CHROMOSOMAL ABERRATIONS; RADIOINDUCTION; RADIOSENSITIVITY; LYMPHOCYTES; SPECIES DIVERSITY; SPERMATOCYTES; OOCYTES; DNA; BIOLOGICAL REPAIR; RADIOSENSITIVITY EFFECTS; COMPARATIVE EVALUATIONS; IRRADIATION PROCEDURES; HUMAN POPULATIONS; GENETICALLY SIGNIFICANT DOSE; RISK ASSESSMENT; DOSE RATES; MUTAGENS; BIOLOGICAL EFFECTS; MAN.

85028 Automated Analyses for Biochemical Indicators of Genetic Differences. Mrochek, J.E. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 182. **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 fusion(50). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective is to develop automated instrumentation and methodologies for blood sample preparation, identification, and quantification of mutant proteins therein and the assessment of their rates of occurrence in human populations. The approach is to develop and test prototypes of unique instrumental concepts and new methodologies capable of processing many physiologic samples for purposes of identifying mutant proteins and quantifying their rates of occurrence. The prototypical system for the automated processing of whole blood into plasma, washed erythrocyte, and hemolysate fractions was successfully tested and evaluated at an external laboratory. An immobilized enzyme-containing microreactor was employed to demonstrate continuous monitoring of enzyme activity in eluents after rapid chromatographic separation of three isoenzymes of creatine kinase. The first prototype for a new concept in high-throughput, high-resolution electrophoresis was fabricated. This modular prototype is designed to dynamically cast multiple (12) gel columns in stacked plastic discs, electrophorese the stacks of discs, stain for specific enzyme activity, and finally, scan each disc (12 gels per disc) for protein position (relative to internal standards) and amount within one minute. This new prototype system will be tested and its capability to resolve mutant proteins by means of differences in shape as well as charge verified.
Keywords: BIOLOGICAL INDICATORS; BIOASSAY; GENETIC VARIABILITY; PROTEINS; BIOCHEMISTRY; ENZYMES; MUTATIONS; BLOOD; HUMAN POPULATIONS; SAMPLE PREPARATION; MUTATION FREQUENCY; ELECTROPHORESIS; EQUIPMENT.

85029 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 fuels(general)(100). **R and D categories:** Health effects.

Our work on spermatogonia and oocytes provides the cellular basis for interpretation of fertility and genetic effects of radiation and chemicals. Information on normal gametogenesis also has furnished guidelines for extrapolation of genetic data in the mouse to other species, including man. Recent data suggest that the change in mutational response of the mouse oocyte occurs in a state with comparable cytology and radiation response in all mammals so far examined. Therefore, data on early mouse oocytes may have more relevance to estimation of genetic hazards in the human female than has commonly been thought. Our experimets using irradiation and chemicals in combination with labeling with 3He-thymidine in spermatogonia, and of labeling with L-[1-3H]fucose in females will be continued in order to determine the dose limits over which normal cell dynamics are maintained.
Keywords: X RADIATION; ACUTE IRRADIATION; MICE; BIOLOGICAL RADIATION EFFECTS; SPERMATOGENESIS; OOGENESIS; GERM CELLS; GENETIC RADIATION EFFECTS; MUTATION FREQUENCY; MUTATIONS; RADIOINDUCTION; OOCYTES; SPERMATOGONIA; TRITIUM COMPOUNDS; TRACER TECHNIQUES.

85032 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 fuels(general)(100). **R and D categories:** Health effects.

The objectives of the project are to define the role of radiation-induced immunodepression in the mechanism of radiation-induced carcinogenesis, progressive tumor growth, and life shortening; and to explore the humoral and cell-mediated immune mechanisms involved. The approach to meeting these objectives is the determination of whether the inherent acute immunodepression is a critical obligratory component in the pathogenesis of radiation-induced cancer and its metastatic spread. Current efforts center on defining and manipulating immunologic regulator mechanisms, enhancing depressed immune competence by immunologic reconstitution, and determining if decreased immune activity can be related to suppressor cells associated with tumorigenesis. By correlating immune competence with tumor incidence, latency, metastatic spread, and mean lifespan the importance of radiation sensitive immune mechanisms and how they relate to radiation sensitive non-immunologic factors, e.g., radiation induced susceptible target cells, in the genesis and control of cancer should be elucidated.
Keywords: X RADIATION; IRRADIATION; MICE; BIOLOGICAL RADIATION EFFECTS; IMMUNE REACTIONS; IMMUNOSUPPRESSION; RADIOINDUCTION; CARCINOGENESIS; NEOPLASMS; STEM CELLS; CELL PROLIFERATION; LIFE SPAN; BIOLOGICAL MODELS; IMMUNOLOGY.

85039 Ionizing Radiation Biophysics. Randolph, M. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 000281. **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:** Health effects.

Understanding of the basic phenomena of radiation damage and cellular responses thereto is the underlying theme behind the activities of this program. Much of the work involves use of bacterial mutants combined with bacteriological and biophysical techniques to study detailed cellular processes in terms of rather rigorous, statistically-derived kinetic models. Extension of the bacterial work to specific, almost monochromatic high LET radiations available at the ORIC accelerator is being planned. Aside from any contribution to our knowledge of cellular behavior the direct practical significance of the high LET work is that the magnitude of these effects, thought to be free from biological repair, may be of a prime hazard in the low-dose rate leakage radiation from fission reactors. Also involved in such hazard assessment are studies on the ratio of dose to neutron fluence, especially at low neutron energies (less than 20 eV) where simplistic calculations tend to overestimate the ionizing dose.

Keywords: IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS; RADIATION INJURIES; RESPONSE MODIFYING FACTORS; MICROORGANISMS; HEALTH HAZARDS; BIOCHEMICAL REACTION KINETICS; NUCLEAR ENERGY; RADIOSENSITIVITY; CELL CYCLE.

85044 Medical and Molecular Genetics. 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: fossil fuels(100). **R and D categories:** Health effects.

The primary objective of the Medical and Molecular Genetics Group is to elucidate the molecular events in human cells when cellular macromolecules such as DNA are damaged by radiation or chemical agents. We study and characterize (1) the sequence of DNA repair events, (2) the various modalities of repair, (3) the genetic inhibition of repair due to mutation, and (4) the physiological inhibition of repair due to biochemical inhibitors. Our technological capacities reside in the several very sensitive, rapid and informative experimental techniques we have developed for the assay of DNA repair in all of its facets. Examples are: (1) bromodeoxyuridine photolysis, (2) radiochromatography, (3) molecular weight analyses, and (4) enzymatic assays for chemical carcinogen-induced DNA lesions in human cells. Our ultimate goals are: (1) to isolate and analyze the repair component of the mutagenic and/or carcinogenic event in human cells, (2) to elucidate the magnitude and significance of this repair component as it impinges on the practical problems of human radiation or exposure to actual or potential chemical mutagens and carcinogens. Our major research effort is currently directed at elucidating molecular DNA repair events after treatment of human cells with representative class compounds of coal conversion and related studies.

Keywords: IONIZING RADIATIONS; DNA; BIOLOGICAL RADIATION EFFECTS; MUTAGENESIS; CARCINOGENESIS; GENETICS; BIOLOGICAL REPAIR; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; COAL INDUSTRY; HEALTH HAZARDS.

85046 Fusion Tech: Aquatic Environmental Cycling and Effects. Blaylock, B.G. (Oak Ridge National Laboratory, Building 1505, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00604. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

85047 Cycling of Fusion-Activation Products in Terrestrial Environment. Francis, C.W. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 00605. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$110,000.

Related energy source: nuclear fusion(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective of this project is to clarify which processes, biotic and abiotic, control the cycling in the terrestrial environment of fusion induced activation products generated in thermonuclear reactors. The major emphasis is directed at defining the fate of Ni-63, V-49, and Tc-99 in the terrestrial environment. Because the movement of V-49 and Tc-99 in soils and the subsequent plant uptake is highly dependent on the oxidation state of the radionuclide, considerable effort is being made to characterize their sorption characteristics to soils and clay minerals at various redox potentials and pH's. Methods are being developed to determine oxidation states of the sorbed and labile species of V and Tc in soil suspensions at redox potentials varying from 100 to 200 mv. Plant uptake of Tc-99 and V at varying redox potentials is also being studied. A plant uptake experiment has been carried out to assess the influence of mycorrhizal fungi on the uptake of Co-60 and Ni-63 in pine seedlings. Soil chromatographic methods are being used to compare the mobility of Ni-63 and Tc-99 to the dominant fission products (Sr-90 and Cs-137) and actinides (uranium, thorium, and plutonium).

Keywords: THERMONUCLEAR REACTORS; RADIOACTIVE EFFLUENTS; NICKEL 63; VANADIUM 49; COBALT 60; TECHNETIUM 99; ENVIRONMENTAL TRANSPORT; RADIOECOLOGICAL CONCENTRATION; TERRESTRIAL ECOSYSTEMS; SOILS; RADIONUCLIDE MIGRATION; REDOX POTENTIAL; SORPTIVE PROPERTIES; PH VALUE; ROOT ABSORPTION; MYCORRHIZAS; FUNGI; MOBILITY.

85050 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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

85051 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: fossil fuels(50); nuclear fuels(general)(30); geothermal(10); solar(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

85053 Integrated Nuclear Assessments Program. Parzyck, D.C. (Oak Ridge National Laboratory, Building 7509, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00613. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Assessments. **Funding:** DOE-$350,000.

Related energy source: nuclear fission(100). **R and D categories:** Integrated assessment.

This program has been established to support the Division of Technology Assessment (DTA) mission relating to the development and implementation of nuclear energy technology. The DTA mission is to provide an overview of environmental, health, and safety issues and to serve as a resource to the Assistant Secretary for Environment (ASEV) for information relating to environmental, health, and safety impacts associated with energy technologies. The Environmental Development Plan (EDP) is the means whereby environmental, health, and safety concerns and associated requirements are identified. The EDPs can then be used to ensure that environmental, health, and safety research is carried out in a manner timely to the needs of the technology. Information on the environmental, health, and safety impacts associated with various energy technologies is provided through assessments designed to quantify the impact of technology on society. This program will contribute to both aspects of the DTA mission through support of the EDP process and through a number of integrated assessments focusing on specific aspects of the nuclear fuel cycle.

Keywords: FUEL CYCLE; ENVIRONMENTAL IMPACTS; NUCLEAR INDUSTRY; SOCIAL IMPACT; ECONOMIC IMPACT; TECHNOLOGY ASSESSMENT; HUMAN POPULATIONS; RISK ASSESSMENT; PUBLIC HEALTH; SAFETY; RADIATION HAZARDS; MATHEMATICAL MODELS.

85054 Toxicant Formations in Condenser Cooling Systems. Mattice, J.S. (Oak Ridge National Laboratory, Building 1505, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00679. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Ecological/biological processes and effects.

The goal of research encompassed in this proposal is development of the capability to predict the environmental effects of toxicants resulting from efficient operation of condenser cooling systems. Emphasis is on chlorine and its reaction products. Power plant operational data are being examined in an attempt to determine the minimum levels of chlorine required to control fouling. These results will allow prediction of effluent levels for comparison with results of toxicology studies. These toxicological studies are focused on both residual chlorine compounds and chlorinated organics. For the former compounds, research is oriented toward validation of a procedure for assessing toxicity which has been developed at ORNL. This involves studies of the relative toxicities of the potential products under varying conditions of pH, dose time, temperature, etc., chosen to span the range of conditions which might obtain at power plants. In the case of the latter, twenty-one chlorinated organics have been identified in power plant chlorinated effluents. Seventeen of these have been tested, singly and as mixtures, for acute and chronic effects on mortality and sublethal parameters using carp egg and Daphnia bioassays. Effects have not been found at concentrations so far measured at power plants. Identification and screening is continuing and bioaccumulation studies are planned. Results will be an important component in decisions regarding optimum design and operation of power plants and imposition of scientifically reasonable effluent chlorine limits.

Keywords: COOLING SYSTEMS; POWER PLANTS; ENVIRONMENTAL EFFECTS; CHLORINE; ENVIRONMENTAL TRANSPORT; TOXICITY; ORGANIC CHLORINE COMPOUNDS; BIOASSAY; BIOLOGICAL FOULING; FISHES; DAPHNIA; BIOLOGICAL EFFECTS.

85055 Effects of Man-Induced Stresses on Fish Populations. Van Winkle, W. (Oak Ridge National Laboratory, Building 1505, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00680. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$106,000.

Related energy source: all(100). **R and D categories:** Ecological/biological processes and effects.

The objective of the project is to develop and apply modeling and statistical methodologies for fish populations that will be of value in evaluating consequences of manmade stresses, in placing previously qualitative statements into a quantitative framework, and in defining issues where research is needed. Two interrelated approaches are used in our computer simulation modeling of fish populations. First, an empirically-based or a theoretically-based transport model for the young-of-the-year population is developed and applied in cases where it is important to consider spatial phenomena in addition to temporal phenomena. Such population models serve to estimate short-term impacts, such as the yearly reduction, due to entrainment and impingement mortality, in the number of fish that survive their period of susceptibility to power plants. Second, an age-dependent, life-cycle population model is developed using the Leslie matrix and is applied to estimate the long-term impact of increased mortality on the size and age structure of the total population and, where appropriate, on the yield to the fishery. Stock-recruitment models are developed and coupled with the life-cycle model approach where appropriate. Each model is validated to the extent possible, a procedure which involves locating, storing, and analyzing extensive field data from offsite research.

Keywords: FISHES; POPULATION DYNAMICS; BIOLOGICAL MODELS; ENVIRONMENTAL IMPACTS; ENTRAINMENT; IMPINGEMENT; POWER PLANTS.

85056 Environmental Effects of Cooling Tower Drift. Taylor, F.G. Jr. (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: fossil fuels(25); nuclear fuels(general)(25); geothermal(25); solar(25). **R and D categories:** Ecological/biological processes and effects.

The key objective of this program is to develop knowledge necessary to assess the impacts of cooling tower operation on terrestrial ecosystems. Primary objectives are directed to obtaining a predictive capability for drift transport, deposition, interception and retention by vegetation and soil, and the effects of trace toxicants in drift on biota. An additional objective is that of comparing model estimates of drift deposition with biological data. Products of the research are applicable to utilities and energy consuming industries in siting of cooling systems establishing monitoring programs, and to state and federal regulatory agencies in environmental impact assessments.

Keywords: COOLING TOWERS; ENVIRONMENTAL IMPACTS; AIR POLLUTION; DEPOSITION; SOILS; PLANTS; TERRESTRIAL ECOSYSTEMS; ANIMALS; CHROMIUM; ZINC; WATER POLLUTION; PLUMES; POWER PLANTS; FORECASTING.

85057 Energy Research and Development Inventory. Caton, G.M. (Oak Ridge National Laboratory, Building 2001, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 688. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$175,000.

Related energy source: all(100). **R and D categories:** Integrated assessment.

The objective is to collect and compile information on energy and energy-related R and D that is conducted or sponsored in the U.S. Information is gathered from government agencies, private industry, trade associations, universities, and non-profit organizations. The scope of projects of interest is broad, including: (1) all types of energy sources; (2) electric power-generation, transmission, distribution, and storage; (3) energy uses and conservation; (4) economic, socioeconomic, and legal asepcts; and (5) environmental and health effects. Methods employed are to: (1) identify places and people involved in energy-related R and D and query them; (2) use secondary sources whenever possible; and (3) categorize, keyword, code, edit and verify if necessary the responses. Reports of R and D in geographic regions or on special topics will be published. Total data base is available on DOE/RECON system. Summary tables relating expenditures to type of sponsor, type of performing organization, research location, subject categories, type of research, and combinations of the preceding are prepared.

Keywords: ENERGY; RESEARCH PROGRAMS; DATA COMPILATION; ELECTRIC POWER; POWER GENERATION; POWER TRANSMISSION LINES; ENERGY SOURCES; ENERGY CONSUMPTION; ENERGY CONSERVATION; CONSUMPTION RATES; ECONOMIC IMPACT; LEGAL AS-

PECTS; SOCIAL IMPACT; ENVIRONMENTAL IMPACTS; HEALTH HAZARDS; SOCIO-ECONOMIC FACTORS; DATA; INVENTORIES; DIRECTORIES; US ORGANIZATIONS; INFORMATION SYSTEMS.

85058 Plutonium, Americium and Curium in Environment. Bondietti, E.A. (Oak Ridge National Laboratory, Building 1505, Room 286, Oak Ridge, TN, 37830). **Project number:** 00690. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

85059 Health Physics Research Reactor. Dickson, H.W. (Oak Ridge National Laboratory, Building 7710, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00714. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$295,000.
Related energy source: nuclear fuels(general)(10); nuclear fission(90). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective of the project is to conduct research in radiation dosimetry and radiobiology to determine dose-effect relationships. The approach has been to operate the Health Physics Research Reactor (HPRR) as a radiation source and expose radiation dosimeters and experimental plants and animals. Determination of dose-effect relationships has been a collaborative effort with the Biology Division of Oak Ridge National Laboratory. Various test and intercomparisons of radiation dosimeters are performed on a regular basis. The product of this project includes technical reports and papers resulting from the experiments conducted at the HPRR.
Keywords: HPRR REACTOR; RESEARCH PROGRAMS; DOSEMETERS; PERFORMANCE TESTING; ANIMALS; PLANTS; BIOLOGICAL RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS; BIOLOGICAL MATERIALS; DOSIMETRY.

85060 Medical Physics and Internal Dosimetry. Bernard, S.R.; Ford, M.R. (Oak Ridge National Laboratory, Building 4500S, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00717. **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: nuclear fuels(general)(30); nuclear fission(60); nuclear fusion(10). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

This program bears directly on a central problem for the use of atomic energy, specifically, the evaluation and control of internal exposure within acceptable limits. The program is directed toward estimating the absorbed dose to various body organs resulting from the deposition of radioactive material in the human body. The program provides estimates of permissible concentrations of radionuclides in air, water, and food, or equivalently, of limits of daily or yearly intake which would result in doses to man within prescribed limits. We attempt to obtain reliable metabolic data either from experiments or from the literature and interpret them to obtain estimates of the dose received by body tissues as a consequence of various types of exposure to radionuclides: ingestion, inhalation, wounds, or medical uses. In the area of internally deposited emitters, this program has taken the lead in formulating guidelines currently in use in most nuclear energy programs including those in our own country. This leadership is expected to continue.
Keywords: RADIOISOTOPES; CONTAMINATION; MAN; ORGANS; DOSIMETRY; INGESTION; INHALATION; RADIONUCLIDE ADMINISTRATION; AIR; WATER; FOOD; MAXIMUM PERMISSIBLE CONCENTRATION; CHRONIC INTAKE; ENVIRONMENTAL EXPOSURE PATHWAY; MATHEMATICAL MODELS; RISK ASSESSMENT; RADIONUCLIDE KINETICS; MAXIMUM PERMISSIBLE INTAKE.

85065 Atomic and Molecular Physics. Christophorou, L.G. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** 00722. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$107,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to: (1) study in detail the elementary processes which accompany the interaction of radiation with matter; (2) investigate the effects of the nature and density of the environment on the elementary photophysical and charge transfer properties of biomolecules and the elementary processes that accompany the interaction of radiation (ionizing and nonionizing) with matter; and (3) link the physical and chemical properties of biomolecules in gases with these in the condensed phase. Quantitative and integrated experimental and theoretical studies on low-energy electron-molecule interaction processes, negative ions, electron transport and photoionization of molecules in low- and high-pressure gases in liquids will be employed to obtain this objective.
Keywords: RADIATIONS; IONIZING RADIATIONS; CHARGE EXCHANGE; PHOTOCHEMICAL REACTIONS; CHEMICAL REACTIONS; BIOCHEMISTRY; GASES; ELECTRON-MOLECULE COLLISIONS; PHOTOIONIZATION; MOLECULES; LIQUIDS; ATOMS; ELECTRON-ATOM COLLISIONS; CHEMICAL REACTION KINETICS.

85066 Basic Measurement Science. Nowlin, C.H. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 723. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
R and D categories: Characterization, measurement, and monitoring.

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.

85069 Dosimetry for Human Exposure. Kerr, G.D. (Oak Ridge National Laboratory, Building 4500S, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 00801. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: nuclear fission(50); nuclear fusion(50). **R and D categories:** Health effects.

The objectives of these studies are to improve the physical dosimetry of human radiation exposures and the assessment of radiation exposure risks to man. Total cancer risks from mixed neutron and gamma-ray exposures are being investigated using data from animal studies and data from human epidemiological studies. These studies will provide an improved basis for making sound judgments regarding radiation protection against neutrons at current fission power reactors and future fission power reactors. Mathematical models and computer codes are developed to investigate radiation dose--biological effect relationships. Extensive use is made in these studies of the vast medical and epidemiological studies of the Japanese atomic-bomb survivors which constitute the most extensive source of data on the latent effects of human exposure to gamma rays and neutrons. The studies have provided the first accurate assessment of dose to bone marrow and risk of leukemia from neutron exposures. Estimates of other cancer risks from neutrons will be made, and estimates of total risk of leukemia and other

cancers will be used to review the adequacy of current radiation protection criteria and monitoring practices for neutrons.
Keywords: MAN; NEUTRON BEAMS; GAMMA RADIATION; ANIMALS; EPIDEMIOLOGY; RADIATION PROTECTION; DOSE-RESPONSE RELATIONSHIPS; A-BOMB SURVIVORS; DELAYED RADIATION EFFECTS; CARCINOGENESIS; LEUKEMOGENESIS; BIOLOGICAL RADIATION EFFECTS; BIOLOGICAL MODELS; RBE; BONE MARROW; DATA ANALYSIS.

85071 Mechanical Impacts of Impingement. McLean, R.B. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** 00863. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Ecological/biological processes and effects.

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.

85072 Oak Ridge Environmental Research Park. Kitchings, J.T. (Oak Ridge National Lab., Environmental Sciences Division, Bldg. 1505, Oak Ridge, TN, 37830). **Project number:** 00929. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000.
R and D categories: Ecological/biological processes and effects.

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.

85076 Ecosystem Models for Energy. Burgess, R.L. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 00962. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$120,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(25); biomass(25). **R and D categories:** Integrated assessment.

This project applies systems analysis techniques (in particular, simulation modeling) to the assessment of the environmental implications of energy policy. Motivation has been drawn to a large degree from previous assessments conducted by the Division of Technology Overview, Energy Research and Development Administration (now Department of Energy). In particular the environmental components of the National Coal Utilization Assessment have highlighted numerous problems requiring further attention. Additional guidance has been provided by the staff of the Division of Regional Assessment. Tasks in three specific areas are described: (1) streamflow analysis, (2) effects of pollutants on forest ecosystems, and (3) effects of pollutants on agricultural ecosystems. The final task, a synthesis of effects at the landscape scale, integrates the results of other efforts to provide a construct for the analysis of regional environmental impacts.
Keywords: ENERGY POLICY; ENVIRONMENTAL POLICY; REGIONAL ANALYSIS; SYSTEMS ANALYSIS; FORESTS; TERRESTRIAL ECOSYSTEMS; AGRICULTURE; SOILS; ENERGY; ENVIRONMENTAL IMPACTS; DECISION MAKING; MATHEMATICAL MODELS; STREAMS; WATER QUALITY.

85080 Sand Tracing Techniques. Case, F.N. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 001289. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to develop and apply methods for better understanding the transport of particulate matter in the nearshore zone. Since most contaminants are particulate their environmental distribution will be controlled by particle transport processes. Radioactive tracers are used to label and follow sand and silt transport. Sediment concentrations in bottom boundary layers are measured. Transport models are compared to actual data in order to test understanding of transport processes. Quantitative rates of sediment transport are the product of sediment concentrations and current flow. Qualitative insight into transport processes results from tracer distribution patterns.
Keywords: PARTICLES; ENVIRONMENTAL TRANSPORT; SEDIMENTS; SAND; SILT; TRACER TECHNIQUES; COASTAL WATERS; MATHEMATICAL MODELS; OCEANOGRAPHY.

85082 Environmental Response Center. Wilkes, D.J. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** GK-01-01-02-0;001462. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

Continued development of an efficient response and referral clearinghouse to facilitate transfer of environmental information to researchers and policy makers will be the focus of effort in this program. ERC has been actively involved in providing data and technical assistance to a diverse user community both within DOE and its National Laboratory System, and outside DOE. This experience will continue with significant attention directed towards assessment and incorporation of advanced fossil energy systems data and synthetic fuels development data. ERC will continue its service functions, data management and acquisition activities, and development of operating procedures which facilitate rapid inquiry processing and expansion of the information range.
Keywords: INFORMATION CENTERS; TECHNOLOGY TRANSFER; ENVIRONMENTAL POLICY; ENERGY POLICY; US DOE; INFORMATION NEEDS; FOSSIL FUELS; SYNTHETIC FUELS; DATA BASE MANAGEMENT; DATA ACQUISITION.

85084 Ecological Sciences Information Center. Pfuderer, H.A. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 001464. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$95,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Integrated assessment.

Information support will be provided to ERDA/AAEV projects, particularly those within the ORNL Environmental Sciences Division in the areas of environmental effects of electric power generation and effects of emerging energy technologies. Documents will be selected using automated and manual techniques. These documents will be analyzed and indexed by technically trained information specialists and will be input to and retrievable from a computerized information file. Critical and non-critical reviews and information overviews will be written as a need is shown.
Keywords: INFORMATION SYSTEMS; ECOLOGY; POWER GENERATION; ENVIRONMENTAL EFFECTS; INFORMATION RETRIEVAL; MATHEMATICAL MODELS; POWER PLANTS; TECHNOLOGY ASSESSMENT.

85088 **Mechanisms of Mammalian Mutagenesis.** 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: fossil fuels(100). **R and D categories:** Health effects.

The objective is to study the mechanisms of mutagenesis in mammalian germ cells in order to better use genetic data from the mouse and submammalian species for genetic risk estimates in human germ cells. The chemical dose received by the germ cells of male mice is being measured using isotopically labeled chemical mutagens. After in vivo treatment the amount of bound mutagen in the intact germ cell, in the DNA and in proteins is determined by liquid scintillation counting. In vivo DNA repair in the germ cells occurring after mutagen treatment is being measured by the unscheduled incorporation of [3H]thymidine. Relationships between DNA repair and repair of genetic damage are being studied. Chemical dosimetry studies have recently shown that it is alkylation of germ cell protamine and not DNA that is correlated with the occurrence of chromosome aberrations in the germ cells. Findings of this type improve the applicability of experimental results to the estimation of human genetic risks. Benzo[a]pyrene (BP) has been found to bind very little to testes DNA while extensive binding to liver DNA occurs. Presumably the germ cells can not activate BP to relative metabolites. In agreement with this data is our finding that no measurable DNA repair occurs in the germ cells after exposure to BP.
Keywords: MAMMALS; MUTAGENESIS; MICE; TRACER TECHNIQUES; BIOLOGICAL REPAIR; CHEMICAL EFFLUENTS; CHROMOSOMAL ABERRATIONS; DNA; BENZOPYRENE; GERM CELLS; SPERMATOZOA; BIOLOGICAL EFFECTS; PROTEINS; GENETIC EFFECTS; RISK ASSESSMENT.

85090 **Studies of Physical Parameters for Health Protection from Chemical Pollutants.** Turner, J.E. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** 01478. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.
Related energy source: fossil fuels(25); coal(25); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Characterization, measurement, and monitoring.

The project objective is the development and understanding of physical and biological concepts and principles on which can be based a system for health protection against chemical pollutants from energy production and utilization. The approach chosen is to conduct theoretical and experimental investigations in collaboration with biologists and biochemists to develop physical characterizations of pollutants that correlate with toxicity and with potential health hazards to humans.
Keywords: CHEMICAL EFFLUENTS; HEALTH HAZARDS; TOXICITY; SULFUR OXIDES; MAN; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; PARTICLES; AEROSOLS; METALS; BIOCHEMISTRY; METABOLISM.

85091 **Public Health and Demographic Studies.** Walsh, P.J. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 01479. **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: fossil fuels(10); nuclear fuels(general)(25); nuclear fission(65). **R and D categories:** Health effects.

The purpose of this project is to assess the state of methodology and to develop methodology for analytical studies of the health impact of nuclear and fossil energy facilities. The methodology will utilize vital statistics and other public health and demography data for the public and occupational groups to assess the health risks associated with utilization of nuclear and fossil power. A second aspect will analyze the methods used by epidemiologists, biostatisticians, and other scientists in the literature on health effects. Analyses have been made of cancer mortality and morbidity statistics of populations surrounding Oak Ridge and several shipyards that service nuclear submarines. Future analyses will concentrate initially on Rocky Flats (a plutonium processing facility) and Grand Junction (where uranium mill tailings were used as fill material for buildings), both in Colorado, and other locations as directed by the Department of Energy. Close collaboration with other groups is planned.
Keywords: NUCLEAR FACILITIES; FOSSIL-FUEL POWER PLANTS; HEALTH HAZARDS; HUMAN POPULATIONS; POPULATION DYNAMICS; PUBLIC HEALTH; RISK ASSESSMENT; STATISTICS; EPIDEMIOLOGY; MATHEMATICAL MODELS; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS.

85099 **Somatic Effects of Environmental Agents.** 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: fossil fuels(100). **R and D categories:** Health effects.

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 metabolitc(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.

85102 **Bioengineering Research.** Shumate, S.E. II. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001565. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
R and D categories: Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to explore fundamental relationships in areas of biochemical engineering such as microbial and enzyme engineering, separation technology and bioprocess development for fuel production, energy conservation, resource recovery, and environmental protection. The approach is to use established chemical engineering research methods and techniques to conceive, design, and evaluate practical biochemical reactors and processes. Results include development of a new type of fluidized-bed bioreactor and processes for removal of nitrates, special hydrocarbons (e.g., phenols), and heavy metals from fuel (nuclear, coal) processing industry wastewaters.
Keywords: MICROORGANISMS; ENZYMES; ENGINEERING; POLLUTION; BIOCHEMISTRY; CHEMICAL EFFLUENTS; WATER.

85103 **Inhibition of DNA Repair by Chemicals.** Regan, J.D. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 001566. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

DNA repair mechanisms are important in preserving and monitoring the genetic integrity of cellular DNA. The purpose of this project is to determine if compounds derived from coal liquifaction and gasification processes (1) cause repaired or unrepaired damage to human DNA or (2) inhibit DNA repair processes which correct damage by other agents (e.g., ultraviolet radiation). Several such compounds, including derivatives of benzo(a)pyrene, quinoline, hydrazine and fluorene, are proven or suspected mutagens and/or carcinogens and can be expected to cause some of the aforementioned effects on DNA of human cells. We have sensitive, rapid and informative techniques for studying DNA repair which include (1) bromodeoxyuridine photolysis and (2) molecular weight analysis. In addition, we have fully characterized DNA repair in human cells (normal and repair deficient mutants) after DNA damage by a variety of these agents. Several compounds, including benzo(a)pyrene metabolites, quinoline derivatives and N-acetoxyacetamino fluorene, have shown a variety of effects on human DNA including DNA cross-linking, damage repaired by uv and x-ray type repair systems, photodynamic breakage of DNA and partial inhibition of repair. We are continuing to investigate the above com-

pounds and their metabolic derivatives in addition to other compounds including chrysenes, benzanthracenes and other polycyclic derivatives of coal conversion.
Keywords: DNA; BIOLOGICAL REPAIR; INHIBITION; CHEMICAL EFFLUENTS; COAL LIQUEFACTION; COAL GASIFICATION; ULTRAVIOLET RADIATION; BENZOPYRENE; FLUORENE; CONDENSED AROMATICS; QUINOLINES; HYDRAZINE; HEALTH HAZARDS; TOXICITY.

85105 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: fossil fuels(100). **R and D categories:** Health effects.

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.

85106 Mamm Chem Mutagenesis Testing program. Russell, L.B. (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: fossil fuels(100). **R and D categories:** Health effects.

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.

85107 Ion Chemistry in the Atmosphere. Stockdale, J.A.D. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 01602. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$193,000.
Related energy source: fossil fuels(60); nuclear fission(20); other advanced(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to elucidate the physics or gas phase chemistry of atmospheric ion-molecule and ion-ion interactions which result from natural and manmade sources in the environment. Reaction rates, dissociative products, fragment kinetic energies, and reaction spectra are determined for a variety of molecular species. Low-energy negative ions are produced by dissociative electron attachment reactions. The negative ions thus produced are allowed to react with target molecules where products are analyzed by a quadrupole mass spectrometer. In a second experiment dissociative ionization by electron bombardment is used to produce molecular ion products which are energy and mass analyzed by time-of-flight and by a quadrupole mass filter.
Keywords: EARTH ATMOSPHERE; CHEMICAL REACTIONS; AIR POLLUTION; IONS; CHEMICAL REACTION KINETICS; ELECTRONS; MOLECULES; ION-MOLECULE COLLISIONS; MASS SPECTROSCOPY; MOLECULAR IONS.

85108 Physicochemical Properties of Chemical Pollutants, Biologically Active Molecules and Related Structures. Christophorou, L.G. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** 001603. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$161,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects.

The objectives are to determine basic physical and chemical properties of important pollutants and toxic compounds and to unravel their interaction mechanisms and pathways. Novel photophysical, electron impact, ion impact and mass spectrometric techniques will be employed as well as theoretical and computational methods and synthesis of existing knowledge on the physical and chemical properties and interactions of pollutants and toxic compounds.
Keywords: AIR POLLUTION; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL EXPOSURE PATHWAY; TOXICITY; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; ELECTRON BEAMS; PHOTON BEAMS; SCREENING; EARTH ATMOSPHERE; SULFUR OXIDES; NITROGEN OXIDES; NITRATES; CARBON OXIDES; HYDROCARBONS; GASES; ORGANIC COMPOUNDS.

85109 Studies of Pollutant Ion Formation and Atmospheric Clustering. Klots, C.E. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 01604. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$182,000.
Related energy source: fossil fuels(60); nuclear fuels(general)(20); other advanced(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Through theoretical calculations and experimental measurements, the clustering reactions of a number of positive and negative ions will be determined. Species of interest in atmospheric processes and in combustion of fossil fuels are to be characterized as to types of cluster ions formed, cluster sizes, characteristics, and clustering rates under different ambient conditions. Supersonic expansion nozzles will be used to create molecular clusters which interact in a crossed beam apparatus with photons, electrons, and atomic beams. Reaction products are analyzed by time-of-flight and by quadrupole mass spectrometry.
Keywords: CATIONS; ANIONS; IONS; EARTH ATMOSPHERE; AIR POLLUTION; FOSSIL FUELS; COMBUSTION; COMBUSTION PRODUCTS; NOZZLES; ATOM-MOLECULE COLLISIONS; ELECTRON-MOLECULE COLLISIONS; PHOTON-MOLECULE COLLISIONS; MASS SPECTROSCOPY; TIME-OF-FLIGHT METHOD; ION PAIRS; SPECTROSCOPY.

85110 Studies of Surface Interactions and Ion Particulate Accretion. Ritchie, R.H. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** 01605. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$175,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring.

The objectives are to understand the basic interactions of environmental pollutants with matter and to study, theoretically and experimentally, the forces on charged or neutral bodies located near a solid or liquid surface. Basic techniques of theoretical physics (e.g., classical electromagnetic theory, quantum mechanics) will be employed in this work. Emphasis will be placed on the role of collective electron and ion oscillatory motion associated with the surface of the condensed phase in determining these forces. Experimental measurements of such forces will be made to complement the theoretical studies.

Keywords: POLLUTION; CHEMICAL REACTIONS; SOLIDS; LIQUIDS; SURFACE PROPERTIES; ELECTRON MOBILITY; PARTICLES; IONS.

85111 Development of Portable Analyzer. Mrochek, J.E. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 01606. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to adapt or develop methodologies for the sensitive and specific assays of labile environmental pollutants by measurement of transmission absorption, fluorescence, chemiluminescence, or light-scattering signals on the portable Centrifugal Fast Analyzer. Analytical methods for the inorganic nutrients ammonia, phosphate, and silica were adapted and tested. A sensitive kinetic procedure for adenosine phosphates was developed for the detection and quantitation of microbial populations and the procedure was used in support of bioreactor operation. The fast measurement capability of the portable analyzer was utilized to demonstrate the feasibility of monitoring chlorine (as hypochlorous acid) by ultrasensitve chemiluminescence. New assembly language software was written for the microcomputer of the portable analyzer to give it minimal linear search capability and also the capability to compute a standard curve from onboard reference solutions and calculate concentrations of unknown solutions based on the standard curve. The instrument now has the capability to measure a number of pollutants in remote locations.
Keywords: WATER POLLUTION; MONITORING; CHEMICAL EFFLUENTS; LIQUID CONTAMINATION MONITORS; MEASURING INSTRUMENTS; AMMONIA; PHOSPHATES; SILICA; NITRATES; QUANTITATIVE CHEMICAL ANALYSIS; TRACE AMOUNTS; COMPUTER CALCULATIONS; PHOTOMETERS; DESIGN; BIOCHEMISTRY; BIOMASS; ECOSYSTEMS; MUTAGENESIS; WATER; NUTRIENTS.

85112 Advanced Multidetector Spectrographic Detector Systems for Atomic and Molecular Analysis. Davidson, J.B. (Oak Ridge National Laboratory, Instrumentation and Controls Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 01607. **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: fossil fuels(50); nuclear fuels(general)(10); nuclear fission(20); all(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

85113 Resonance Ionization Spectroscopy. Hurst, G.S.; Kramer, S.D. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 01608. **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: fossil fuels(60); nuclear fuels(general)(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

85114 Continuous Monitors for Effluents. Pitt, W.W. Jr. (Oak Ridge National Laboratory, 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-$108,000.
Related energy source: coal(50); all(50). **R and D categories:** Characterization, measurement, and monitoring.

The objective is the development of: (1) automated analytical systems for isolation and identification of specific pollutants; and (2) systems for continuous on-site monitoring of pollutants and health hazards. A three pronged approach is being taken: (1) detailed characterization studies of specific effluents; (2) adaptation of existing detectors for use as environmental monitors; and (3) identification and conceptualization of new monitors for pollution detection and measurement. A prototype aquatic environmental monitor which continuously measures native fluorescence and the chemical oxygen demand has been assembled and installed for use in monitoring the treated wastewater from coal liquefaction tests. A prototype, portable remote sensing device for detecting fugitive emissions and spills containing polynuclear aromatic hydrocarbons has been assembled and is undergoing evaluation.
Keywords: POLLUTION; MONITORING; CHEMICAL ANALYSIS; HEALTH HAZARDS; BIOLOGICAL EFFECTS; CHEMICAL EFFLUENTS; EQUIPMENT; FLUORESCENCE; WATER POLLUTION; COAL LIQUEFACTION; WASTE WATER; POLYCYCLIC AROMATIC HYDROCARBONS; AIR POLLUTION; LAND POLLUTION.

85116 Environmental Fate of Emissions from Coal Combustion Plants. Lindberg, S.E.; Turner, R.R. (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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

85119 Ecological Effects of Coal Combustion: Responses of Vegetation to SO2. McLaughlin, S.B.; Shriner, D.S. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 001627. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$127,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

This research encompasses laboratory and field research aimed at determining the individual and combined effects on terrestrial ecosystems of atmospheric pollutants associated with coal combustion. The studies are designed to characterize the nature of phytotoxic effects of SO/sub 2/, O/sub 3/, and acid rain and to determine what level of control is necessary to reduce detrimental effects to tolerable levels. Laboratory studies are addressing identification of physiological indices of pollutant stress to both acute and chronic pollutant exposure. Field studies are currently being initiated to quantify integrated impacts on growth of ambient levels of pollutants (principally ozone and acid rain) and to relate plant responses in the field to specific pollution episodes. In addition long-range effects of pollutant stress on forest systems are being examined with the use of a forest growth and succession model. This research will be useful in evaluating the dose-response relations for major pollutants in the eastern United States so that ambient air quality standards may be designed to consider dosage characteristics of greatest significance to vegetation response. It will also assist in evaluating the potential future impacts of additional burdens of atmospheric pollutants derived from fossil-fuel combustion.

Keywords: TERRESTRIAL ECOSYSTEMS; AIR POLLUTION; COAL; COMBUSTION PRODUCTS; TOXICITY; SULFUR DIOXIDE; OZONE; ACID RAIN; BIOLOGICAL STRESS; PLANTS; FORESTS; DOSE-RESPONSE RELATIONSHIPS; AIR QUALITY.

85120 Numeric Information Support for Modeling, Analysis, and Assessment of Environmental Impacts of Energy Related Technology. Strand, R.H. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 001651. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$60,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objectives are: (1) to coordinate data management and processing activities within the Division; (2) to assess and implement data management capabilities for Division research projects; (3) to store computer accessible data as a resource for future research; and (4) to apply data management techniques to project needs. A data base resource is being developed containing both numeric research results and textural documentation for the support of projects which analyze and evaluate the environmental impacts of energy technology on regional scales. Research and development efforts are directed toward collection, management, analysis, and display of data on ecological data. Data resources have been applied to research needs in collaboration with ongoing projects. Several joint publications have resulted from these activities. Data management, analysis and display capabilities have been provided to meet current and anticipated needs; however additional developments are needed in the areas of display and mapping and making computer resources more readily available. The data resources will be maintained under project 189 No. 1668 and additional development will be done in response to individual project needs and funding.
Keywords: DATA BASE MANAGEMENT; DATA PROCESSING; DATA ACQUISITION; INFORMATION NEEDS; TECHNOLOGY TRANSFER; ENERGY; ENVIRONMENTAL IMPACTS; REGIONAL ANALYSIS; ECOLOGY; COMPUTERS; INFORMATION SYSTEMS; DATA; ENVIRONMENT; INFORMATION RETRIEVAL.

85123 Global Carbon Cycles and Climatic Risks. 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: fossil fuels(90); biomass(10). **R and D categories:** Integrated assessment.

The objectives are to: (1) develop models relating fossil and nonfossil CO/sub 2/ to biosphere and global cycle; (2) project large-scale (biospheric) and long-range consequences of climatic change; and (3) evaluate required information, cost or benefit, and risks of decisions. The approach involves variants of CSMP simulation models to reveal consequence of fuel scenario, possible nonfossil CO/sub 2/ sources and CO/sub 2/ storage in biosphere; and comparison with observed CO/sub 2/ records and credible future projections and their implications from state-of-the-art climatology (with NOAA, NSF) and to the very specific requirements of biospheric and modeling research in a national climate program relevant to energy/environment policy. Initial models on forest clearing and burning as significant for both CO/sub 2/ source areas and potential CO/sub 2/ storage areas, with biospheric subdivisions by main forest (nonforest) area or main ecosystem pools of rapidly or slowly exchanging carbon--in reports, publications and several talks--have been completed. Comparison with inductive analysis of geophysical cycles, better global rate estimates, 13C, 14C, and implications for (and from) climate/ecosystem relations are expected.
Keywords: CARBON DIOXIDE; GREENHOUSE EFFECT; CLIMATES; FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL EFFECTS; EARTH ATMOSPHERE; FORESTS; COMBUSTION; MATHEMATICAL MODELS; CARBON 13; CARBON 14; SIMULATION; RISK ASSESSMENT.

85124 Physical and Chemical Characteristics of Plutonium in Soils. Lee, S.Y.; Tamura, T. (Oak Ridge National Laboratory, 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-$105,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The physical-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: MOUND LABORATORY; NEVADA TEST SITE; ORNL; ROCKY FLATS PLANT; RADIOACTIVE EFFLUENTS; SOILS; RADIONUCLIDE MIGRATION; PLUTONIUM; ENVIRONMENTAL TRANSPORT; PARTICLE SIZE; PARTICLE RESUSPENSION; HUMAN POPULATIONS; ENVIRONMENTAL EXPOSURE PATHWAY; INHALATION.

85128 Regional Studies Program. Davis, R.M. (Oak Ridge National Laboratory, P.O. Box X, Building 4500-N, MS G-22, Oak Ridge, TN, 37830). **Project number:** 1684. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$782,000.
Related energy source: coal(30); oil and gas(10); nuclear fuels(general)(30); geothermal(10); solar(10); conservation(10). **R and D categories:** Integrated assessment.

The objectives are to: (1) conduct national and regional technology assessments of alternative energy technologies and energy fuel cycles; (2) perform lead laboratory assessment responsibilities for (a) scenario disaggregation, (b) siting, and (c) water availability analysis; (3) identify and analyze regional environmental issues; and (4) assist in dissemination and utilization of research. The approach is 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; (3) develop, maintain, and apply county-level data bases and analysis techniques to conduct scenario, siting, and water analysis and assessments; and (4) maintain contact and communication with public and private sector officials in the South. The products include: (1) Regional Assessment of Coal Utilization (continuing); (2) Regional Assessment of the National Energy Plan (continuing); and (3) Regional Assessment of Solar Technologies (future).
Keywords: REGIONAL ANALYSIS; ENERGY SOURCE DEVELOPMENT; MANAGEMENT; TECHNOLOGY ASSESSMENT; SOLAR ENERGY; COAL; FOSSIL-FUEL POWER PLANTS; NATIONAL ENERGY PLAN; ENERGY SOURCES.

85133 Environmental Behavior of U and Th. Bondietti, E.A. (Oak Ridge National Laboratory, Building 1505, Room 286, Oak Ridge, TN, 37830). **Project number:** 01691. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The proposed research will evaluate the environmental consequences if high specific activity U, Th, and related nuclides are released to terrestrial and aquatic ecosystems from activities related to the thorium fuel cycle. The research needs thus far identified are an evaluation of the existing knowledge of the environmental behavior, including food-chain dynamics, of these elements and the establishment of research selected on the basis of inadequate information of environmental pathways or transfer parameters. The results of the research will help (1) evaluate the fraction of native U and Th in soils which is plant available and determine how contaminant U and Th isotopes equilibrate with native U and Th; and (2) compare U, Th, and Pu behavior in the soil--plant--animal food chain by evaluating what fraction of soil U, Th and Pu end up in bone and other animal tissues.
Keywords: URANIUM; THORIUM; THORIUM CYCLE; FOOD CHAINS; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; RADIONUCLIDE MIGRATION.

85136 Ultrastructural Cell Biology of Respiration. Heckman, C.A. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 001700. **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: fossil fuels(100). **R and D categories:** Health effects.

Characterization of preneoplastic lesions is one of the most important goals of basic and clinical cancer research. It is the key to: (1) identification of individuals at high risk for developing cancer and (2) development of therapeutic intervention in the latency period. The objectives of our studies are (1) to correlate morphological and biochemical changes with the evolution of neoplasia in the

respiratory tract after chemical carcinogen exposure and (2) to correlate cellular changes with altered biological behavior such as growth capacity, anchorage-independence, and invasiveness. The approach employs tracheal transplants for localized induction of preneoplastic lesions by polyaromatic hydrocarbons. Carcinogen-altered epithelium and invasive carcinomas are obtained for in vivo and in vitro studies and for comparison with normal epithelium. Morphological and biochemical markers which discriminate between neoplastic and normal cells in vitro are identified and used to study early and late carcinogen-induced lesions in vivo. The results suggest that changes in glycolytic metabolism and lipid biosynthesis may be found early after carcinogen treatment. However, cellular deformability, which appears to be correlated with the ability of cells to invade surrounding tissues, may increase only after a "latent" period. Future results will increase our understanding of the effects of hydrocarbon carcinogens and of the latent period.
Keywords: NEOPLASMS; BIOCHEMISTRY; ANIMAL CELLS; POLYCYCLIC AROMATIC HYDROCARBONS; MORPHOLOGY; CARCINOGENESIS.

85138 Pollutants in Cardiovascular Disease. 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: fossil fuels(100). **R and D categories:** Health effects.

In in vitro studies, cadmium (cadmium is a known pollutant from energy-related and industrial process) has been shown to bind to sulfhydryl groups of alpha receptors and various enzymes with a subsequent stimulation or inhibition in the activity of the receptor or enzymes. It is thus inferred that cadmium may affect the binding of the alpha agonist through its ability to bind to sulfhydryl groups of the beta receptor. Research efforts during FY-78 to FY-79 will be devoted to determining the interactions of cadmium with sulfhydryl groups of alpha receptors obtained from various tissues. These studies will include (1) the role of sulfhydryl groups of beta receptor in agonist binding, (2) the interactions of trace elements on beta and alpha agonist and antagonist binding, (3) the effects of divalent cations on cadmium induced binding of beta agaonist. This research approach is justified by the known control of blood pressure by the alpha receptor of smooth muscle. The above studies will be complemented by studying the effects of cadmium on contraction of isolated aortic strips in the presence or absence of noradrenaline or adrenaline. A similar approach will be used to study the effects of cadmium on isolated renal artery strips. Since we have observed that the aorta accumulates cadmium attempts will be made to determine the diffusion rate of cadmium through the aorta in perfusion studies.
Keywords: CARDIOVASCULAR DISEASES; POLLUTION; CADMIUM; BIOLOGICAL EFFECTS; HEALTH HAZARDS; BIOCHEMISTRY; IN VITRO; CHEMICAL BONDS.

85140 Microdosimetry, Biologically Modelling, and Theoretical Biophysics. Wright, H.A. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** 01706. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$118,000.
Related energy source: fossil fuels(20); nuclear fuels(general)(80). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of the project are to improve our understanding of the physical and chemical interactions that radiation undergoes with biological material and to develop models for predicting the biological effects of radiation. The approach to the process involves starting with basic cross sections, describing the initial physical interactions that radiation undergoes with matter, and linking these early physical events to later chemical events and ultimately to biological effects.
Keywords: IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS; BIOLOGICAL MATERIALS; MICRODOSIMETRY; BIOPHYSICS; MOLECULAR BIOLOGY; RADIOBIOLOGY; PHYSICAL RADIATION EFFECTS; CHEMICAL RADIATION EFFECTS; CROSS SECTIONS; BIOLOGICAL MODELS.

85141 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:** 01707. **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(80); oil shales and tar sands(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

85143 Facility for the Chemical Support of Biological and Environmental Studies Related to Coal Conversion. Clark, B.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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

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.

85145 Inventory of Federal Energy-Related Environmental and Safety Research. Peck, L.J.; Shriner, C.R. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 001725. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$98,000.
R and D categories: Integrated assessment.

The objective is to maintain a computerized inventory of the projects funded by all federal agencies dealing with energy-related biomedical and environmental research. BER personnel are able to obtain: (1) publication of inventory documents printed directly from the computer; (2) manipulation of the data to provide upon demand special listings and funding summaries; and (3) online availability for computer searching at both ORNL and DOE.
Keywords: US ERDA; RESEARCH PROGRAMS; INFORMATION SYSTEMS; ENERGY; DATA BASE MANAGEMENT; ENVIRONMENT.

85146 RUSTIC: Regional and Urban Studies Information Center Unified-Socioeconomic Analysis and Retrieval System. Loebl, A.S. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 1726. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$60,000.
Related energy source: fossil fuels(5); coal(4); oil and gas(5); hydroelectric(4); geothermal(4); solar(4); biomass(4); conservation(70). **R and D categories:** Integrated assessment.

The objective is to provide socioeconomic data, analysis, assessment and technical assistance to a diverse user community. Services have been oriented toward providing the specific data needed to focus on problems of local, state and federal organizations, to investigate technical questions in support of DOE research programs, to develop an integrated information system and to provide effective assistance in comprehensive data analysis and display related to socioeconomic and energy related studies. The approach is to maintain a small staff, trained in the social, information, statistical, economic and computer sciences to acquire volatile, massive data bases, make these skills and constantly developing areas of expertise available by providing data and technical assistance on an intra-DOE program basis, maintaining and expanding information resources,

assessing information needs of the user community, automating and centralizing documentation and data, developing methods for data analysis and manipulation.
Keywords: REGIONAL ANALYSIS; URBAN AREAS; SOCIO-ECONOMIC FACTORS; INFORMATION CENTERS; INFORMATION RETRIEVAL; ENERGY SOURCES; DATA ANALYSIS; SOCIOLOGY; ENERGY SOURCE DEVELOPMENT.

85147 Assessment of Environmental and Biological Effects of Fusion Power Technology. Easterly, C.E. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 01731. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Overview. **Funding:** DOE.
Related energy source: nuclear fusion(100). **R and D categories:** Integrated assessment.

The purpose of this program is to assess the potential health and environmental effects from radioactive releases and magnetic fields associated with fusion power. A systematic assessment is proposed to evaluate available data, and models to identify potential environmental and health effects, and to identify what new information is required for a comprehensive environmental analysis of Magnetic Fusion Reactors. The objectives will be accomplished using the best present estimates of releases, environmental behavior, and risks to human health. At each stage of the assessment, the current state of knowledge will be reviewed to identify the unknowns and to estimate the relative effect of uncertainties on the final potential impact. A systematic assessment will identify where the data are deficient, and where and what kinds of research will be needed to assess accurately the health impacts from fusion.
Keywords: THERMONUCLEAR REACTORS; RADIOACTIVE EFFLUENTS; ENVIRONMENTAL TRANSPORT; ENVIRONMENTAL IMPACTS; MAGNETIC FIELDS; HEALTH HAZARDS; EARTH ATMOSPHERE; HUMAN POPULATIONS; RADIATION HAZARDS; RISK ASSESSMENT; SAFETY; RADIOISOTOPES.

85148 Biomedical Computing Technology Information Center (BCTIC). Maskewitz, B.F. (Oak Ridge National Laboratory, Engineering Physics Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 1733. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: all(100). **R and D categories:** Health effects.

BCTIC, a national technology resource, serves biomedical research and development and medical clinical practice by collecting, organizing, processing, evaluating, packaging, and disseminating computing technology. The goal is the more effective use of computers with consequent cost savings. The purposes are to save time, prevent duplication of effort, and to advance the state of the art. With emphasis on nuclear medicine computing technology, BCTIC supports DOE programs to provide the bases for new and useful applications of radiation and radioisotope methodology in clinical, biological, and environmental research. The scope includes six distinct functions: (1) a clearinghouse for algorithms, documentation, computer programs, data, and interface designs pertinent to clinical and/or research biomedicine is established; (2) a bimonthly newsletter highlights important developments in the field, surveys existing biomedical computer installations, notes upcoming meetings and events of interest, and provides a bibliography of recent biomedical computing literature; (3) BCTIC conducts seminars, workshops, and topical meetings on biomedical computing technology and publishes and distributes the proceedings as state-of-the-art reviews; (4) BCTIC maintains an information storage and retrieval system containing bibliographic citations and abstracts accumulated through review of pertinent books, journals, and reports, and periodically publishes bibliographies and abstracts; (5) BCTIC personnel actively promote hardware and software standards in biomedical computing; and (6) a Directory of Clinical Resources in the biomedical computing community provides an index of equipment and clinical procedures performed at the various installations.
Keywords: BIOMEDICAL RADIOGRAPHY; TECHNOLOGY TRANSFER; NUCLEAR MEDICINE; INFORMATION CENTERS; INFORMATION RETRIEVAL; COMPUTERS; BIBLIOGRAPHIES; BIOLOGICAL MODELS; MEETINGS; INDEXES; COMPUTER CODES; DATA; BIOCHEMISTRY; HEALTH HAZARDS; TOXICITY; POLLUTION; DATA BASE MANAGEMENT.

85157 Information Center for Energy Safety. Hoy, H.C. (Oak Ridge National Laboratory, P.O. Box Y, Bldg. 9764, Oak Ridge, TN, 37830). **Project number:** 2258. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Impacts. **Funding:** DOE-$100,000.
Related energy source: fossil fuels(55); nuclear fusion(5); hydroelectric(5); geothermal(5); solar(5); ocean thermal(5); biomass(5); wind(5); conservation(5); other advanced(5). **R and D categories:** Integrated assessment.

The Information Center for Energy Safety (ICES) was established at Oak Ridge National Laboratory (ORNL) by the Department of Energy (DOE) as a national center for collecting, storing, evaluating, and disseminating safety information related to the development and use of several non-nuclear forms of energy. In particular, this center will be uniquely concerned with the safety considerations and relevant standards useful in the design, construction, and operation of the various energy systems and their supportive research facilities. ICES operates in collaboration with the DOE Technical Information Center (TIC) in the maintenance of energy safety information in a computerized data base on RECON, DOE's computerized information network. This data base enables ICES to efficiently provide a variety of products and services to the energy associated community. The Center, established in 1976, has a staff that will analyze current information, prepare state-of-the-art reviews of the safety of the various energy systems, and answer technical inquiries. The environmental, physical science, and engineering aspects of energy conversion, storage, and use are emphasized. In addition energy safety information is routinely collected by information specialists who scan all available sources, screen out those of pertinence (and not already indexed by TIC), separate the sources into ICES's subject areas, and route them for abstracting, key wording, and adding to RECON's Energy Data Base (EDB).
Keywords: ORNL; INFORMATION CENTERS; SAFETY; HAZARDS; INFORMATION SYSTEMS; ENERGY CONVERSION; PRODUCTION.

85159 Environmental Policy Analysis. Jacobs, D.G. (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). Div. of Policy Analysis. **Funding:** DOE-$355,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objective is to analyze the relationships among technical, environmental, health, economic, and societal factors of legislation, policy decisions, and regulations as they affect energy research, development, and demonstration or affect commercialization of developed energy systems. Specific studies will be conducted of proposed standards for high level radioactive waste disposal, criteria for decontamination of sites, the implications for new energy technologies of the Resource Conservation and Recovery Act of 1976, and constraints on water availability for energy use in the eastern United States.
Keywords: ENVIRONMENTAL POLICY; TECHNOLOGY ASSESSMENT; ENVIRONMENTAL IMPACTS; HEALTH HAZARDS; SOCIAL IMPACT; ECONOMIC IMPACT; LEGISLATION; DECISION MAKING; POLLUTION REGULATIONS; ENERGY POLICY; RADIOACTIVE WASTE DISPOSAL; DECONTAMINATION; ENERGY SOURCE DEVELOPMENT; RESOURCE CONSERVATION; WATER RESOURCES; CONSUMPTION RATES; USES; USA; DECOMMISSIONING; NUCLEAR FACILITIES.

85160 Ultrasensitive Pollutant Analysis by Laser Fluorescence Techniques. Chen, C.H.; Payne, M.G. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 02389. **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: fossil fuels(60); nuclear fuels(general)(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to develop advanced instrumentation techniques for detection of atmospheric pollutants. Laser-induced fluorescence of organic molecules is to be studied in a seeded molecular jet. Time-resolved spectra are obtained with a pulsed tunable dye laser, in visible and near ultraviolet spectral regions.
Keywords: AIR POLLUTION MONITORS; AIR POLLUTION; MONITORING; LASER RADIATION; ORGANIC COMPOUNDS; FLUORESCENCE SPECTROSCOPY; DYE LASERS.

85161 Environmental Transport and Effects of Coal Conversion. Gehrs, C.W. (Oak Ridge National Laboratory, Environmental Sciences Division, Bldg. 1505, Oak Ridge, TN, 37830). **Project number:** 01693. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$705,000.
Related energy source: coal(100). **R and D categories:** Ecological/biological processes and effects.

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. Concommittantly, 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 IMPACTS; COAL GASIFICATION; COAL LIQUEFACTION; TOXICITY; CHEMICAL EFFLUENTS; LIQUID WASTES; GASEOUS WASTES; ENVIRONMENTAL TRANSPORT; METABOLISM; UPTAKE; AVAILABILITY; SITE SELECTION.

85163 Chemical Characterization of Complex Organic Materials Related to Coal Conversion Technology (CCT). Guerin, M.R.; Pitt, W.W. (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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to find fast, efficient and economical methods for the isolation and analysis of specific compounds and compound classes in coal derived materials (including effluents, e.g., aqueous discharges) to determine isomeric compounds. Resources are spent on the characterization of materials from the standpoint of their relevance as well as the interest which has developed in specific compound types. Chromatographic methods are utilized to simplify complex mixtures and analyses are made relying on spectroscopic methods, elemental analysis and combined gas-chromatography/mass spectrometry with specific ion monitoring and mass chromatography. Procedures for the isolation, as classes, of polycyclic aromatic hydrocarbons, azzarenes and sp/sup 3/--N--heterocyclic multiring compounds are being refined. Basic research is beginning to learn methods of identifying the exact isomeric forms of isomers in compound classes of the same kind.
Keywords: SEPARATION PROCESSES; CHEMICAL ANALYSIS; COAL; COAL LIQUIDS; COAL GAS; LIQUID WASTES; GASEOUS WASTES; CHROMATOGRAPHY; SPECTROSCOPY; GAS CHROMATOGRAPHY; MASS SPECTROSCOPY; POLYCYCLIC AROMATIC HYDROCARBONS; HETEROCYCLIC COMPOUNDS; ORGANIC NITROGEN COMPOUNDS.

85165 Biochemical Treatment of Waste Streams from Coal Conversion Processes. Lee, D.D. (Oak Ridge National Laboratory, P.O. Box X, Bldg. 4505, Oak Ridge, TN, 37830). **Project number:** 001711. **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: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The aqueous waste effluent streams from coal gasification or liquefaction must be treated to comply with EPA guidelines. The most attractive treatment method that is both economical and technically feasible is the biological treatment method. The design of a biosystem process, integrated with chemical and physical methods, capable of treating various pollutants contained in coal conversion wastes is a primary objective. This is done by: (1) developing proposed methods as bench-scale operating systems, (2) determining the most promising of these, and (3) testing the system by treating coal conversion aqueous waste. The results of this program of development can be directly applied to the now emerging field of coal conversion. Since the aqueous waste from coal gasification and liquefaction are qualitatively similar on a chemical constituent basis, the results apply to both processes. The general biological treatment methods (trickling filters, activated sludge) consist of relatively slow, single stage systems that are subject to shock load and poisoning upsets. The fluidized bed system under development operates as a multistage reactor, and because of the ease of removing and replacing the solid support particles, it can be made almost immune to shock and poisonings. The specific compounds under investigation are phenols, thiocyanate, ammonia, nitrate, and other carbon compounds.
Keywords: COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; LIQUID WASTES; WASTE PROCESSING; BENCH-SCALE EXPERIMENTS; METABOLISM; BIOCHEMICAL REACTION KINETICS; FLUIDIZED BED; PHENOLS; THIOCYANATES; AMMONIA; NITRATES; FILTRATION; ACTIVATED SLUDGE PROCESS; MICROORGANISMS.

85167 Environmental Evaluation: Guyan Oil Company EOR Pilot Project. Hildebrand, S.G. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 02925. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$62,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

The key objective of this project is to conduct an independent environmental review of the Guyan Oil CO/sub 2/ Injection pilot project to insure the environmentally safe progression of this project. Two environmental assessments have previously been prepared for this project by other investigators. Our approach to achieve the above objective will include periodic site and project inspections, a detailed review of all assessments and recommendations prepared, review and analysis of all environmental monitoring data available for this project, and interaction with all governmental agencies with authority or interest in this project. We have submitted an interim progress report in June, 1978 which summarizes the chronology of environmentally important events surrounding this project to date, and preliminary evaluations of sedimentation and erosion, ground and surface water quality, and air quality and noise. Sedimentation and surface water quality appear to be the potential major problem areas concerning this project. Our investigation is continuing and we expect a final evaluation report will be submitted in October, 1978.
Keywords: CARBON DIOXIDE INJECTION; ENVIRONMENTAL IMPACTS; OIL WELLS; PETROLEUM; ENHANCED RECOVERY; ENVIRONMENTAL EFFECTS; EROSION; WATER QUALITY; AIR QUALITY; NOISE POLLUTION; MONITORING.

85168 Evaluation of Environmental Monitors. Pitt, W.W. Jr. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 4103. **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: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of the program are twofold: (1) development, design, and construction of advanced, automated, continuous monitoring systems for specific environmental pollutants, and (2) characterization of expected pollutants and evaluation of advanced systems in actual and simulated process effluents. The program is primarily concerned with the second task as it relates to coal conversion processes. Specific environmental pollutants associated with coal conversion processes will be identified, and automated environmental systems for continuous in-situ monitoring of specific airborne or soluble pollutants will be developed. An evaluation of automated instrumentation will be pursued. Results will include a prototype Aquatic Environmental Monitor for continuously measuring the chemical oxygen demand and fluorescence characteristic of PNAs and a prototype portable spill spotter for detection of surface contamination by PNAs.
Keywords: ENVIRONMENT; MONITORING; BIOCHEMICAL OXYGEN DEMAND; COAL GASIFICATION; COAL LIQUEFACTION; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; WATER POLLUTION; OIL SPILLS.

85169 Environmental Applications of Portable Analyzers. Mrochek, J.E. (Oak Ridge National Laboratory, Post Office Box X, Oak Ridge, TN, 37830). **Project number:** 004104. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to develop the capabilities of the portable centrifugal analyzer so as to emphasize its utility in monitoring environmental pollutants in remote locations. Assembly language software was developed for the microcomputer to enable it to search rate data obtained by linear regression for a region having linearity equivalent to or in excess of an operator-selected correlation coefficient. In addition, a program was developed to fit n standards to a linear and a quadratic equation, select the best fitting model, and then compute concentrations for the remaining samples in the rotor based on the parameters of the best-fitting model. This software enables the portable analyzer to make use of the sulfate-catalyzed depolymerization of zirconia to measure sulfate in the range of 0 to 16 ppM. Also developed and tested were methods for the analysis of nitrite, organic acids and nitrate. Enzymatic methods were employed for the latter two analyses providing specificity as well as sensitivity.
Keywords: CENTRIFUGAL FAST ANALYZERS; AIR POLLUTION MONITORS; DATA PROCESSING; COMPUTER CODES; SULFATES; MONITORING; CATALYSIS; DEPOLYMERIZATION; ZIRCONIUM OXIDES; NITRITES; NITRATES; ORGANIC ACIDS; ENZYMES; SENSITIVITY; DESIGN.

85183 Full-Scale Impact Testing for Environmental and Safety Control 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. **Support-**

ed by: Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$220,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

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.

85185 Assessment of Environmental Control Technology for Coal Conversion Wastewater. 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). Div. of Environmental Control Technology. **Funding:** DOE-$200,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

85186 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: fossil fuels(100). **R and D categories:** Health effects.

The objective is to apply the methodologies we have developed for studying the cellular nucleotide pools and the transcription of the various classes of RNA (messenger, ribosomal, transfer, and chromatin RNAs) with regard to molecular mechanisms associated with two major biomedical areas: chemical carcinogenesis and certain kinds of chemical toxicology. A variety of neoplastic cell lines, and normal cells, in culture are compared with regard to the above parameters under normal growth conditions and where their environment is influenced by selected carcinogens and toxicants. A novel effect of adenosine on ribosomal RNA synthesis was discovered; definite differences between normal and neoplastic cells in culture have been found with regard to their abilities to expand nucleotide pools; and studies under way with a tracheal line developed at the Biology Division indicate significant nutritional effects of nucleosides.
Keywords: NUCLEIC ACIDS; BIOCHEMICAL REACTION KINETICS; CARCINOGENS; BIOLOGICAL EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS.

85187 Carcinogen Activity in Human Cells. Selkirk, J.K. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002589. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Mechanism of activation in metabolism of chemical carcinogens is being extensively studied in several rodent species both in vivo and in vitro. Since it has become apparent that there is a wide spectrum of species and tissue susceptibility to chemical carcinogen, we are interested in probing human cell systems ascertained, as the rate-limiting steps in activation and detoxification are similar in human as in model rodent systems when exposed to environmentally prevalent carcinogens. This is of critical importance since carcinogenesis and mutagenesis data in non-mammalian systems is routinely being used to predict the activity of suspected carcinogenic chemicals in humans. We are examining a series of carcinogenic polycyclic hydrocarbons with regard to their metabolic profiles and reaction rates as compared to their non-cancerous isomers (e.g., benzo(a)pyrene vs. benzo(e)pyrene). We are monitoring susceptible and resistant cell lines, both epithelial and fibroblastic cells, as model systems to compare against normal and malignantly transformed human cells. The amount of the activated species of the carcinogen molecule, as well as the rate of its removal to detoxification, may determine how prevalent the presumed ultimate carcinogen BP-7,8-diol-epoxide is in human vs. rodent cells and tissues at any given time point. Also, the degree of interaction with DNA, RNA and nucleoprotein in susceptible and resistant cells may predict a probability of a given cell becoming malignantly transformed.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; MAN; ANIMAL CELLS; BIOCHEMICAL REACTION KINETICS; POLYCYCLIC AROMATIC HYDROCARBONS; BENZOPYRENE; METABOLISM; RODENTS.

85189 Reproductive Physiology and Teratol. Wallace, R.A. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002526. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$280,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

A major theme of our work has been the demonstration that macromolecular yolk precursors as well as heterologous materials present in the maternal serum are incorporated by the growing oocyte, stored in compartmentalized membrane-bound inclusions, and utilized during embryogenesis. Thus, it appears likely that environmental materials present at subthreshold levels of toxicity in the adult female will be acquired, concentrated and stored by growing oocytes and made available to the embryo when the yolk compartment is utilized. Continuing studies include the development of long-term culture techniques for oocytes (so that perturbation of oocyte growth can be examined more directly) and an examination of the effects of hazardous materials from effluents of energy producing processes on early embryogenesis of an aquatic vertebrate such as the amphibian, Xenopus laevis. The effects of phenols, anilines, quinolines and untreated process and retort waters on such parameters as fertilizability, teratogenicity, and survival are being studied. Most of our efforts are devoted to effects caused by sublethal concentrations since these are more directly related to teratogenic development. Acquired data will be useful for the determination of maximum safe environmental concentration standards and in developing this system as a sensitive vertebrate model for aquatic toxicology/teratology.
Keywords: TERATOGENESIS; AQUATIC ORGANISMS; VERTEBRATES; REPRODUCTION; PHYSIOLOGY; BIOLOGICAL MODELS.

85190 Review Criteria of Criticality Safety for Transportation of Fissile Materials in 10 CFR 71. Thomas, J.T. (Oak Ridge National Laboratory, Computer Sciences Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800040. **Contract:** 800040. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$30,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

The objectives are to examine and define margin of safety inherent in criteria for Nuclear Criticality Safety as specified in 10 CFR 71. The effect of fissile mass loadings of various commonly used package insulating materials such as Celotex, wood and Foamglass will be examined to determine the extent that current criteria for specification of mass loadings in packages breach acceptable margins of safety and are consistent in assignment of transport indicies. Criteria for Class I packages are inconsistent with requirements for Fissile Class II shipments. Criteria for Fissile Class II and for Fissile Class III shipments can allow shipments with negligible margins of subcriticality.
Keywords: SAFETY; CRITICALITY; FISSILE MATERIALS; REGULATIONS; THERMAL INSULATION; TRANSPORT; SHIELDING MATERIALS; CASKS; SAFETY STANDARDS.

85191 Coal Conversion--Hydrocarbon and Carbon Monoxide Effluent Control. Klein, J.A.; Villiers-Fisher, J.F. (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). Div. of Environmental Control Technology. **Funding:** DOE-$57,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

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.

85192 Radionuclide Sources in the Coastal Zone. Cutshall, N.H. (Oak Ridge National Lab., 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

85193 Inventory of Transuranics in Clinch River. Eyman, L.D. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** 002569. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$140,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine the distribution and concentrations of transuranium elements in the Clinch River sediments in the vicinity of the Oak Ridge facility. Sediment cores have been collected from a 32 km reach of the Clinch River. Cores are analyzed for the vertical distribution of gamma-emitting radionuclides (primarily cesium and cobalt). Selected increments of the cores are analyzed for transuranic (TU) radionuclide content. A report detailing the distribution pattern of TU elements in the vicinity of Oak Ridge facilities and the distribution of gamma emitting radionuclides throughout the 32 km stretch of the Clinch River will be completed by the end of FY 1978.
Keywords: TRANSURANIUM ELEMENTS; RADIOECOLOGICAL CONCENTRATION; CLINCH RIVER; SEDIMENTS; DRILL CORES; DISTRIBUTION; GAMMA RADIATION; RADIOACTIVITY; CONTAMINATION.

85194 Fossil Fuel Pulmonary. Dalbey, W.E. (Oak Ridge National Lab., Biology Div., P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002363. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The overall objective of this work is to help define the role of selected airborne energy-related agents in the induction and progression of emphysema or chronic obstructive pulmonary disease. Acute exposures of rats to cadmium aerosol are used to provide a relevant and convenient model for the induction of emphysema. The progression of emphysematous lesions is monitored by pulmonary function tests and by morphometric and scanning electron microscopic examination of the lungs. The influence of host factors or other concurrent environmental stresses is being considered. Long-term nitrogen dioxide exposures are also being investigated in relation to emphysema. A dose-response study established that emphysematous lesions with minimal fibrosis can be produced by acute cadmium exposures. A single large and multiple smaller exposures resulting in the same cumulative dose produced similar lesions; this observation will be further pursued. An increase in pulmonary elastase was associated with the cellular infiltration after single cadmium exposures. Preliminary data indicate an effect of mechanical stress on the progression of cadmium-induced lesions. Elastase activity will be monitored in this study. Vitamin A status and sex were not found to alter the reaction to cadmium. The influence of vitamin A status in a well controlled study on the pulmonary phospholipid and hyperplastic response to NO2 is still uncertain, but was not as pronounced as in pilot work with less controlled diets. Chronic intermittent (weekly) exposures to NO2 were initiated to study nonadapted lungs and NO2-induced emphysematous lesions. Interaction studies with cadmium and NO2 have begun.
Keywords: FOSSIL FUELS; HEALTH HAZARDS; AIR POLLUTION; EMPHYSEMA; LUNGS; PATHOLOGICAL CHANGES; CADMIUM; BIOLOGICAL MODELS; NITROGEN DIOXIDE; TOXICITY; RATS.

85196 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 fuels(general)(100). **R and D categories:** Health effects.

Plutonium mutagenesis experiments were stimulated by the recent finding that plutonium concentrates in or near the basement membrane of the seminiferous tubules of the testis and therefore has the potential of exposing spermatogonial stem cells to a significant dose. It is likely that any effects of such long-term, low-level radiation exposure would be more easily detected by gene mutation tests than by chromosomal damage. Our laboratory is the only one in the USA equipped for this study. Mice injected with 239-Pu citrate are being tested for the transmission of specific-locus mutations. Since the possibility exists that the spectrum of mutational events produced by plutonium differs qualitatively from that produced by x or gamma irradiation, the nature of all recovered mutations is subsequently analyzed. Other genetic effects being tested are heritable translocations, and chromosomal abnormalities in diakinesis of the exposed males themselves. Gonadal effects are being analyzed in exposed animals of both sexes, since such analysis is of importance for the understanding of the genetic findings. Dosimetry determinations are being done by scintillation counting of various tissues. Gonadal dose is also being measured by autoradiography in order to derive an estimate of dose distribution within the organ.
Keywords: MICE; PLUTONIUM 239; MUTAGENESIS; GENETIC RADIATION EFFECTS; RADIATION DOSES; GONADS; INTRAVENOUS INJECTION; PLUTONIUM COMPOUNDS; CITRATES.

85200 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: fossil fuels(100). **R and D categories:** Health effects.

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 c 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.

85203 Chemical Carcinogenesis of Cells In Vitro. Huberman, E. (Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002361. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$204,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The aim of this project is to develop cell culture systems for screening potential hazardous chemicals reliably, quickly and cheaply relative to current animal exposure techniques. We will use and further develop in vitro malignant cell transformation assays as well as our cell-mutagenesis assay with different chemical carcinogens. Cells from human or rodent cell lines can be readily mutated by chemically reactive carcinogens, but not by chemicals that require metabolism for their effect. This can be overcome by their cocultivation with cells from different organs that can metabolize such compounds. This approach can lead to the identification of potential carcinogens in the environment including synthesis fossil fuel byproducts and can indicate the possible route of their metabolic activation. Using this approach we have identified the major mutagenic and transforming metabolites of the environmental chemical carcinogen benzo(a)pyrene. We have also developed, by using the cell-mediated assay with different cultured cells, means to determine species and organ specificity of environmental chemicals.
Keywords: CARCINOGENESIS; CHEMICAL EFFLUENTS; BIOLOGICAL MODELS; ANIMAL CELLS; MAN; RATS; BENZOPYRENE; BIOASSAY; BIOLOGICAL EFFECTS; HEALTH HAZARDS.

85204 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:** Physical and chemical processes and effects.

The goal is to characterize the transport behavior of potentially hazardous trace organic contaminants from a point source in a riverine environment, to provide directly applicable information for prediction of impact of commercial-scale coal conversion facilities. Study site is a large coking plant in eastern Pennsylvania which satisfied eight selection criteria. Experimental approach is collection of water samples for 10 km distance below outfall, using a lithium chloride injection into the effluent as an internal tracer to compensate for dilution and dispersion. Water samples are extracted, and extracts are purified and analyzed for polycyclic aromatic hydrocarbons (PAH) by gas chromatography. Sediment samples are collected and similarly analyzed. Rates of photolysis and microbial transformation, and the extent of sorptive partitioning onto suspended particles, are determined on site. Preliminary results include tentative identifications of 170 PAH in initial sediment samples; chromatographic distribution pattern of a sample from 6 km below the outfall shows the characteristic peak pattern of the outfall sediment. Final output will include (1) distributions of PAH in water and sediment as a function of season, and (2) validation of a PAH transport model which is being formulated using laboratory-derived transport process rate expressions.
Keywords: COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; COKE OVENS; WASTE WATER; HYDROCARBONS; ORGANIC COMPOUNDS; ENVIRONMENTAL TRANSPORT; RIVERS; TRACER TECHNIQUES; WATER; SEDIMENTS; SAMPLING; GAS CHROMATOGRAPHY; PARTICLES; POLYCYCLIC AROMATIC HYDROCARBONS; MATHEMATICAL MODELS; SEASONAL VARIATIONS.

85205 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: fossil fuels(100). **R and D categories:** Health effects.

Lack of understanding of the genetic and the environmental factors that produce differential response to mutagenic agents has been a stumbling block in the extrapolation of mutagenic data from experimental mammals to man, and therefore in the derivation of risk estimates. This project explores the metabolism of chemical mutagens as it relates to the genetic material (germcells). The mixed-function oxidase system is involved in the metabolism, activation, and detoxification of certain chemical mutagens, particularly those produced by coal-related technologies. Experiments underway have already allowed us to separate genetic and environmental factors responsible for differential response. In future work with coal-related compounds and mixtures, we shall attempt to identify the components of the mixed-function oxidase system that are involved in the activation and detoxification of product-fractions found to be mutagenic in lower organisms. In choosing agents for these experiments, we shall emphasize those that have been tested or are scheduled for test in the mammalian chemical mutagenesis testing program. In addition, we plan to continue basic studies on the metabolism of such model compounds as benzo[a]pyrene.
Keywords: MUTAGENS; RISK ASSESSMENT; METABOLISM; GENETIC EFFECTS; MUTAGEN SCREENING; COAL INDUSTRY; BIOLOGICAL EFFECTS; ANIMALS.

85206 Initiation of Teratogenesis. 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: fossil fuels(100). **R and D categories:** Health effects.

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.

85207 Biotoxicity of Chemicals. Hammons, A.S. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 2578. **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: fossil fuels(25); coal(25); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives of the project are to identify, compile, and assess toxicological information on known pollutants resulting from combustion/utilization of fossil fuels including coal, oil, gas, oil shales, and tar sands (limited to DOE-sponsored research). Searches of available literature and data bases and personal contacts with authors of recent pertinent reports were selected as a means of establishing an initial listing of subject pollutants. Initial listing of pollutants and acquisition of identified documents are in progress, and preparation of summary report is expected to be completed on schedule.
Keywords: COAL; PETROLEUM; NATURAL GAS; OIL SHALES; OIL SANDS; COMBUSTION; CHEMICAL EFFLUENTS; FOSSIL-FUEL POWER PLANTS; CARCINOGENESIS; MUTAGENESIS; TERATOGENESIS; TOXICITY; AIR POLLUTION; WATER POLLUTION; HEALTH HAZARDS; RISK ASSESSMENT; COMBUSTION PRODUCTS.

85208 RNA Metabolism in Precancerous Cells. Uziel, M. (Oak Ridge National Lab., Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 002590. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective is to study effects of hydrocarbons derived from the environment or coal technology on RNA metabolism in precancerous cells. We hope to define the nature of the interactions, the biochemical effects of the products of interaction and biochemical lesions leading to malignant transformation. We are measuring unique excretion products (modified nucleosides) derived from RNA as a monitor of carcinogen induced catabolism. The changes in RNA populations are also being monitored by chromatographic or electrophoretic analysis of cell extracts. We plan to extend these studies to human epithelial cells. Excreted carcinogen--RNA adducts will also be measured. We have discovered nucleosides as well as modified

nucleosides are normally excreted by resting cells. The rate of excretion is increased more than 100% when the cells are treated with BaP but not when treated with BeP. The excretion change precedes cell toxicity. The excretion process is ubiquitous. We have observed excreted Urd and Cyd in epithelial, transformed epithelial, fibroblast and lymphoid cells. These data and this approach will be useful in identifying potential carcinogens, in surveillance of exposed populations, and as a measure of carcinogen potency.
Keywords: RNA; NEOPLASMS; METABOLISM; HYDROCARBONS.

85209 Critical Review of Cooling Systems Impacts. Coutant, C.C. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 02600. **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: fossil fuels(25); nuclear fuels(general)(25); geothermal(25); solar(25). **R and D categories:** Ecological/biological processes and effects.

The objectives are to critically analyze aquatic ecological data relevant to impacts that have been hypothesized or demonstrated for power plant cooling systems, and prepare a report that will be suitable for both assessing the state of the art and for research and policy planning by the Department of Energy. The approach taken is analysis of risk. All sources of potential ecological damage are included, such as thermal discharges, biocides, entrainment, and impingement.
Keywords: THERMAL POWER PLANTS; CONDENSER COOLING SYSTEMS; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; THERMAL POLLUTION; WATER POLLUTION; AQUATIC ORGANISMS; ENTRAINMENT; IMPINGEMENT; ANTIFOULANTS; BIOLOGICAL EFFECTS; THERMAL EFFLUENTS; CHEMICAL EFFLUENTS; CHLORINE; RISK ASSESSMENT.

85210 Development of Guidelines for Monitoring Ecological Effects at Department of Energy Energy Sites. Sanders, F.S. (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: fossil fuels(50); geothermal(10); solar(10); ocean thermal(10); biomass(10); wind(10). **R and D categories:** Ecological/biological processes and effects.

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.

85211 NERP Environmental Reference System. Harris, W.F. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** 02937. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of this project is to develop an operational plan to use the DOE/NERP network to monitor long-term environmental change and pollutant fate. Such a system is necessary to confidently predict the impacts of man's technology on the environment. The approach used will involve evaluation of relevant environmental questions and design of specific measurement protocols to address these questions. On the basis of this analysis and design, the second phase of the project involves implementing the monitoring plan on the proposed Oak Ridge NERP. The expected products are baseline information and insights into how long-term trends of environmental pollution progress and the fate and effects of dispersed pollution in the region.
Keywords: POLLUTION; ENVIRONMENTAL TRANSPORT; TECHNOLOGY UTILIZATION; ENVIRONMENTAL IMPACTS; BASELINE ECOLOGY; NATURE RESERVES; ECOSYSTEMS; ENVIRONMENT; TENNESSEE; MATHEMATICAL MODELS.

85212 Environmental Effects of Fluorides from UF6. Taylor, F.G. Jr. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 02940. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Ecological/biological processes and effects.

The key objective of this project is to understand and document potential effects and environmental impacts from fluorides released from the nuclear fuel cycle. The intent of the research is to define environmental consequences of fluorides released from facilities that use UF6. The program provides information on the atmospheric chemistry and transport of fluorides, on accumulation and weathering of fluorides in plants and ecosystems, on responses of vegetation to exposures of chronic and intermittent concentrations. Objectives are to evaluate pertinent effects and accumulation from exposures during severe meteorological conditions, and to determine visible and physiological effects on species for threshold and intermittent exposure modes in environs of reference UF6 facility. Results will be useful to define standards and limitations of fluoride releases. Information will also be used to upgrade monitoring protocols at facilities that routinely use or release fluorides.
Keywords: URANIUM HEXAFLUORIDE; NUCLEAR FUELS; ENVIRONMENTAL TRANSPORT; TERRESTRIAL ECOSYSTEMS; PLANTS; STANDARDS; MONITORING; RADIOACTIVE WASTES.

85214 Environmental Evaluation of Wilderness Sites Proposed Under the USFS/RARE II Program and Energy Resource Site Conflicts. Klopatek, J.M. (Oak Ridge National Lab., Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 03214. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.
Related energy source: coal(40); oil and gas(40); nuclear fuels(general)(5); hydroelectric(10); geothermal(5). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The Forest Service's Roadless Area Review and Evaluation (RARE-II) Program has recently resulted in the release of an inventory of sites qualified to be included in the Wilderness System. These 2668 sites encompass nearly 65.7 million acres of land. In addition, 34 areas totalling 690,259 acres, though not included in the inventory, are included in the listing because their wilderness potential is being reevaluated concurrently. There is a need to address each land parcel's potential for alternative uses aside from that of a wilderness, e.g., its potential for energy resource development. As a result, DOE has subcontracted Oak Ridge National Laboratory to evaluate the ecological attributes of the RARE-II sites and to help alleviate potential conflicts between energy resources and potential wilderness. This work is subdivided into two major tasks, under the responsibility of the Environmental Sciences Division (ESD) and the Energy Division (ED), respectively. The first task of this project is designed to accomplish two goals: (1) the development of a computer model by which an environmental rating of sites designated as potential USFS wilderness areas can be assessed; and (2) a quantified environmental rating of the proposed wilderness sites based on ecological parameters intrinsic to the particular sites. The second task of this project is designed to support DOE Office of Policy Analysis and the Division of Biomedical and Environmental Research in evaluating the energy resources foregone through possible wilderness designation of the 2668 proposed tracts and 34 areas under the Roadless Area Review and Evaluation (RARE-II) Program. The results of these analyses will not be ready until October 1, 1978. At that time the ecological ratings, energy resource evaluations, and trade-off alternatives will be completed for the eastern United States and the Rocky Mountain Overthrust Belt.
Keywords: NATURE RESERVES; ENERGY SOURCE DEVELOPMENT; SITE SELECTION; INVENTORIES; LAND USE; FORESTS.

85215 Tritium Oxidation and Exchange. Easterly, C.E. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 02610. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The development of fusion reactors to provide a long-term energy source must be accompanied by a prudent program designed to ensure the health and safety of occupational personnel and members of the public. One of the principal issues in occupational protection and environmental assessments is that of the rate o conversion of molecular tritium to tritiated water. An experimen utilizing gas phase reactions of tritium gas at various pressures anu atmospheric air will be employed to determine the rate and mechanisms of conversion of HT to HTO. The design and construction of an experimental apparatus has nearly been completed. Initially, measurements using MPC/sub a/ levels of tritium in dry air will proceed with increasing concentration to near 1 mCi/ml. Emphasis will be

placed on obtaining data for times soon after the introduction of the tritium gas, since this will simulate conditions just after a tritium leak has occurred. Information on the early reaction rates will be most useful in assessment hazards to occupational personnel and members of the public.
Keywords: TRITIUM; OXIDATION; WATER; AIR; CHEMICAL REACTION KINETICS; MAXIMUM PERMISSIBLE CONCENTRATION; LEAKS; RADIATION DOSES; PERSONNEL; HUMAN POPULATIONS.

85216 Automated Analysis for Workplace Environment Re: Coal Conversion. Clark, B.R. (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). Div. of Pollutant Characterization and Safety Research. **Funding:** DOE-$70,000.
Related energy source: fossil fuels(25); coal(50); oil shales and tar sands(25). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

85217 Regional Studies Program. Davis, R.M. (Oak Ridge National Laboratory, Building 4500-N, MS G-22, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 2976. **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 fuels(general)(30); geothermal(10); solar(10); conservation(10). **R and D categories:** Integrated 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.

85218 Environmental Assessment of Cogeneration as a District Heating Source. Stockdale, W.G. (Union Carbide-Nuclear Division, 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, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$50,000.
Related energy source: conservation(100). **R and D categories:** Environmental control technology.

The objective 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. Typical cogeneration system will be selected and source terms for emissions calculated. A comparison of current emissions from localized sources will be made to that which would be expected if these sources were replaced by a district heating system utilizing a single cogeneration unit. Summary report of the study will be issued.
Keywords: CO-GENERATION; DISTRICT HEATING; AIR POLLUTION CONTROL; ENVIRONMENTAL IMPACTS; FLUE GAS; URBAN AREAS.

85219 Assessment of Environmental Control Options for CO2. Beall, S.E. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 800210. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$40,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

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.

85220 Gasifiers in Industry--UMD Project: Pollutant Characterization. Cowser, K.E. (Oak Ridge National Laboratory, Central Management Office, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 2943. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE-$241,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

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, plant effluents, and the working environs will be characterized chemically and physically by on-line and in-plant sample collections, measurements, and monitoring. Data developed will be used to guide subsequent bioassays and ecological testing of samples, to correlate possible worker exposures, and to assess the potential health and environmental impacts of this demonstration facility.
Keywords: COAL GASIFICATION PLANTS; GASEOUS WASTES; LIQUID WASTES; SOLID WASTES; ENVIRONMENTAL EFFECTS; HEALTH HAZARDS; CHEMICAL ANALYSIS; ON-LINE SYSTEMS; SAMPLING; MONITORING; SAFETY; HYDROCARBONS; MEASURING INSTRUMENTS; PARTICLES; EMISSION; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; ORGANIC COMPOUNDS.

85221 Water Availability Analysis--Extension to Entire U.S. Dobson, J.E.; Shepherd, A.D. (Oak Ridge National Laboratory, Energy Division, Oak Ridge, TN, 37830). **Project number:** 02949. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$85,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

This project involves an extension of the existing Section 13 water availability study to cover all of the U.S. (including Hawaii and Alaska as data are available) at the WRC Aggregated Subarea (ASA) level. These data are needed for DOE'S input to the Water-for-Energy Task Force (called for in the President's Environmental Message). The following work will be completed: (1) projections of energy facility deployment patterns for two 142 quad cases; (2) resource development patterns for all energy resources; (3) tabulation of underlying demand for energy resources by various end-use sectors; and (4) quantification of water needs by source (saline, fresh, surface, ground-water) and by technology types (synfuels, electric generation, cooling types, etc.).
Keywords: WATER RESOURCES; USA; DATA COMPILATION; ENERGY FACILITIES; WATER REQUIREMENTS; ENERGY DEMAND; CONSUMPTION RATES; POWER GENERATION; ELECTRIC POWER; COOLING; SURFACE WATERS; FRESH WATER; SEAWATER; BRINES; AVAILABILITY; WATER.

85222 Gasifiers in Industry--UMD Project: Human Health Related Assessments. Walsh, P.J. (Oak Ridge National Laboratory, Health and Safety Research Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 3078. **Contract:** W-7405-EnG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Technology Assessments. **Funding:** DOE-$40,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The objective of this program is to assess the potential impacts on human health (both occupational employees and the general public) of the low-Btu gasifier facility at the University of Minnesota at Duluth. Information and data developed by the on-site environmental and health, monitoring and testing program at UMD will be used in the assessment procedure CHIM (Composite Hazard Index Methodology). Expected results include site-specific, human health assessments, coupled with procedures recommended for extrapolating biological test results and with best estimates of permissible human exposures for those compounds or material presently undefined as to limiting exposures.
Keywords: COAL GASIFICATION PLANTS; HEALTH HAZARDS; ENVIRONMENTAL EFFECTS; LOW BTU GAS; MONITORING; EVALUATION; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON OXIDES; HYDROCARBONS; PARTICLES; ORGANIC COMPOUNDS; EVALUATION; RISK ASSESSMENT; SAFETY; INHALATION; INGESTION; EMISSION.

85223 Gasifiers in Industry--UMD Project: Ecological Studies. Gehrs, C.W. (Oak Ridge National Laboratory, Environmental Sciences Division, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 03079. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$36,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to establish an environmental monitoring program for the University of Minnesota-Duluth Gasifier in Industry facility. Key parameters measured will include ambient SOx, NOx, H2S, CO, hydrocarbons, total suspended particulates, and photochemical oxidants at stations both up- and down-wind of the operating gasifier. Expected products include an evaluation of the incremental impact of the gasifier operation on local ambient air quality.
Keywords: COAL GASIFICATION PLANTS; ENVIRONMENTAL EFFECTS; MONITORING; SULFUR OXIDES; NITROGEN OXIDES; HYDROGEN SULFIDES; CARBON MONOXIDE; HYDROCARBONS; PARTICLES; NITRATES; SULFATES; ORGANIC COMPOUNDS; AIR QUALITY; EARTH ATMOSPHERE; ECOLOGY; EMISSION; OZONE; SAMPLING; PLUMES; AIR POLLUTION.

85224 NESS EIS/Environmental Assessments. Wilbanks, T.J. (Oak Ridge National Laboratory, Energy Division, P.O. Box X, Bldg. 4500N, Oak Ridge, TN, 37830). **Project number:** 003268. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$250,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objectives are: (a) to prepare a legislative environmental impact statement for National Energy Plan II; (b) to submit first-cut assessments of environmental and social impact of possible energy policy initiatives during the development of the plan; and (c) to identify or develop data and modeling capabilities as needed to perform these tasks. Project work will be carried by a consortium of Oak Ridge National Laboratory staff and subcontractors, feeding data and modeling results into integrated assessments by a small core team. The result will be draft and final environmental impact statements, together with portions of the plan which relate to environmental objectives, strategies, criteria, and impacts.
Keywords: ENVIRONMENTAL IMPACT STATEMENTS; SOCIAL IMPACT; ENVIRONMENTAL IMPACTS; NATIONAL ENERGY PLAN.

86001 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: fossil fuels(20); nuclear fuels(general)(20); nuclear fission(40); nuclear fusion(20). **R and D categories:** Health effects.

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: NUCLEAR POWER PLANTS; WASTE MANAGEMENT; BIOLOGICAL RADIATION EFFECTS; STRONTIUM 90; INGESTION; BIOLOGICAL MODELS; NEOPLASMS; RADIOINDUCTION; RATS; BEAGLES; RADIATION DOSES; RADIATION INJURIES; NUCLEIC ACIDS; HYBRIDIZATION; CARCINOGENESIS; IONIZING RADIATIONS; DNA; BIOCHEMISTRY; NEOPLASMS; ANIMALS; ENZYMES; GENETICS; MOLECULAR STRUCTURE; PATHOLOGICAL CHANGES.

86003 Inhalation Hazard to Uranium Miners. Cross, F.T. (Battelle Pacific Northwest Laboratory, 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 fuels(general)(100). **R and D categories:** Health effects.

The objective is to determine the agents or combinations of agents and their levels that are responsible for the high incidences of severe respiratory disease such as pneumoconiosis, emphysema, and carcinoma that are reaching epidemic proportions in uranium miners. Experimental studies have resulted in pulmonary fibrosis, severe emphysema, and bronchiolar-alveolar and squamous carcinoma in rodents and beagle dogs that receive daily exposures to radon daughters and uranium ore dust, with and without concomitant cigarette smoking. Continuing studies are designed to: (1) define the possible contributing pathogenic roles of uranium ore dust and cigarette smoking; (2) provide reliable data to relate exposure dose to absorbed dose; (3) determine effects of altered dose-rate on carcinogenesis; and (4) measure the relative effectiveness of altered radon daughter attachment fractions and ratios upon induction of severe respiratory disease to determine whether the working level concept may not be both inadequate and dangerous in evaluation of inhalation hazards of present and future uranium mining operations.
Keywords: URANIUM MINES; RESPIRATORY SYSTEM DISEASES; MINES; PNEUMOCONIOSES; NEOPLASMS; LUNGS; FIBROSIS; RODENTS; BEAGLES; RADON; DAUGHTER PRODUCTS; URANIUM ORES; TOBACCO SMOKES; RADIATION DOSES; INHALATION; DUSTS; HEALTH HAZARDS; MINING; ALPHA SOURCES.

86004 Removal of Deposited Radionuclides. Smith, V.H. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 000403. **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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

This project seeks to find methods to decrease the damage potential from inhaled, skin- or wound-absorbed, or ingested radionuclides. Diethylenetriaminepentaacetic acid and other chelating agents are being tested for their ability to remove Pu, other actinides and radionuclides from rats and dogs (previously exposed to the radionuclide by inhalation or through simulated wounds). Mechanisms of radionuclide uptake and release and the ability of test agents to influence such release from cells are made in a lung macrophage test system. This is especially useful in studying methods to remove particulate forms of radionuclides. Various pharmaceutic forms of agents are prepared for testing, e.g. slow-release and encapsulated forms. Successful agents are evaluated for toxicity since they will have potential application in man.
Keywords: RADIOISOTOPES; INGESTION; INHALATION; SKIN; WOUNDS; CONTAMINATION; PLUTONIUM ISOTOPES; CHELATING AGENTS; DTPA; EXCRETION; RATS; DOGS; RADIATION DOSES; NUCLEAR INDUSTRY; ACCIDENTS; PERSONNEL; PATHOGENESIS; PLUTONIUM; TOXICITY; MEDICINE; THERAPY.

86006 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects.

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 spec-

trum 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.

86007 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Ecological/biological processes and effects.

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.

86009 Atmospheric Boundary Layer Studies. Simpson, C.L. (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: fossil fuels(60); coal(40). **R and D categories:** Physical and chemical processes and effects.

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.

86010 Urban Pollution Characteristics Transport and Deposition. Young, J.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000540. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

This project is designed to determine the nature and quantities of various energy related pollutants which are emitted to the atmosphere, to determine the rates of transport and diffusion and deposition on the earth's surface, and the chemical and physical transformations during transport. The data obtained are used to develop parametrizations of the various processes for incorporation into numerical models which will then be tested and validated. Inert tracers are introduced into urban plumes or advantage is taken of the presence of inert atmospheric tracers (CO or fluorocarbons). Concentrations of these tracers and urban pollutants, like SO2, particulates, NOx, are then measured at various downwind distances using aircraft or ground level vehicles. Data for various times and distances permit elucidation of the processes which are operative.
Keywords: URBAN AREAS; DIFFUSION; ENVIRONMENTAL TRANSPORT; AIR POLLUTION; DEPOSITION; EARTH ATMOSPHERE; MATHEMATICAL MODELS; SULFUR DIOXIDE; CARBON MONOXIDE; TRACER TECHNIQUES; AEROSOLS; PARTICLES; NITROGEN OXIDES.

86011 Particle Resuspension and Translocation. Simpson, C.L. (Battelle Pacific Northwest Lab., 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-$230,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects.

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 objective of this research is 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 climatic and geographic conditions.
Keywords: PARTICLE RESUSPENSION; RADIOACTIVE AEROSOLS; RADIONUCLIDE MIGRATION; AIR POLLUTION; PLUTONIUM; TRANSURANIUM ELEMENTS; CLIMATES; METEOROLOGY; NUCLEAR ENERGY; HEALTH HAZARDS; SOILS; CONTAMINATION.

86012 Behavior of Transuranic Elements and Actinides in the Soil-Plant System. Wildung, R.E. (Battelle Pacific Northwest Lab., 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: nuclear fission(100). **R and D categories:** Physical and chemical processes and effects.

The principal objective of this study is to develop an understanding of the soil, plant, and foliar interaction factors influencing the availability of transuranics and actinides to agricultural plants and to animals with major emphasis on the (1) soil and soil microbial processes which influence the formation of ligands stabilizing transuranics in soil solutions and determination of transuranic long-term behavior in soil; (2) deposition and plant interception of airborne submicronic particles containing the transuranic elements and their susceptibility to leaching; and (3) plant processes which influence transport across the plant root membrane and foliar surfaces, the form and sites of deposition of transuranics and actinides in mature plants and in animals consuming plants.
Keywords: ACTINIDE ISOTOPES; TRANSURANIUM ELEMENTS; ENVIRONMENTAL TRANSPORT; FOLIAR UPTAKE; ROOT ABSORPTION; TRANSLOCATION; SOILS; RADIONUCLIDE MIGRATION; MICROORGANISMS; RADIOACTIVE AEROSOLS; LEACHING; PLANTS; RADIONUCLIDE KINETICS; DEPOSITION.

86014 Aerosol and Trace Gas Transformations. Alkezweeny, A.J. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 000553. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$220,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objectives of this program are to determine transformation rate of gaseous to particulate in urban plumes from urban areas and power plant complexes, and to identify mechanism(s) responsible for it. Special emphasis is placed on sulfur dioxide to sulfate and ozone in the plume from Milwaukee. The approach consists of field experiments supported by diagnostic modeling and data interpretation. The measurement will be made in a Lagrangian frame of reference using instrumented aircraft.
Keywords: GASEOUS WASTES; AEROSOLS; URBAN AREAS; POWER PLANTS; SULFUR DIOXIDE; SULFATES; CHEMICAL REACTION KINETICS; PRODUCTION; OZONE; PLUMES; AIR POLLUTION; WISCONSIN; MATHEMATICAL MODELS; DATA ANALYSIS.

86016 Research Aircraft Operations. Simpson, C.L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000556. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$180,000.
Related energy source: fossil fuels(40); coal(60). **R and D categories:** Physical and chemical processes and effects.

The purpose of this program is the provision of technical support for DOE-DBER Atmospheric Research programs, in the form of airborne laboratories and tracer-release facilities. Aircraft support is required especially for the following Atmospheric Sciences programs: Precipitation Scavenging, Atmospheric Boundary Layer Studies, Particle Resuspension and Translocation, Cooling Tower and Cooling Pond-Atmospheric Impact, Aerosol and Trace Gas Transformation, and Urban Pollution and Tracer Studies. Two aircraft, a Cessna-411 and a Douglas DC-3, have been equipped with tracer release facilities as well as the necessary instrumentation for highly sophisticated measurements of cloud physics, aerosols, pollutant-gases, atmospheric tracers, and turbulence.
Keywords: PRECIPITATION SCAVENGING; AIR POLLUTION; TRACER TECHNIQUES; BOUNDARY LAYERS; COOLING TOWERS; COOLING PONDS; AEROSOL MONITORING; MONITORING; TRACE AMOUNTS; GASEOUS WASTES; TURBULENCE; DATA ACQUISITION; AERIAL MONITORING; AIRCRAFT; URBAN AREAS.

86018 Terrestrial Ecology. 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: all(100). **R and D categories:** Ecological/biological processes and effects.

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.

86021 Analysis of Natural Systems. Eberhardt, L.L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000622. **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: all(100). **R and D categories:** Ecological/biological processes and effects.

The objective is to develop guantitative methodology for the description and interpretation of ecological data. Research and test applications in areas of sampling, statistical methods, modelling and data analysis as applied to ecological problems are in progress.
Keywords: ECOSYSTEMS; ECOLOGY; SAMPLING; MATHEMATICAL MODELS; DATA ANALYSIS; STATISTICS; DATA ACQUISITION; BIOLOGICAL MODELS.

86022 Environmental Behavior of 99-Tc and 129-I. Garland, T.R. (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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

86023 Sublethal Effects of Tritium on Aquatic Systems. Strand, J.A. (Battelle Pacific Northwest Lab., 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:** Ecological/biological processes and effects.

The study objectives are to determine the effects of low-level tritium irradiation on the immune response of rainbow trout to infectious disease; the nature of radiation stress on immune competence; the genetic transmission of radiation-induced immune incompetence; and the development of techniques for measuring sublethal stress. Trout, exposed to tritium irradiation during embryogenesis, are challenged with a pathogen and their antibody synthesis is measured and compared to controls. Modifications in blood chemistry are measured electrophoretically, and the potential for genetic transmission of radiation-induced changes is investigated through study of the progeny of irradiated fish.
Keywords: TRITIUM; INTERNAL IRRADIATION; SUBLETHAL IRRADIATION; TROUT; BIOLOGICAL RADIATION EFFECTS; IMMUNE REACTIONS; ONTOGENESIS; INFECTIOUS DISEASES; ANTIBODY FORMATION; GENETICS; PROGENY.

86028 Ecological Effects of Combined Aquatic Stressors. Anderson, D.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000637. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$140,000.
Related energy source: all(100). **R and D categories:** Ecological/biological processes and effects.

The combined effects program is designed to quantify the combined action of several chemical pollutants (i.e., nickel, chlorine, and temperature) on the physiology of economically and ecologically important aquatic organisms. Also, information is being developed on the performance capabilities of fish under these stresses. The objective of the program is to devlelop an understanding of the response of economically important aquatic organisms to multiple stressors resulting from energy production. Results from the studies of synergistic action of chlorine and metals could influence the selection of condensor tubing in steam electric power plant cooling towers.
Keywords: AQUATIC ECOSYSTEMS; AQUATIC ORGANISMS; FISHES; POPULATION DYNAMICS; WASTE HEAT; DATA ACQUISITION; THERMAL EFFLUENTS; BIOLOGICAL EFFECTS; NICKEL; CHLORINE; ENERGY SOURCE DEVELOPMENT; METALS; SYNERGISM; ENVIRONMENTAL EFFECTS; CHEMICAL EFFLUENTS; THERMAL POLLUTION; WATER POLLUTION; THERMAL POWER PLANTS.

86030 Marine Chemistry of Energy-Related Pollutants. Crecelius, E.A. (Battelle Pacific Northwest Lab., 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: fossil fuels(25); coal(25); nuclear fission(25); ocean thermal(25). **R and D categories:** Ecological/biological processes and effects.

The increased energy needs of our country will continue to result in pollution of the oceans. The future environmental quality of the oceans is dependent upon man's knowledge of the oceans' biogeochemical and physical processes. This program will investigate both the input rates of pollutants from coal, oil and oil shale to the coastal marine environment and the biogeochemical and physical processes that control the distribution of these contaminants. Of particular interest will be the chemical forms of toxic trace metals and combustion organics after entering seawater. In order to understand the impact of contaminants introduced to the oceans it will be necessary to continue to establish accurate baseline measurements in marine waters. By mid-FY80 the survey of chemical forms of soluble elements in aerosols will be completed and also the experiments measuring the rate of Hg uptake by seawater will be completed. By early FY81 preliminary scanning of organic combustion products will be completed and detailed marine interaction experiments will begin.
Keywords: WATER POLLUTION; SEAWATER; COAL; PETROLEUM; OIL SHALES; COASTAL WATERS; HEALTH HAZARDS; METALS; TRACE AMOUNTS; COMBUSTION; BIOGEOCHEMISTRY; DISTRIBUTION; CHEMICAL STATE; AEROSOL MONITORING; AEROSOLS; MERCURY; UPTAKE; MONITORING.

86032 Energy Systems Effects on Coastal Ecosystems. Roesi, J. (Battelle Pacific Northwest Lab., 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: fossil fuels(20); oil and gas(20); nuclear fuels(general)(20); ocean thermal(20); other advanced(20). **R and D categories:** Ecological/biological processes and effects.

The use of the coastal zone as a site for energy conversion (e.g., nuclear and fossil fuel steam electric stations; ocean thermal

energy conversion and geopressure; transfer and oil transshipment; coal gasification and gas liquefaction) and resource extraction (e.g., offshore oil drilling) has resulted in the routine discharge of potentially harmful substances into the marine environment; a situation which, in some cases, has been shown to have an adverse effect on loca habitats. Under most circumstances, the concentrations of contaminants entering the marine environment are extremely low or rapidly diluted, and their impact on marine biota is not well understood. The long-term consequences of energy effluents to marine organisms and, ultimately, communities need to be defined if the actual costs and benefits of energy technologies are to be realistically evaluated. In order to assess the effects of environmental perturbations at the population and community levels of organizaion, it is essential to understand the responses of the individual organisms. The goal of this program is to provide an understanding of the biological effects of energy effluent materials on Pacific Northwest species.
Keywords: COASTAL WATERS; THERMAL EFFLUENTS; AQUATIC ORGANISMS; FISHES; COAL; RADIOACTIVE WASTES; GEOPRESSURED SYSTEMS; OFFSHORE OPERATIONS; BIOLOGICAL EFFECTS; SEAWATER; SOLID WASTES; LIQUID WASTES.

86037 Rad Instrument--Radiological Chemistry. Wogman, N.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000737. **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: fossil fuels(30); nuclear fuels(general)(10); nuclear fission(40); nuclear fusion(10); geothermal(10). **R and D categories:** Characterization, measurement, and monitoring.

This program is primarily concerned with the development of radiochemical instrumentation and analytical technology for the measurement of low levels of radionuclides which enter the environment from the nuclear industry and nuclear testing operations. It is also concerned with the development and refinement of neutron activation analysis technology for the trace elements released to the environment from fossil fuel combustion, coal conversion, oil shale retorting, and geothermal power generation. In the nuclear fuel cycle transuranium and long-lived fission products are of immediate concern. Instrumentation and technology developed can be utilized in radioisotope studies of environmental samples; it can be applied with neutron activation analysis to define stable element behavior whereby routes used by natural, tracer, or waste radioisotopes and other toxic pollutants can be followed in the environment. Improved x-ray, beta-gamma, alpha-beta-gamma, and gamma ray radiation detection systems, together with x-ray fluorescence, neutron activation and other techniques will be combined with analytical techniques to characterize radioisotope and trace element movement through the environs at the various levels encountered. Large surface area detectors with low backgrounds will be developed for direct measurement of x-ray emitting isotopes. A portable field detector for Pu analysis to be developed with a sensitivity of at least an order of magnitude better than now available will be tested in areas contaminated with long-lived radionuclides. The use of a neutron subcritical multiplier will allow trace elements to be determined through their short half-life neutron capture products. Special emphasis will be placed on developing techniques for measuring toxic trace elements in fossil fuels and in the effluents of fossil-fueled electrical generating plants.
Keywords: RADIOCHEMISTRY; MEASURING INSTRUMENTS; RADIOISOTOPES; NEUTRON REACTIONS; NUCLEAR INDUSTRY; ACTIVATION ANALYSIS; FOSSIL FUELS; COAL; COMBUSTION; ALPHA DETECTION; BETA DETECTION; GAMMA DETECTION; X-RAY DETECTION; SPECIFICATIONS; RADIATION HAZARDS; CONTAMINATION; OIL SHALES; CALIFORNIUM 252; HEALTH HAZARDS; CHEMICAL EFFLUENTS; FUEL CYCLE; TRACE AMOUNTS; ELEMENTS; RADIATION DETECTORS.

86038 Radiation Dosimetry. Roesch, W.C. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000738. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$192,000.
Related energy source: nuclear fission(90); nuclear fusion(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The Radiation Dosimetry program has the long-term goal of developing basic theoretical relationships between observable physical characteristics of ionizing radiation and the induction of biological damage. Understanding the physical and temporal factors involved in radiation-induced damage provides the knowledge necessary for logical extrapolation of experimental laboratory results to the chronic dose levels to which man may be exposed as a result of nuclear power generation. Such knowledge is also valuable in assessing the potential of new radiation (e.g., neutrons and pions) for use in cancer therapy. This study includes the development of mathematical models of the radiation effect and recovery processes and the design of suitable tests of the validity of those models. Another aspect is the characterization of the initial interaction of radiation with matter in a way which is most closely related to the biological effect. To accomplish this, it will, of necessity draw heavily on the more basic information regarding the physical and early chemical effects of radiation and upon fundamental radiobiological data at the cellular level. Experimental portions of the program provide specialized irradiation apparatus and dosimetry to determine the radiation parameters relevant to specialized biological experiments.
Keywords: IONIZING RADIATIONS; MICRODOSIMETRY; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; RADIATION INJURIES; MATHEMATICAL MODELS; BIOLOGICAL RECOVERY.

86039 Radiation Physics. Toburen, L.H. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000740. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$364,000.
Related energy source: nuclear fission(90); nuclear fusion(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This research is directed toward understanding the mechanisms through which radiation interacts with matter with major emphasis on material of biological interest. Information on the interactions by which ionizing radiation loses energy in traversing matter and the subsequent transport and degradation of that energy is needed as input to any model which relates the observed biological effect to measurable physical quantities. This program provides an integrated experimental and theoretical investigation of initial interactions by which ionizing particles transfer energy to matter and the subsequent transport and degradation of that energy. Measurements concentrate on determination of initial interaction cross sections for gas targets and on measurements of life times of quenchable excited species in liquid systems. The work includes investigation of the partition and distributions of energy in the radiation field and in the irradiated media, and determination of the rates and mechanisms of energy transport in the early stages of molecular rearrangement.
Keywords: IONIZING RADIATIONS; BIOPHYSICS; ENERGY LOSSES; BIOLOGICAL MODELS; ENERGY TRANSFER; PARTICLES; TARGETS; PARTICLE TRACKS; CHARGED-PARTICLE TRANSPORT; BIOLOGICAL RADIATION EFFECTS; ANIMALS; PLANTS; COMPUTER CODES; MOLECULAR STRUCTURE; DOSIMETRY.

86040 Radiation Biophysics. Nelson, J.M. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 000741. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$86,000.
Related energy source: nuclear fission(90); nuclear fusion(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The Radiation Biophysics program provides the critical experimental tests of existing and evolving theories of radiation action needed to guide further development of these theories. The kinetic behavior of biological repair and other processes at lethal and sublethal radiation levels are studied with emphasis placed on those aspects of the theories which are necessary for the extrapolation of biological effects from typically high laboratory doses and dose rates to the chronic doses that may be experienced as a result of nuclear power generation. Theories developed in the Radiation Dosimetry program are tested on simple biological systems with emphasis on mammalian cells but utilizing other eucaryotes as needed for specific experiments. The effects of dose rate and LET on the probability of reproductive death will be investigated as a function of factors such as cell cycle age, oxygen concentration and temperature. A cellular system in which the cumulative effects of free radical damage are not masked enzymatic recovery processes will be sought.
Keywords: BIOPHYSICS; RADIOBIOLOGY; BIOLOGICAL RADIATION EFFECTS; LETHAL RADIATION DOSE; BIOLOGICAL REPAIR; DOSE RATES; DOSIMETRY; ANIMAL CELLS; MAMMALS; LET; CELL CYCLE; OXYGEN; TEMPERATURE DEPENDENCE; RADICALS; RADIATION INJURIES; RADIOSENSITIVITY EFFECTS; COMPUTER CODES; MUTATIONS; IN VITRO; MICRODOSIMETRY; MATHEMATICAL MODELS.

86041 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(80); nuclear fusion(20). **R and D categories:** Characterization, measurement, and monitoring; Physi-

cal and chemical processes and effects; Ecological/biological processes and effects.

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.

86043 Effects of Hydroelectric Generation. Fickeisen, D.H. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000836. **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: hydroelectric(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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: RIVERS; ECOLOGY; HYDROELECTRIC POWER PLANTS; GASES; SUPERSATURATION; AQUATIC ORGANISMS; GAS BUBBLE DISEASE; FISHES; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; FLOW RATE; TOXICITY.

86044 Fate and Effects of Petroleum Hydrocarbon in Marine Coastal Ecosystems. Anderson, J.W. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 000838. **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: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

This is a laboratory research program to define effects of petroleum (crude oil and refined oils) on marine intertidal communities and to develop standard procedures to allow comparison between this and other laboratory studies and field results. A continuous-flow petroleum metering system for bioassay work has been developed and tested using chemical measurement methods and bioassay organisms. Preliminary tests and a six-month continuous exposure have been conducted using a No. 2 fuel oil and field-colonized artificial substrates. Minimally the approach provides a highly efficient screening device to determine oil-sensitive species.

Keywords: ENVIRONMENTAL EFFECTS; PETROLEUM; AQUATIC ECOSYSTEMS; BIOLOGICAL EFFECTS; POLLUTION; BIOASSAY; WATER POLLUTION; MONITORING; SEAS; FUEL OILS; COASTAL WATERS.

86049 Toxicology of Krypton-85. Ballou, J.E. (Battelle Pacific Northwest Laboratory, 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:** Health effects.

The objective is to evaluate the biological hazard of exposure to elemental tritium and Kr-85 by determining the biological effects in rodents and larger animal species exposed to the radioactive gas atmosphere. Studies will include both short-term and chronic exposure of animals to H-3 and Kr-85 gas atmospheres to determine tissue distribution and retention kinetics, 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 and pulmonary function.

Keywords: TRITIUM; KRYPTON 85; TOXICITY; HEALTH HAZARDS; AIR POLLUTION; BETA PARTICLES; DOSE-RESPONSE RELATIONSHIPS; NUCLEAR ENERGY; RADIONUCLIDE KINETICS; ANIMALS; INHALATION; METABOLISM; NEOPLASMS; TERATOGENESIS; TISSUE DISTRIBUTION; RODENTS.

86050 Toxicology of Thorium Cycle Nuclides. Ballou, J.E. (Battelle Pacific Northwest Laboratory, 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The uranium-thorium breeder reactors proposed for nuclear power production will employ fuel mixtures and fuel recycle process solutions that have not been evaluated for the biological hazards needed for safety evaluation. This project will investigate for special hazards associated with these materials; namely, the mixed U--Th--Pu oxide fuels, the nitric acid process solutions of these fuels, the high specific activity uranium isotopes and the radioactive decay products that are unique to this nuclear process. The metabolism of the oxide fuels and nitrate solutions of the major radionuclides, following inhalation, ingestion and cutaneous application will be studied in rodents. The influence of specific activity, amount of radioactivity and composition of various fuels and process solutions on the toxicology will be determined. The toxicity of uranium isotopes in equilibrium with their decay products or in freshly separated state will be investigated. The long-term biological effects of inhaled fuels, U-232, U-233 and process solutions will be determined and compared with results from similar studies with the transuranic elements.

Keywords: BREEDER REACTORS; URANIUM ISOTOPES; THORIUM ISOTOPES; NUCLEAR FUELS; HAZARDS; PLUTONIUM ISOTOPES; NITRIC ACID; DECAY; RODENTS; METABOLISM; OXIDES; NITRATES; TOXICITY; URANIUM 232; URANIUM 233; BIOLOGICAL RADIATION EFFECTS; AEROSOLS; ANIMALS; NEOPLASMS; INGESTION; INHALATION; IN VITRO; ANIMAL CELLS.

86051 National Environmental Research Park. 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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

86053 Real-Time Measurement of Plutonium in Air at Below-MPC Levels. Stoffels, J.J. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001267. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$129,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this project is to develop an instrument which will measure airborne particulate plutonium at concentrations below the MPC level on a continuous, real-time basis. An additional objective is that the instrument provide information on the quantity of plutonium in each individual particle and, under appropriate conditions, on the size of each particle. A new mass spectrometric technique for detection and measurement of plutonium in air is being investigated. A small mass spectrometer with a direct air-inlet to the ion source is being developed for this purpose. Particulate material entrained in the stream of air sampled will strike a hot filament in the source and produce a burst of ions. The ions will be mass separated in the magnetic field of the spectrometer and an ion detector will monitor mass 271 corresponding to 239Pu--16O2.

Keywords: EARTH ATMOSPHERE; RADIOACTIVITY; PARTICLES; PLUTONIUM 239; PLUTONIUM OXIDES; RADIATION MONITORING; MASS SPECTROSCOPY; MASS SPECTROMETERS; PERFORMANCE TESTING; REAL TIME SYSTEMS; PARTICLE SIZE.

86054 In Situ Pollutant Measurements. Wogman, N.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352).

Project number: 001287. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$54,000.
Related energy source: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to evaluate potential hazards of pollutants associated with sediment drift, dredging operations, or biological uptake in harbors, estuaries and coastal waters. This program improves existing techniques and applies the new measurement techniques for in situ analysis for trace pollutants from coal, oil, oil shale, coal conversion and nuclear technologies. In situ measurements are developed which require no sample collection or subsequent laboratory analysis, thereby permitting real-time analysis and analysis of the sediment surface in its undisturbed natural environment. Three areas will be emphasized: (1) in situ analysis of toxic trace elements; (2) in situ analysis of radionuclides; and (3) in situ analysis of organic pollutants. An in situ x-ray fluorescence probe will be used to map concentrations in sediments of inorganic pollutants which are ranked as priority one by EPA. The x-ray fluorescence analysis probe will be evaluated at Puget Sound and in Lake Washington with correlation of data obtained by other techniques. Depth profile capabilities will be improved to allow in situ analysis of energy-related pollutants which have been deposited over a period of tens of years. Carbon and Ni pollutants from oil-related materials will be measured with a portable 14 MeV neutron generator.
Keywords: DREDGING; SEDIMENTS; COAL INDUSTRY; PETROLEUM INDUSTRY; OIL SHALE INDUSTRY; NUCLEAR INDUSTRY; POLLUTION; CHEMICAL ANALYSIS; WATER POLLUTION; ACTIVATION ANALYSIS; ENVIRONMENTAL EFFECTS; PUGET SOUND; COASTAL WATERS; X-RAY FLUORESCENCE ANALYSIS.

86055 MAP3S Modeling Studies. Drake, R.L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001328. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The principle objective of this project is to develop a computer model which will simulate the atmospheric transport, chemical transformation, and wet and dry removal of the pollutants produced from coal-fired power plants. The model is to be used in the evaluation of the human health and ecological effects of these pollutants over a multi-state region. The initial emphasis will be the sulfate problem in the northeast United States. This project is to be accomplished by developing the model in a segmented fashion. It is to be composed of the most technically and economically appropriate methods available for describing the relevant processes. A comprehensive series of tests with meteorological data as well as source data will be conducted to determine the model's sensitivity to the parameterizations of the transformation and removal processes. Continuing interaction with experimental programs will provide information valuable for the parameterizations.
Keywords: COAL; FOSSIL-FUEL POWER PLANTS; MATHEMATICAL MODELS; CHEMICAL REACTIONS; TRANSPORT; GASEOUS WASTES; AEROSOLS; HEALTH HAZARDS; ENVIRONMENTAL EFFECTS; SULFUR DIOXIDE; SULFATES; METEOROLOGY; REMOVAL; CHEMICAL REACTION KINETICS; PRODUCTION; AIR POLLUTION.

86056 Uptake of Actinides by Plants as Affected by Weathering and Aging. Schreckhise, R.G. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001329. **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 fission(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of the project is to determine the effect of time (aging and weathering) on the uptake of actinide elements from soil by range and crop plants. An experimental approach using small, weighing lysimeters is used to expose soil and plants to realistic soil water, temperature, and other field conditions.
Keywords: ACTINIDES; ROOT ABSORPTION; SOILS; CONTAMINATION; GRASS; CROPS; RADIONUCLIDE KINETICS; AGING; WEATHERING; RADIONUCLIDE MIGRATION.

86057 Bioavailability of Energy Effluent Materials in Coastal Ecosystems. Gibson, C.I. (Battelle Pacific Northwest Lab., 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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of this program is to enable man to predict the long-term effects of energy related activities on the coastal ecosystem and thus make sound judgements on the uses of this region and allow a maximum utilization of a resource with a minimum of environmental impact. A multidisciplinary effort is being made to identify the source term, chemical interactions, bioavailability and effects, and fate of the effluent materials through field and laboratory investigations. Site measurements of pollutant quantities and forms are made and the data used to design laboratory experiments. The laboratory experimental results are used to develop predictions models which are then verified by field investigation.
Keywords: CONTAMINATION; AQUATIC ECOSYSTEMS; MATHEMATICAL MODELS; SEAWATER; SEAS; WATER POLLUTION; POLLUTION; CHEMICAL REACTIONS; CHEMICAL EFFLUENTS; ENVIRONMENTAL TRANSPORT; DATA ACQUISITION.

86058 Environmental Pollution Analysis, Instruments and Methods Development. Wogman, N.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001334. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$115,000.
Related energy source: fossil fuels(80); nuclear fission(20). **R and D categories:** Characterization, measurement, and monitoring.

The energy needs of the country can best be met by major utilization of coal, oil, natural gas, oil shale, nuclear fuels, and geothermal steam. Before a realistic assessment can be made of the potential environmental impact of the pollutants from these energy-related technologies, it is essential that amounts and physical and chemical properties of associated pollutant materials be determined. Pollutants enter the environment as a result of fuel extraction, transport, conversion and utilization in energy production and should receive early and detailed characterization to provide the essential information for subsequent studies of their environmental impact. This program develops both laboratory and field instrumentation and methods for detailed pollutant analysis. It designs and evaluates new sampling and analysis techniques required to obtain maximum sensitivity under practical conditions, and methods to study the physical and chemical forms of non-nuclear pollutants in the environment. Environmental pollution analysis requires the development of laboratory and field methods and instrumentation to measure the molecular form, chemical form, physical form, transport, fate, and transformation of pollutants. The most useful techniques for characterization include anodic stripping, voltametry, specific ion analysis, ESCA, ion probe, and the GC/MS.
Keywords: AIR POLLUTION MONITORS; AEROSOLS; PARTICLES; VOLTAMETRY; ION SELECTIVE ELECTRODE ANALYSIS; ELECTRON SPECTROSCOPY; ION MICROPROBE ANALYSIS; MASS SPECTROSCOPY; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; FOSSIL-FUEL POWER PLANTS; NUCLEAR POWER PLANTS; GEOTHERMAL POWER PLANTS; AIR POLLUTION.

86059 Regional Assessment. Hessel, D.L. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 001348. **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 shales and tar sands(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

86060 Inhaled Transuranics in Rodents. Sanders, C.L. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The purpose of this project is to examine in small mammals the fate and effects of inhaled transuranic compounds, specifically the nitrate forms of Pu-238 and Es-253 and the dioxide forms of Pu-238, Pu-239, Am-241, and Cm-244. Both the Wistar rat and the Syrian golden hamster have been studied, with emphasis being placed on studies with the rat. The scope of the research also includes: (1) an examination of the spatial and temporal dose-distribution patterns (for alpha irradiation) in the lung as they influence the pathogenesis and incidence of lung cancer; (2) a morphometric study of the response of lung tissue to inhaled 239PuO2; and (3) attempts to determine the mechanism(s) of malignant transformation in the lung.

Keywords: AMERICIUM 241; CURIUM 244; EINSTEINIUM 253; PLUTONIUM 238; PLUTONIUM 239; AMERICIUM OXIDES; CURIUM OXIDES; EINSTEINIUM OXIDES; PLUTONIUM NITRATES; PLUTONIUM OXIDES; RADIOACTIVE AEROSOLS; INHALATION; HAMSTERS; RATS; LUNGS; SPATIAL DOSE DISTRIBUTIONS; TEMPORAL DOSE DISTRIBUTIONS; CARCINOGENESIS; DOSIMETRY; BIOLOGICAL RADIATION EFFECTS; NEOPLASMS; RADIOINDUCTION.

86061 Inhaled Plutonium Nitrate in Dogs. Dagle, G.E. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The objectives are to determine the deposition, translocation, distribution, dosimetry, and biological effects of inhaled soluble forms of plutonium in a long-lived species of animals so that the results of accidental contamination in man can be evaluated. Beagle dogs will be given single inhalation aerosol exposures to 238-Pu(NO3)4 or 239-Pu(NO3)4 at initial alveolar deposition levels of 2, 10, 50, 250, 1250, or 3000 nCi. These dogs will be held for life span observations and additional dogs will be periodically sacrificed to provide information on deposition and translocation and to study the pathogenesis of dose-related effects. The dogs on study receive periodic examination, thoracic radiographs, and hematologic and clinical chemistry evaluations. The dogs sacrificed receive a complete necropsy and histopathologic examination, and tissues are radiochemically analyzed.

Keywords: PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM NITRATES; INHALATION; BEAGLES; BIOLOGICAL ACCUMULATION; TISSUE DISTRIBUTION; RETENTION; DOSIMETRY; RADIONUCLIDE KINETICS; INTERNAL IRRADIATION; DELAYED RADIATION EFFECTS; LIFE SPAN; TISSUES; RADIOCHEMICAL ANALYSIS; RADIATION DOSES.

86062 Aerosol and Analytical Technology. Cannon, W.C. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001408. **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:** Health effects.

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: AEROSOL GENERATORS; RADIOACTIVE AEROSOLS; INHALATION; RADIOCHEMICAL ANALYSIS; PLUTONIUM; COST; SENSITIVITY; LUNG CLEARANCE; RESPIRATORY SYSTEM; DEPOSITION; EXPOSURE CHAMBERS.

86064 Modifying Radionuclide Effects. Mahlum, D.D. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

This project is directed at evaluating the influence of exogenous agents and environmental situations on the metabolism and effect of transplutonic elements. The project currently involves studies on the influence of iron reserves on plutonium metabolism, on the mechanisms of induction of mammary tumors in rats injected with plutonium, plutonium metabolism and effect during pregnancy and lactation, and on the relationships between size of exposed area and the effects of beta irradiation on the skin of miniature swine. Studies on the effects of alcohol on the metabolism of plutonium and other radionuclides are presently being completed and experiments on transplutonic element metabolism under conditions of protein deficiency are being initiated.

Keywords: PLUTONIUM; TRANSPLUTONIUM ELEMENTS; METABOLISM; TOXICITY; RATS; RADIONUCLIDE KINETICS; BIOLOGICAL RADIATION EFFECTS; IRON; BIOLOGICAL EFFECTS; RESPONSE MODIFYING FACTORS; CARCINOGENESIS; MAMMARY GLANDS; NEOPLASMS; RADIOINDUCTION; PREGNANCY; LACTATION; SWINE; SKIN; ALCOHOLS; PROTEINS; NUTRITIONAL DEFICIENCY; BETA PARTICLES.

86065 Gut-Related Radionuclides Studies. Sullivan, M.F. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The objective of the project is to determine the toxicity of ingested radionuclides. Various forms (compounds) of reactor fuels will be administered to animals by ingestion and their toxicity determined.

Keywords: NUCLEAR FUELS; INGESTION; LABORATORY ANIMALS; TOXICITY; INTESTINAL ABSORPTION; RADIONUCLIDE KINETICS; INTESTINES; RADIOISOTOPES.

86067 Dosimetry of Internal Emitters. Cross, F.T. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001417. **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 fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The Dosimetry of Internal Emitters Program is aimed primarily at providing dosimetric guidance and support to radiobiology programs at BNL. In particular, the program includes considerations of dosimetric design experiments; materials; theoretical and experimental dosimetry of various tissues and organ systems; and eventual relating of dosimetry data to observed biologic effects. The program assists in providing the scientific data required to evaluate risks, establish acceptable levels of exposure, and elucidate mechanisms of radiation interaction with biological systems. The program combines scientific data with theoretical and experimental dosimetry of biological tissues. The test systems are in vivo (mouse, rat, hamster, dog, swine, primate) and in vitro. The exposure conditions involve radioisotopes and range from acute to all manner of chronic. The biological endpoint will be relating relevant absorbed dose to all biologic effects.

Keywords: RADIOISOTOPES; INHALATION; ANIMALS; DOSIMETRY; INTERNAL IRRADIATION; RADIATION DOSES; TISSUES; ORGANS; ACUTE EXPOSURE; CHRONIC EXPOSURE; BIOLOGICAL RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS.

86069 Analytical Technique for 99-Tc Measurements 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

86072 Radioisotope Customer List. Counts, L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001433. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Program Coordinator. **Funding:** DOE-$6,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

This document lists the FY 1977 and transition quarter commercial radioisotope production and distribution activities of ERDA (DOE) facilities at Argonne National Laboratory, Brookhaven National Laboratory, Hanford Engineering Development Laboratory, Oak Ridge National Laboratory, Pacific Northwest Laboratory, Mound Laboratory, Idaho Operations Office, United Nuclear Industries, and Savannah River Operations Office.
Keywords: RADIOISOTOPES; PRODUCTION; DATA COMPILATION; INVENTORIES; US DOE; MARKET.

86073 Inhaled Plutonium Oxides in Dogs. Park, J.F. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

This project is concerned with long-term experiments to determine the dose-effect relationships of inhaled plutonium oxide in beagle dogs, and shorter-term experiments to study the kinetics and dosimetry of transplutonium elements, such as 241-AmO2, 244-CmO2, and various oxide mixtures. A life-span study involving about 300 beagles is currently in progress. The dogs received a single 5 to 30-min exposure to 239-PuO2 or 238-PuO2 aerosols 3 to 5 yrs ago.
Keywords: AMERICIUM 241; AMERICIUM OXIDES; CURIUM 244; CURIUM OXIDES; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM OXIDES; RADIOACTIVE AEROSOLS; INHALATION; SINGLE INTAKE; ACUTE EXPOSURE; BEAGLES; RADIONUCLIDE KINETICS; DELAYED RADIATION EFFECTS; RADIATION DOSES; TISSUE DISTRIBUTION; DOSIMETRY; DOSE-RESPONSE RELATIONSHIPS.

86074 Fetal and Juvenile Radiotoxicity. Sikov, M.R. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The objective of this project is to obtain information on metabolism and effects needed to establish appropriate exposure limits for radionuclides of potential hazard to the rapidly growing infant or child or for the pregnant woman. Specific areas of current emphasis in this project include studies on the factors controlling the transplacental passage and distribution of plutonium and other transplutonic elements in the fetoplacental unit. Studies on the differential metabolic and morphologic factors responsible for differences in the biological disposition and effects of 239-Pu and 241-Am administered in the prenatal and neonatal periods are in progress. Studies using organ culture are examining the pathogenesis of the embryotoxicity of prenatally administered radionuclides. The role of cell kinetics and differentation in amplifying the potential for neoplastic change after perinatal radionuclide exposure is being studied in other experiments. Studies on the deposition and retention of inhaled 239-PuO2 by neonatal and adult rats are being extended to include intermediate ages and evaluations of effects.
Keywords: PLUTONIUM 239; AMERICIUM 241; INHALATION; RATS; TISSUE DISTRIBUTION; PREGNANCY; PLACENTA; FETUSES; NEONATES; RADIONUCLIDE KINETICS; METABOLISM; TOXICITY; TISSUE CULTURES; CARCINOGENESIS; NEOPLASMS; RADIOINDUCTION; RETENTION; BIOLOGICAL RADIATION EFFECTS.

86075 Trace Constituent Analysis by Laser. Bushaw, 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: fossil fuels(50); nuclear fission(30); nuclear fusion(20). **R and D categories:** Characterization, measurement, and monitoring.

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.

86076 Coal Conversion Pollutant Chemistry. Petersen, M.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001654. **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: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objective of the project is to characterize the inorganic, organic, and possibly metallorganic compounds which are released during pilot plant operations of various coal conversion processes. We will determine the concentrations and distribution of the toxic elements, the general class of organic and metallorganic compounds in the major effluent and emission stream at each pilot plant and the concentrations of the more toxic mutagenic and carcinogenic substances. Samples and subfractions of samples will be tested using the Salmonella/microsome mutagenicity test as a screening technique to find which fractions are most mutagenic or carcinogenic. Although the principal objective is not the development of analytical techniques for measuring pollutants, where necessary, we may improve the technology to permit a detailed characterization. Neutron activation and x-ray fluorescence techniques will be used to determine trace metal concentrations. Aqueous and liquid samples will be analyzed using spectroscopy, polarography, dc discharge emission spectroscopy, and mass spectrometry. Organic and organometallic compounds will be separated into class groups using gas chromatography, high pressure liquid chromatography, and mass spectrometry. The Salmonella/microsome mutagenicity tests will be used for screening compound classes.
Keywords: COAL PREPARATION PLANTS; PILOT PLANTS; CHEMICAL EFFLUENTS; INORGANIC COMPOUNDS; ORGANIC COMPOUNDS; ORGANOMETALLIC COMPOUNDS; MUTAGENESIS; CARCINOGENESIS; MUTAGEN SCREENING; AIR POLLUTION; WATER POLLUTION; NEUTRON REACTIONS; ACTIVATION ANALYSIS; X-RAY FLUORESCENCE ANALYSIS; EMISSION SPECTROSCOPY; MASS SPECTROSCOPY; POLAROGRAPHY; CHROMATOGRAPHY; CHEMICAL ANALYSIS.

86077 Precipitation Scavenging in MAP3S. Hales, J.M. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001655. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$500,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Physical and chemical processes and effects.

The project is designed to study the distribution and quality of precipitation in the greater northeast USA and to relate this to fossil fuel emissions and synoptic meteorology. It also involves a study of the mechanism of scavenging of gaseous and aerosol pollutants by storm systems and a development of models which describe the scavenging mechanism. Four tasks will be performed in order to accomplish the goals of this project. These are: (1) the specification of wet transformation rates and the concurrent meteorological conditions for the conversion of SO2 to sulfate; (2) the analysis of the movement of air pollution in frontal storms; (3) the prediction of wet removal of pollutants from the atmosphere; and (4) the acquisition of wet removal of air pollution in chemistry data.
Keywords: USA; AIR POLLUTION; FOSSIL-FUEL POWER PLANTS; AEROSOL MONITORING; MONITORING; MATHEMATICAL MODELS; SULFUR DIOXIDE; SULFATES; METEOROLOGY; GASEOUS WASTES; REMOVAL; ATMOSPHERIC PRECIPITATIONS; FEASIBILITY STUDIES; SAMPLING; CHEMICAL REACTIONS; WASHOUT; STORMS; PRECIPITATION SCAVENGING; ENVIRONMENTAL EFFECTS.

86079 Inhalation Hazards to Coal Miners. Karagianes, 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(100). **R and D categories:** Health effects.

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.

86081 Malnutrition and Metal Toxicity. Ragan, H.A. (Battelle Pacific Northwest Lab., 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: fossil fuels(80); nuclear fission(20). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

Iron deficiency and protein deficiency are common in both industrialized and underdeveloped countries. However, little is known about the synergistic toxicity when nutritional deficiencies are combined with exposures to heavy metals. Certain metals are known to interfere with iron deficiency, and some are detrimental to the immune system. In addition, the hematopoietic system and immunocompetence are adversely affected by either iron or protein deficiency. The objectives of this project are to define these interrelationships. This project will investigate, in laboratory animals, the effects of iron and/or protein deficiency on the toxicity of pollutant metals. Screening studies will determine those metals whose toxicity or absorption appears enhanced in nutritionally deprived animals. Based on these preliminary studies, subsequent investigations will investigate, in detail, the effects on the hematopoietic and immune systems. The incidence of neoplasia of nutritionally deprived animals exposed to pollutant metals will be compared to control animals similarly exposed.
Keywords: METALS; TOXICITY; ANEMIAS; IRON; PROTEINS; NUTRITION; ANIMALS; POLLUTION; METABOLISM.

86082 Toxicology of Plutonium--Sodium. Mahlum, D.D. (Battelle Pacific Northwest Laboratory, 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:** Health effects.

The objective is to determine the biological behavior and effects of plutonium released with sodium in a manner simulating a hypothetical core disruptive accident in a liquid metal fast breeder reactor. The approach is to: (1) develop technology for generating vaporization--condensation aerosols from LMFBR fuel and mixing these with sodium in appropriate sequence; (2) develop and apply techniques for exposing experimental animals to these aerosols; and (3) study the deposition, distribution, excretion and biological effects of these inhaled aerosols.
Keywords: PLUTONIUM; SODIUM; TOXICITY; FISSION PRODUCTS; AIR POLLUTION; RADIOACTIVE AEROSOLS; RADIATION MONITORING; SYNERGISM; LMFBR TYPE REACTORS; ANIMALS; INHALATION; METABOLISM; REACTOR CORE DISRUPTION; ENVIRONMENTAL IMPACTS.

86083 Toxicology of Inhaled Acid Aerosols. Ballou, J.E. (Battelle Pacific Northwest Lab., 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: fossil fuels(70); nuclear fission(30). **R and D categories:** Health effects.

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. The objective is to supplement our knowledge of the latent effects of acid exposure where little information is now available. Rats will be exposed by inhalation to graded doses of acid aerosols and the late developing histopathology will be observed in life span studies. The dose-response relationship for lung and bone tumor induction will be of particular interest since earlier studies indicate these lesions may be related to acid inhalation.
Keywords: HYDROCHLORIC ACID; NITRIC ACID; SULFURIC ACID; AEROSOLS; INHALATION; RATS; BIOLOGICAL EFFECTS; TOXICITY; LUNGS; SKELETON; NEOPLASMS; LATENCY PERIOD; LIFE SPAN; DOSE-RESPONSE RELATIONSHIPS.

86084 Late Effects of Oil Shale Pollution. Renne, R.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001993. **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: fossil fuels(30); oil shales and tar sands(70). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The purpose of the study is to identify the potential health hazards which may be associated with exposure to particulates resulting from mining and retorting of oil shale and to evaluate the carcinogenic potential of shale oil fractions shown to have mutagenic activity by the bacterial and cell-culture assay systems in the project Mutagenicity of Oil Shale. The initial studies to evaluate the fibrogenic potential of oil shale and spent shale particulates and possible carcinogenic activity of these materials are underway. The experimental animals are exposed to the particulates by intratracheal injection in both studies.
Keywords: OIL SHALES; SPENT SHALES; OIL SHALE PROCESSING PLANTS; CHEMICAL EFFLUENTS; SHALE OIL FRACTIONS; HEALTH HAZARDS; HUMAN POPULATIONS; RISK ASSESSMENT; CARCINOGENESIS; MUTAGENESIS; MUTAGEN SCREENING; PARTICLES; ANIMALS; BIOLOGICAL MODELS; INTRATRACHEAL ADMINISTRATION; INHALATION; AIR POLLUTION; AEROSOLS; LUNGS; PATHOLOGICAL CHANGES.

86085 Mutagenicity of Shale Oil and Shale Oil Fractions. Pelroy, R.A. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001994. **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: fossil fuels(30); oil shales and tar sands(70). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

This program provides a rapid screening procedure which will identify potentially carcinogenic materials in oil shale, or materials formed during the processing of the shale into new shale oil, upgraded shale oil, etc. Such potentially carcinogenic materials (including pure chemicals identified in the various fractions) will then be available for more extensive testing in animals. We are therefore investigating the development and utilization of bioassays employing microbial and mammalian cells in culture. These assays, used as a screen for mutagenic and carcinogenic effect, may allow the selection of agents and concentration ranges for evaluation in whole-animal assays. They can be performed at relatively low cost and relatively quickly, allowing evaluation of large numbers of test materials and combinations of materials. Further, since these assays involve cultured cells, they also afford simple biochemical means for studying the mode of action of a given mutagenic and/or carcinogenic substance.
Keywords: SHALE OIL; SHALE OIL FRACTIONS; CARCINOGENESIS; MUTAGENESIS; MUTAGEN SCREENING; BACTERIA; CELL CULTURES; ANIMAL CELLS; MUTATIONS; EFFICIENCY; ECONOMICS; BIOCHEMISTRY; PATHOLOGICAL CHANGES; RISK ASSESSMENT; HEALTH HAZARDS; HUMAN POPULATIONS.

86086 Microdosimetry of Internal Sources. Roesch, W.C. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001997. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

This project will provide fundamental results upon which increasingly credible conclusions can be drawn concerning social, economic, and occupational health issues. The project addresses requirements in transformation, transport, and fate of nuclear pollutants and in the effects of nuclear pollutants. The studies are relevant to nuclear power production, both fission and fusion. The purpose of this study is to develop practical methods for calculating statistical or microscopic dose distributions for soft tissue and for lung tissue in which radionuclides are deposited. Calculational methods will be developed for radioactive species germane to potential hazards associated with energy production from fission and from fusion. Emphasis will be on plutonium or other alpha emitting substances, particularly when deposited in particulate form and on tritium. This information is needed to aid in correlating and extrapolating radiation effects between species and differing levels and types of exposure. This application of microdosimetric concepts will help in judging which cases of internal deposition can be considered similar and which different from other radiation risks. The ability to make such comparisons will be particularly helpful in setting and defending radiation protection standards.

Keywords: PLUTONIUM; ALPHA SOURCES; TRITIUM; INHALATION; INGESTION; MAN; RADIATION HAZARDS; LUNGS; TISSUES; MICRODOSIMETRY; SPATIAL DOSE DISTRIBUTIONS; NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; HUMAN POPULATIONS; RADIATION PROTECTION; BIOLOGICAL RADIATION EFFECTS; MATHEMATICAL MODELS.

86087 Mobilization of Deposited Metals. Smith, V.H. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 001999. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: fossil fuels(70); nuclear fission(30). **R and D categories:** Health effects.

This research project seeks to develop treatments for overexposure of workers or the public to toxicants, particularly metallic or organometallic agents, encountered during non-nuclear energy or fuels research, development or production. Metal removal agents are being sought from among natural chelating agents, e.g., the siderochromes produced by some microorganisms, and from existing chelators. The candidate agents are tested for their relative chelating ability toward Pb, Cd, Hg, V, Cr, Co, As, Fe, and Tl using chromatography. Chelon and chelate toxicity are evaluated in tissue cell culture systems. If they appear promising further tests are made for the ability of the agents to remove injected or inhaled metallic toxicants from mice or rats. Successful agents will be tested in rodents and dogs to see if they can ameliorate pathological conditions due to acute exposures and to chronic, low-level exposure to the toxicants, as well as being toxicologically evaluated for possible trial in man.
Keywords: METALS; ORGANOMETALLIC COMPOUNDS; ENERGY; ENERGY SOURCE DEVELOPMENT; DECONTAMINATION; REMOVAL; MICROORGANISMS; CHELATES; LEAD; CADMIUM; MERCURY; VANADIUM; CHROMIUM; COBALT; ARSENIC; IRON; THALLIUM; CHRONIC EXPOSURE; CELL CULTURES; INHALATION; AEROSOLS; RISK ASSESSMENT.

86088 Analog Elements for Predicting Behavior of Transuranics in the Environment. Weimer, W.C. (Battelle Pacific Northwest Laboratory, 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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 similar 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.

86091 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:** Physical and chemical processes and effects.

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.

86093 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: fossil fuels(20); coal(80). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

86094 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 shales and tar sands(100). **R and D categories:** Physical and chemical processes and effects.

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.

86095 Statistical Health Effect Studies. Gilbert, E.S. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002131. **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:** Characterization, measurement, and monitoring; Health effects.

The objectives of this project are: (1) to evaluate the effects of chronic, low-level radiation exposures on human populations; and

(2) to develop adequate statistical and epidemiological methodologies for assessing available data on chronic low-level exposures. Our tasks include analysis of the Hanford mortality data, expanding the Hanford mortality base to include J.A. Jones construction workers, developing and adapting statistical and epidemiological procedures for analyzing chronic low-level exposures, and critically evaluating other studies and opinions concerning human risks from chronic exposures.
Keywords: IONIZING RADIATIONS; CHRONIC IRRADIATION; LOW DOSE IRRADIATION; HUMAN POPULATIONS; BIOLOGICAL RADIATION EFFECTS; MAN; EPIDEMIOLOGY; STATISTICS; MORTALITY; DATA COMPILATION; RISK ASSESSMENT.

86096 Restoration of Surface-Mined Lands. 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(50); oil shales and tar sands(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

86100 Oil Shale, Tar Sands, and Coal Conversion Research Materials Preparation Documentation. 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 shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

86101 Plutonium Lung Counting. Swinth, K.L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002281. **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: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The precision and accuracy of lung counting techniques will be evaluated in order to assure effective control of inhalation hazards to workers in the nuclear industry. Although the work will be applied to the exposure of workers to plutonium, similar techniques are applicable to uranium and other transuranic materials. This program will assess the adequacy of occupational health procedures in this specific area. Two tasks are entailed in this program. Major emphasis will be on assisting in the design of and the coordination of the United States efforts on a 103-Pd--51-Cr interlaboratory comparison of lung burden measurement capabilities. In conjunction with a calibration phantom being developed at LLL, this will provide a realistic measure of precision and an estimate of accuracy. The second task will examine the effects of non-uniform lung distribution and intraorgan distribution on plutonium lung counting. The magnitude of the variations will be estimated along with their probable effect on counting accuracy.
Keywords: PLUTONIUM; RADIOACTIVE AEROSOLS; INHALATION; PERSONNEL; NUCLEAR INDUSTRY; PERSONNEL MONITORING; LUNGS; COUNTING TECHNIQUES; PALLADIUM 103; CHROMIUM 51; RADIATION DETECTORS; CALIBRATION; PHANTOMS; ACCURACY.

86102 Environmental Policy Analysis. 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: fossil fuels(25); nuclear fission(75). **R and D categories:** Integrated 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.

86106 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). Div. of Operational and Environmental Safety. **Funding:** DOE-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

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.

86108 Assessment of the Status of Criticality Safety. Lloyd, R.C. (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). Div. of Operational and Environmental Safety. **Funding:** DOE-$45,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

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.

86110 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). Div. of Environmental Control Technology. **Funding:** DOE-$500,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

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.

86112 Energy Material Transportation, Now Through 2000. 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). Div. of Environmental Control Technology. **Funding:** DOE-$250,000.
Related energy source: fossil fuels(35); nuclear fuels(general)(65). **R and D categories:** Environmental control technology.

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.

86114 Transportation Safety Studies. 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). Div. of Environmental Control Technology. **Funding:** DOE-$320,000.
Related energy source: coal(10); oil and gas(10); nuclear fuels(general)(80). **R and D categories:** Environmental control technology.

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.

86116 ECT for Shale Oil Waste Waters. 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). Div. of Environmental Control Technology. **Funding:** DOE-$150,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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.

86118 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 Health and Environmental Research. **Funding:** DOE-$10,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

86119 Compressed Air Energy Storage Environmental Control Technology Concerns. Stottlemyer, J. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800246. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology.

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.

86120 ES and H Standards Identification 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). Div. of Operational and Environmental Safety. **Funding:** DOE-$125,000.
Related energy source: geothermal(100). **R and D categories:** Operational safety.

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.

86121 Effects of Low Levels of Tritium on Marine Organisms. Roesijadi, G. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 000643. **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: nuclear fission(50); nuclear fusion(50). **R and D categories:** Ecological/biological processes and effects.

The objectives of the project are to determine the potential for compartmentalization of tritium in marine eggs, larvae, and reproducing adults, and to determine the effects of low levels of irradiation on the organisms' life histories. Eggs from the shrimp Pandalus danae were exposed to water containing tritium to determine the effects on hatching success. The effects of tritium on survival, molting, and duration of development of P. platyceros larvae are being measured. Tritium turnover rate at sequential stages of development is being measured on zoeal stages of the crab Pinnixa occidentalis.
Keywords: TRITIUM; TISSUE DISTRIBUTION; METABOLISM; AQUATIC ORGANISMS; EGGS; LARVAE; ADULTS; SHRIMP; CRUSTACEANS; RADIONUCLIDE KINETICS; LOW DOSE IRRADIATION; BIOLOGICAL RADIATION EFFECTS; HATCHING; LIFE SPAN; MOLTING; ONTOGENESIS; REPRODUCTION.

86122 Plan for Geothermal Liquid Waste Disposal Program. Deferling. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 800186. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.
Related energy source: geothermal(100). **R and D categories:** Environmental control technology.

The DOE Geothermal Liquid Waste Disposal Program is expected to identify and make available economic, safe, and environmentally acceptable techniques for the handling and disposal of geothermal liquid wastes. The purpose of PNL involvement in this program is: (1) to provide an overview of the state-of-the-art; and (2) to formulate a research program plan for geothermal liquid waste disposal. The PNL program has the following objectives for FY1978: (1) to assess the state of knowledge of geothermal liquid waste disposal techniques; and (2) to develop a program plan leading to commercially viable techniques for liquid waste disposal within safety and environmental constraints.
Keywords: GEOTHERMAL ENERGY; LIQUID WASTES; WASTE DISPOSAL; TECHNOLOGY ASSESSMENT; COMMERCIALIZATION; ENVIRONMENTAL IMPACTS; SAFETY ENGINEERING.

86124 Coordination of Pacific Marine Sciences Program. 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.
R and D categories: Ecological/biological processes and effects.

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 responsibilites 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, who will provide coordination services. This proposal provides for coordination of the Pacific Coast region.
Keywords: PACIFIC OCEAN; OCEANOGRAPHY; RESEARCH PROGRAMS; DATA COMPILATION; RECOMMENDATIONS.

86125 LNG Safety Studies. Hall, R.J. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800156. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$300,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

The principle issue addressed in this plan is the concern that LNG operations and facilities may present an unacceptable risk to the public. This perception may work to limit the number or capacity of LNG facilities at a time when they are needed. A better understanding of LNG hazards will provide information for the development of sites and control systems about which public judgements regarding acceptability can be more quickly and equitably made. The program is directed toward providing, through research and development, LNG safety and environmental control information for use by industry, regulatory agencies, and the general public. By conducting adequate background studies and literature searches, and by using the information and opinions of LNG experts, the pertinent information needed to conduct an R and D program in LNG safety and environmental control will be acquired.
Keywords: LIQUEFIED NATURAL GAS; SAFETY ENGINEERING; RISK ASSESSMENT; STORAGE FACILITIES; LNG PLANTS; RESEARCH PROGRAMS; RECOMMENDATIONS.

86129 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: fossil fuels(80); geothermal(20). **R and D categories:** Characterization, measurement, and monitoring.

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.

86130 Toxicology of Sodium and Lithium. Zwicker, G.M. (Battelle Pacific Northwest Lab., 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(40); nuclear fusion(40); solar(20). **R and D categories:** Health effects.

During an accident, high concentrations of sodium hydroxide, carbonate, and perhaps other sodium compounds as well could reach members of the general population for a limited period. Another scenario of interest for purposes of this proposal involves the rupture of a secondary sodium pipe outside of the containment building. Liquid sodium would be sprayed into the air where it would be oxidized and transported to the site boundary. In a relatively humid atmosphere, a large fraction of the sodium would be converted to Na2CO3 which is presumably less toxic than NaCH. In an atmosphere of low relative humidity, more of the sodium would exist as the oxide and hydroxide. The first part of this project would involve the conceptualization, design, and fabrication of an aerosol generation system and an exposure system for rodents. The second part of this project would involve the whole-body exposure of adult and immature rats to different concentrations of aerosol, probably for periods up to 2 hrs.
Keywords: RATS; ADULTS; JUVENILES; CHRONIC EXPOSURE; INHALATION; SODIUM HYDROXIDES; SODIUM CARBONATES; SODIUM OXIDES; HUMIDITY; TOXICITY; AEROSOLS; COMPARATIVE EVALUATIONS; REACTOR ACCIDENTS; AEROSOL GENERATORS; DESIGN.

86131 Biomagnetic Effects. Mahlum, D.D. (Battelle Pacific Northwest Lab., 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(90); other advanced(10). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective is to determine if static and slowly-varying magnetic fields may produce effects in selected biological systems and whole animals. Fish ova, bacteria, cell cultures, isolated nerve preparations, biophysical membranes and gels, and mice (adults, pregnant females, offspring) are exposed to uniform and gradient magnetic fields, static and ramped, up to 1 Tesla strength. Mutagene-

sis, teratogenesis, cellular transformations, alterations in membrane function, and effects on gelation are emphasized.
Keywords: MAGNETIC FIELDS; BIOLOGICAL EFFECTS; BENCH-SCALE EXPERIMENTS; EGGS; BACTERIA; CELL CULTURES; MEMBRANES; NERVE CELLS; GELS; MICE; MUTAGENESIS; TERATOGENESIS; PATHOLOGICAL CHANGES; BEHAVIOR; ANIMAL GROWTH.

86133 Cigarette Smoke and Plutonium. Filipy, R.E. (Battelle Pacific Northwest Lab., 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Because a large portion of the population smokes cigarettes, a synergistic effect of plutonium and cigarette smoking could influence estimates of the health risk of plutonium and other transuranics released to the environment and should be considered in establishing occupational and nonoccupational exposure standards. This project will be directed toward determination of: (1) the influence of cigarette smoking on distribution and retention of inhaled plutonium in the pulmonary airways to experimental animals; and (2) the influence of cigarette smoking on plutonium toxicity.
Keywords: PLUTONIUM; INHALATION; LABORATORY ANIMALS; TISSUE DISTRIBUTION; RETENTION; RESPIRATORY SYSTEM; RADIONUCLIDE KINETICS; TOXICITY; TOBACCO SMOKES; BIOLOGICAL EFFECTS; SYNERGISM.

86134 Lithium/Beryllium Effects on Aquatic Communities. 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/biological processes and effects.

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.

86135 Inter-Laboratory Working Group for Data Exchange. Dionne, P.J. (Battelle Pacific Northwest Labs., P.O. Box 999, Richland, WA, 99352). **Project number:** 002536. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$25,000.
R and D categories: Integrated assessment.

The Regional Studies Program, and DOE objectives in general, require the unprecedented exchange and utilization of large amounts of computerized descriptive information and numeric data among the national laboratories. To address this problem in a timely and cost effective manner, the Inter-Laboratory Working Group for Data Exchange (IWGDE) has been formed to share expertise, establish long and short term objectives, and create and implement standards for the exchange of data and models. Development of this program at each laboratory in the evolution of a highly cost effective approach to inter-laboratory cooperation and collaboration in making the regional character of many Environment and Safety research programs conform to the need for assessment of energy impacts on a nationally integrated basis will be undertaken. It has built on the strong expertise and extensive investment already available in the DOE laboratories in the data management field and is tailored to the needs of users for timeliness, high quality, and easy integration into modeling and policy-oriented projects. The primary program requiring the exchange of large data bases and software is E and S's Regional Studies Program for evaluating energy resources and assessing the impacts of alternative energy policies. This program typifies the broadened DOE mission and is one of the first such programs requiring close cooperation among all DOE national laboratories. In particular, the sharing of data and computational models on the wide spectrum of subject areas involved in regional energy assessment studies demands the adoption of data exchange standards and compatible data management systems. By its nature, this project is directly related to many DOE programs and projects at all the national laboratories.
Keywords: DATA; INFORMATION SYSTEMS; ENVIRONMENT; SAFETY; RESEARCH PROGRAMS; ENVIRONMENTAL IMPACTS; TECHNOLOGY TRANSFER; STANDARDS; INFORMATION THEORY; OPTIMIZATION; INFORMATION NEEDS; MANAGEMENT.

86136 Long-Range Tracer Development and Testing (AMTEAM). Guthals, P.R.; 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: fossil fuels(25); coal(25); oil shales and tar sands(25); nuclear fuels(general)(25). **R and D categories:** Physical and chemical processes and effects.

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.

86137 Solvent Refined Coal Bio Studies. Mahlum, D.D. (Battelle Pacific Northwest Lab., 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: fossil fuels(30); coal(70). **R and D categories:** Health effects.

This proposal concerns a widely-scoped study to characterize and measure substances/mixtures produced in the solvent refined coal (SRC) process which may be of environmental/biomedical concern and to assess their toxicologic properties via a tiered testing approach. SRC materials are subjected to chemical characterization, analysis of dosimetry and metabolism in mammalian tissues, determination of mutagenicity in bacterial systems, study of toxicity and transforming potential on mammalian cells. Analyses of toxic effects for SRC materials on higher animals involves determination of effects on pulmonary function, analyses of developmental toxicity, perinatal consequences, consequences of dermal exposure, analyses of inhalation toxicity, and determinations of prechronic toxicity.
Keywords: COAL LIQUEFACTION; SRC PROCESS; MUTAGEN SCREENING; MATERIALS; TOXICITY; HYDROCARBONS; PARTICLES; SULFUR OXIDES; NITROGEN OXIDES; ORGANIC COMPOUNDS; MUTAGENS; CARCINOGENS; TERATOGENESIS; INGESTION; INHALATION; EMISSION; CHEMICAL EFFLUENTS; ENVIRONMENTAL EFFECTS; LUNGS; SKIN; METABOLISM; TOXINS.

86138 Review of Internal Emitter Research. Bair, W.J. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002717. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$27,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

This proposal is for bibliographic and personal interview research and writing of a definitive general history of internal emitter toxicology research programs (including all radionuclides) from the beginning of the major effort in the early 1940's to the present.
Keywords: RADIOISOTOPES; INGESTION; INHALATION; INTERNAL IRRADIATION; TOXICITY; RESEARCH PROGRAMS; REVIEWS.

86139 Toxic Effects of Geothermal Effluents. Renne, R.A. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 002721. **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: fossil fuels(30); geothermal(70). **R and D categories:** Health effects.

Geothermal power production may result in chronic human exposure to various levels of gaseous hydrogen sulfide and ammonia thru both occupational and environmental exposure. It is therefore important to examine biomedical effects of such exposure in order to determine potential hazards. We propose, in this study, to determine the toxicologic effects on laboratory rodents of acute and subacute exposure to various levels of hydrogen sulfide (H/sub 2/S) and ammonia (NH/sub 3/) gases, alone and in combination. The scope of

the study encompasses the morphologic, physiologic, and biochemical changes resulting from acute and subacute exposures to mixtures of H/sub 2/S and ammonia. Preliminary studies to confirm published data regarding acute affects and to establish appropriate concentrations of each compound alone and in combination will be followed by longer-term exposures to establish subacute, combined toxicologic effects.
Keywords: GEOTHERMAL FLUIDS; TOXICITY; AMMONIA; HYDROGEN SULFIDES; MAN; PHYSIOLOGY; MORPHOLOGY; BIOCHEMISTRY.

86140 Pollutant Transformation in the Atmosphere. Kalkwarf, D.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002728. **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(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The purpose of this program is to measure transformation rates of polynuclear aromatic hydrocarbons and other potentially toxic or carcinogenic species emitted by coal-fired power plants as these compounds are transported through the atmosphere. Transformation rates will be measured in the field and in the laboratory. Through in-field studies at Colstrip, Montana, and at the Hanford site, Richland, Washington, power plant stack emissions will be sampled between the point of release to several kilometers away. In both field and laboratory studies the effects of temperature, light intensity, humidity, and other pollutant concentrations will be evaluated.
Keywords: EARTH ATMOSPHERE; ENVIRONMENTAL TRANSPORT; AROMATICS; HYDROCARBONS; FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; DIFFUSION; MONTANA; WASHINGTON; FLUE GAS; PLUMES.

86141 Long-Term Effects of Hydrocarbons. Gibson, C.I. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002733. **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

This program has been designed to provide necessary data to assess effects of long-term exposure to petroleum hydrocarbons on selected organisms and communities from the northwest U.S. coastal ecosystem. The studies in progress include: (a) constant exposure of selected species to a well-characterized extract of Prudhoe Crude to determine relationships between concentration, exposure time, mortality, and hydrocarbon uptake and release rates, (b) exposure of organisms in the field or laboratory to sediments contaminated with hydrocarbons to varying degrees to determine bioavailability and effects, and (c) in situ depuration studies on rates of release of hydrocarbons from previously contaminated sediment while monitoring of the recruitment rate of benthic organisms in these sediments. The program closely integrates the analytical expertise of the Environmental Chemistry section with the experimental approaches of marine biologists in the Marine Sciences section. While utilizing "state-of-the-art" techniques, development is taking place to produce better analytical methods and experimental approaches to more closely define the transport of hydrocarbons and their effects under natural conditions.
Keywords: HYDROCARBONS; CHRONIC EXPOSURE; PETROLEUM INDUSTRY; TERRESTRIAL ECOSYSTEMS; AQUATIC ORGANISMS; METABOLISM; TOXICITY; AQUATIC ECOSYSTEMS; BIOLOGICAL EFFECTS; ENVIRONMENTAL TRANSPORT; BENTHOS.

86142 Marine Sciences--Ship Time. Templeton, W.L. (Battelle Pacific Northwest Lab., 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:** Ecological/biological processes and effects.

The project consists of ship time funding to support research projects involved in efforts of energy-related pollutants on West Coast marine coastal ecosystems. The projects involved are Marine Chemistry of Energy Related Pollutants; Bioavailability of Energy Effluent Materials in Coastal Ecosystems; Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems; and In Situ Pollutant Measurements.
Keywords: AQUATIC ECOSYSTEMS; COASTAL REGIONS; SHIPS; FINANCING; ENERGY; POLLUTION; HYDROCARBONS; OCEANOGRAPHY; ENVIRONMENTAL TRANSPORT; MONITORING; BASELINE ECOLOGY; CALIFORNIA.

86143 Magnetic Field Dosimeter Development. Doctor, S.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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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) preliminary 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.

86145 Ecological Monitoring of Long-Term Effects. Hinds, W.T. (Battelle Pacific Northwest Lab., 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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

This project is designed to measure slowly paced changes of man-induced contaminants introduced into terrestrial and aquatic ecosystems by developing energy technologies. Study sites would be selected over a gradient of impacts ranging from nil to those that have received damaging amounts of contaminants from historic operations (such as copper smelters). Primary producer and consumer organisms would be monitored over a long period of time to detect changes that might occur so gradually that they could go undetected by short-term monitoring. For the most part this project's activities are expected to be confined to forested ecosystems in the northwestern portions of the United States, and to a major extent will consider the impacts of coal conversion and combustion.
Keywords: TERRESTRIAL ECOSYSTEMS; AQUATIC ECOSYSTEMS; FORESTS; USA; MONITORING; ENERGY SOURCE DEVELOPMENT; COAL; COMBUSTION.

86146 Urinary Excretion of Metals and DTPA. Kalkwarf, D.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 003251. **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: nuclear fuels(general)(100). **R and D categories:** Health effects.

The purpose of this project is to analyze the McCluskey urine specimens collected since his treatments with DTPA in order to (1) test for abnormal excretion of essential body metals; (2) determine the effectiveness of oral zinc supplements in inhibiting the excretion of these metals; and (3) relate the amounts and forms of DTPA salts excreted in urine to those administered intravenously. All of the 600 urine specimens available at this time will be analyzed.
Keywords: DTPA; INTRAVENOUS INJECTION; ZINC; ORAL ADMINISTRATION; MAN; EXCRETION; URINE; CHEMICAL ANALYSIS; METALS; INHIBITION; BIOLOGICAL EFFECTS; DECONTAMINATION.

86147 Assistance for Nationwide Disposition Planning for DOE Nuclear Facilities. 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). Div. of Environmental Control Technology. **Funding:** DOE-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

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.

86148 Decommissioning of Hanford Facilities: Technology. 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). Div. of Environmental Control Technology. **Funding:** DOE-$245,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

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.

87005 Therapy for Inhaled Radionuclides. Muggenburg, B.A. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 000340. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$115,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Inhalation of airborne radionuclides is a potential hazard in the nuclear industry. Such inhaled radioactive particles may cause a variety of diseases of the lung and other organs. Specific objectives of this project are to evaluate, in laboratory animals, methods to remove radioactive materials from the body, to demonstrate prevention of disease by radionuclide removal, to develop methods to treat effects of irradiation and to evaluate the biomedical risks of these procedures. The general approach is to expose animals to a radioactive aerosol and study its removal by different procedures. Lung lavage has been shown to be effective for removing a significant fraction of inhaled, relatively insoluble particles of actinide and lanthanide elements. The use of chelating agents in combination with lung lavage has significantly reduced the translocation of radionuclides from the lung to other organs. The clinical use of lung lavage in man and studies in animals have shown the low risk of this procedure. Animals treated with both lung lavage and chelating agents have survived inhalation exposure to a radionuclide longer than untreated exposed animals. Efforts to treat the effects of acute radiation injury to the lung have met with limited success using anti-inflammatory agents.
Keywords: RADIONUCLIDE KINETICS; DECONTAMINATION; INHALATION; AIR POLLUTION; ANIMALS; MAN; PLUTONIUM 238; PLUTONIUM 239; RADIATION INJURIES; LUNGS; POST-IRRADIATION THERAPY; DRUGS; REMOVAL; CHELATING AGENTS; LAVAGE.

87007 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Individuals may be exposed by inhalation of radionuclides in an acute single exposure, repeated exposures or by chronic exposure. Most past studies on radionuclide inhalation toxicology have assessed single acute exposures. Studies of the effect of repeated inhalation exposures, which are also designed to simulate chronic inhalation exposures, are in progress to assess effects on (1) radiation dose pattern, and (2) resulting biological effects. The general approach is to expose laboratory animals repeatedly at pre-determined intervals and study the resulting patterns to radionuclide retention and observed biological effects. An apparent increase in the long-term retention of 137-Cs-labeled fused aluminosilicate particles has been observed in Beagle dogs exposed weekly for up to 40 weeks compared with dogs exposed once. Beagle dogs, mice, Syrian hamsters and rats have been repeatedly exposed to 144-Ce in relatively insoluble forms. Biological effects observed in the dogs to date (approximately 4 years post-exposure) have been lymphopenia, radiation pneumonitis and pulmonary fibrosis. Significant increases in the incidence of pulmonary tumors and decrease in life span have been observed in mice and Syrian hamsters repeatedly exposed to 144-CeO2 compared with those exposed once. Studies of the effects of repeated inhalation exposure of dogs, Syrian hamsters and mice to 239-PuO2 are also in progress.
Keywords: RADIOISOTOPES; INHALATION; CHRONIC IRRADIATION; RADIOACTIVE AEROSOLS; RADIONUCLIDE KINETICS; CESIUM 137; DOGS; CERIUM 144; PLUTONIUM 239; BIOLOGICAL RADIATION EFFECTS.

87008 Health and Mortality Study. Bigler, W.A. (Mound Laboratory, Miamisburg, OH). **Project number:** 000474. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$26,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Justification for this program is based on the desire of the Division of Biomedical and Environmental Research to enlarge the scope of their existing epidemiological study of lifetime health and mortality experience of employees of DOE contractors. This project was initiated in June, 1964, to establish the relationships, if any, between mortality patterns and levels of radiation exposures. The extension of this project to include all DOE contractor facilities is needed for studying the presence or absence of any lasting biological effects on human populations of the low level occupational radiation exposures received by atomic energy workers over long periods of time. Mound Laboratory maintains the essential personnel and radiation exposure records suitable for contribution to this study.
Keywords: EPIDEMIOLOGY; MORTALITY; RADIATION DOSES; PERSONNEL; BIOLOGICAL RADIATION EFFECTS; HUMAN POPULATIONS; US ERDA; STATISTICS.

87011 Dose-Response Relationships for Inhaled Beta-Emitting Radionuclides. Hahn, F.H. (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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The objective of this project is to conduct studies in laboratory animals to acquire a better understanding of the relationships between absorbed dose and the possible long-term consequences in man of inhaling beta-gamma-emitting radionuclides associated with different segments of nuclear fuel cycles. Dogs have been exposed by inhalation to selected beta-emitting radionuclides with different physical parameters which result in different radiation dose patterns in the body. They are being maintained for their life span to determine their longevity and the diseases induced by the radiation injury. Initial body burdens being studied range from very high, which cause acute injury and early deaths, to low, which are equivalent to the maximum permissible body burden for man. Other studies have been conducted in Syrian hamsters, mice, and rats to study age and species-related influences on dose-response relationships. Current results indicate that cancer of the tissues most heavily irradiated has been the prime long-term biological effect to date. The most important data in these studies will be the results seen in the later stages in life when possible tumor latency has run its course.
Keywords: DOSE-RESPONSE RELATIONSHIPS; INHALATION; BETA DECAY RADIOISOTOPES; DOGS; HAMSTERS; MICE; RATS; BIOLOGICAL RADIATION EFFECTS; FISSION PRODUCTS; RADIONUCLIDE KINETICS.

87012 Applied Health Protection Considerations for Inhaled Radioactive Materials. Cuddihy, R.G. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 001437. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$67,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring.

The prime objectives of this project are to organize the most recent scientific information related to the inhalation toxicology of radioactive aerosols and apply the results to potential human exposure situations. Major effort is placed upon modeling of existing data from inhalation exposures of animals and people to project radiation

dose patterns for all regions of the respiratory tract and to relate the dose distribution patterns to the probabilities for inducing radiation effects. By using radiation dose-response models developed from detailed studies in laboratory animals, the limited data available for relating radiation exposures and effects observed in people can be interpreted better. Also, specialized techniques are being developed to characterize respirable particles by their compositions and solubilities to improve analyses of their toxicities if inhaled. Models developed in these studies are being incorporated into NCRP documents on radiation dosimetry and have been used previously to evaluate the risks to populations from radionuclides used in various nuclear industry operations.
Keywords: RADIOACTIVE AEROSOLS; INHALATION; TOXICITY; ANIMALS; MAN; DOSIMETRY; RADIATION DOSES; RADIONUCLIDE KINETICS; PLUTONIUM; RADIUM.

87013 Studies of Plutonium Aerosols in Industrial Operations. Newton, G.J. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 001446. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring.

Plutonium aerosols are produced in a variety of physical and chemical forms in routine operations in the nuclear industry. These aerosols could be accidentally released from their normal containment and be inhaled by personnel working nearby. A basic knowledge of physical and chemical characteristics of these aerosols provides essential information for evaluation of consequences of potential accidents. To this end, this research involves field measurements of plutonium aerosols at selected industrial sites using sampling techniques and equipment developed at ITRI. Samples taken include: seven-stage impactor samples for measurement of aerodynamic size distribution and concentrations, Lovelace Aerosol Particle Separator (LAPS) samples for study of particles with respect to aerodynamic size and point-to-plane electrostatic precipitator (ESP) samples for electron microscopy. In addition, LAPS samples are used for measurement of in vitro solubility characteristics. Samples of plutonium-containing aerosols present in glove boxes during mixed-oxide fuel fabrication have been obtained. Aerosol size ranges were: AMAD 2.0 to 3.0 mu-m and sigma-g approximately equal to 1.7. Alpha aerosol concentrations ranged from 0.2 to approximately 500 nCi/l for powder comminution-mixing and 600 to 15,000 nCi/l for centerless grinding. Calculated dissolution half-times range from 50 to 500 days for powder operations, 1200 to 8000 days centerless grinding.
Keywords: PLUTONIUM; RADIOACTIVE AEROSOLS; PERSONNEL; HEALTH HAZARDS; INHALATION; SAMPLING; SOLUBILITY; PARTICLE SIZE; NUCLEAR FACILITIES; IN VITRO.

87014 Long Range Air Quality Effects Study (Formerly Project DaVinci). Zak, B.D. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** 1520. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The primary objective of the Long Range Air Quality Effects Study is to provide the information necessary to describe the large scale regional (50 to 1000 km) and subcontinental scale air quality problems associated with NEP scenarios. The primary approach of the project is to conduct studies of the pollutant transport and transformation in a Lagrangian mode utilizing an instrumented superpressure balloon in the vicinity of the source. The balloon provides a Lagrangian marker of the air mass volume. Spatial mapping about the balloon of pollutants and meteorology would be conducted using instrumented aircraft. Another facet of the project will include using the automated data collection package suspended by a helicopter to conduct close-in sampling of plumes.
Keywords: AIR QUALITY; REGIONAL ANALYSIS; ENVIRONMENTAL TRANSPORT; AIR POLLUTION; DIFFUSION; EARTH ATMOSPHERE; PLUMES; SAMPLING; AERIAL MONITORING; AUTOMATION; REMOTE SENSING; OZONE; MATHEMATICAL MODELS; LAGRANGIAN FUNCTION.

87019 Somatic Cell Chromosome Changes in Humans Exposed to 239-Plutonium and 222-Radon. Brandom, W.F. (University of Denver, Department of Biological Sciences, Denver, CO, 80208). **Project number:** 7049. **Contract:** ALO-EP-76-S-04-3639. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$83,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective of our study was to determine whether a biological response related to estimated physical doses could be observed in uranium miners' or plutonium workers' cells. If a biological dose-response was observed, the somatic cell chromosome test could provide a biological indicator of a toxicological problem and supplemental other indications for setting permissible radiation protection standards. The test system used was the prevalence of chromosome aberrations (dicentrics, rings, inversions, translocations, and deletions) in peripheral blood lymphocytes of controls and uranium miners and plutonium workers, plotted against estimated physical radiation doses. Biological respones in the relative prevalence of chromosome aberrations are observed in uranium miners' and plutonium workers' cells. The analysis to date indicates that estimated lung burdens in the plutonium workers are more significant in affecting lymphocyte chromosomes than are current estimated systemic burdens. In the future, it is expected that somatic cell chromosome aberration frequencies will be used in conjunction with physical dosimetric measurements to screen other populations exposed to low levels of ionizing radiation.
Keywords: PLUTONIUM 239; RADON 222; RADIONUCLIDE KINETICS; RADIATION PROTECTION; MINERS; RADIATION HAZARDS; PERSONNEL; CHROMOSOMAL ABERRATIONS; ANIMAL CELLS; HUMAN POPULATIONS; LUNGS; INHALATION; GENETIC RADIATION EFFECTS; BIOLOGICAL INDICATORS.

87021 Analysis of Ocean Bed Disposal. Anderson, D.R.; Talbert, D.M. (Sandia Laboratories, Albuquerque, NM, 87185). **Project number:** 800002. **Contract:** AT(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$2,830,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

The objectives are: (1) to determine the environmental and technical feasibility of disposal of 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.

87023 Package Failure from Malevolent Attack. Reese, R.T. (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). Div. of Environmental Control Technology. **Funding:** DOE-$190,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

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.

87024 Study of Physical Parameters of Transportation Accidents. Pope, R.B.; Priddy, T.G.; Davidson, C.A.; Dennis, A.W.; Hartman, W.F.; Larson, D.W.; McClure, J.D. (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). Div. of Environmental Control Technology. **Funding:** DOE-$70,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

The objective of this task is to extend the work reported in Severities of Transportation Accidents (SLA-74-0001), to describe the accident environment to which large shipping casks may be exposed and, in addition, to describe the marine transport accident environment. These basic environmental descriptions are required to determine the risk of shipping radioactive material and the preparation of environmental impact statements. The basic approach used in this type of study has been to search historical records for the details of railroad, highway, and marine transport accidents. From this data

base, description or profile of various accident types can be formed. Monte Carlo methods are sometimes used to describe the multivariable data base which describes these accidents. From this type of analysis, the probability of occurrence of selected environmental parameters can be determined.
Keywords: TRANSPORTATION SYSTEMS; ACCIDENTS; CASKS; MONTE CARLO METHOD; LAND TRANSPORT; MARITIME TRANSPORT; RADIOACTIVE MATERIALS; TRANSPORT; ENVIRONMENT; SAFETY.

87025 Full Scale Vehicle Testing Program. Yoshimura, H.R. (Sandia Laboratories, Division 5433, Albuquerque, NM, 87185). **Project number:** 800043. **Contract:** E(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$550,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

The primary objectives of the destructive tests of full scale waste transport systems are to assess and demonstrate the validity of current analytical and scale modeling techniques and to assess the safety of TRU waste containment systems under extreme accident conditions. Secondary objectives of this program are (1) to gain scientific knowledge of the extreme accident environment, (2) to provide a means of demonstrating the response of TRU shipping containers and vehicular systems under these conditions, and (3) to provide guidance to the DOE Office of Waste Management (OWM) contractors on optimal methods of designing waste transportation systems. The participating organizations are, and will continue to be, aware of the transportation needs of systems being developed for OWM, thereby ensuring that appropriate research, analyses, testing, and other studies will be carried out to provide timely and adequate guidance to OWM. This will allow OWM to develop optimum systems with a minimum cost within an acceptable time period. Safe and environmentally accurate systems will result, and delays will be avoided in allowing orderly progress toward resolution of the nuclear waste disposition problem. Independent overview and assessment of the techniques or systems being developed by OWM will guarantee that environmental controls are adequate.
Keywords: CASKS; RADIOACTIVE WASTES; ACCIDENTS; TRANSPORTATION SYSTEMS; DESTRUCTIVE TESTING; VEHICLES; DESIGN; TRANSPORT; SAFEGUARDS.

87026 Transportation Accident Environmental Data Bank. Pope, R.B.; Foley, J.T.; Davidson, C.A. (Sandia Laboratories, Albuquerque, NM, 87185). **Project number:** 800049. **Contract:** ALO 51 (ALO 517B). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$60,000.
R and D categories: Environmental control technology.

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 SECTOR; ACCIDENTS; ENVIRONMENTAL EFFECTS; ENERGY SOURCES; TRANSPORT; DATA ACQUISITION; RISK ASSESSMENT; STANDARDS; TRANSPORTATION SYSTEMS.

87027 Transport of and Containers for Radioactive Materials--Films. Colgan, R.C.; Miller, K.R. (Sandia Laboratories, Division 3153, Albuquerque, NM, 87185). **Project number:** 800050. **Contract:** AT(29-1)-789. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$40,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

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.

87032 Assessment of Underground Coal Gasification on Groundwater. Virgona, J.E. (Laramie Energy Technology Center, Laramie, WY, 82071). **Project number:** 800071. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$150,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objective of this program is to determine the necessary environmental control technology required to mitigate impacts of underground coal gasification on groundwater quality. The work will consist of the collection and analyses of pre- and post-operational water samples to quantify changes in groundwater quality as a result of underground coal gasification. These data will be compared with proposed and existent standards for groundwater quality to first determine whether a need exists for control technology to mitigate impacts of the technology. The effects of coal sorption of organic and inorganic constituents in the groundwater migrating from the gasification zone after test completion will be determined. Pre-operational characterization of both the Hanna I coal seam (a water-saturated system) and an aquifer located 15 feet above the coal seam has been completed, including pump tests, interference tests, and recovery monitoring. Pre-operational collection and analyses to establish background water quality have been completed. Both the characterization and analyses showed the two water-bearing zones to be isolated from each other prior to the Hanna III test. During the linkage and gasification phases, data were collected on the temperature, hydrostatic pressure, and electrical conductivity of the groundwater in the monitoring wells. Approximately one year after the completion of the gasification phase, sufficient water had migrated back into the gasification zone to permit continuation of the groundwater monitoring program. The program will continue until equilibrium conditions have been reached.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; GROUND WATER; WATER QUALITY; WATER POLLUTION CONTROL; SAMPLING; CHEMICAL ANALYSIS; HYDROLOGY; ELECTRIC CONDUCTIVITY; ORGANIC COMPOUNDS; ENVIRONMENTAL IMPACTS; AQUIFERS; LEACHING; ENVIRONMENTAL TRANSPORT; CHEMICAL EFFLUENTS.

87035 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 Health and Environmental Research. **Funding:** DOE-$118,000.
Related energy source: solar(100). **R and D categories:** Environmental control technology.

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.

87036 Assessment of the Radiological Impact of Western Coal Utilization. Styron, C.E. (Mound Laboratory, Miamisburg, OH). **Project number:** 800118. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$59,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

87037 Seabed Disposal Program. 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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The ultimate objective of the program is the development and proof of a capability of disposing of high-level wastes into the submarine geologic formations of the deep oceans. The approach is to define the disposal medium and the adjacent medium, the natural processes, and the processes that would be either altered or imposed by the presence of a high-level radioactive waste package.
Keywords: RADIOACTIVE WASTE DISPOSAL; MARINE DISPOSAL; SEA BED; HIGH-LEVEL RADIOACTIVE WASTES.

87038 Policy Studies--Uranium. Snyder, W.A. (Sandia Labs., P.O. Box 5800, Albuquerque, NM, 89115). **Project number:** 2229. **Contract:** EY-76-C-04-0789. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$100,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Integrated 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.

87039 Effect of Low Frequency Electromagnetic Fields on Biological Systems. Wayland, J.R. (Sandia Laboratory, P.O. Box 5800, Albuquerque, NM, 87185). **Project number:** 2836. **Contract:** F-227A. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$122,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is to evaluate genetic changes due to electric fields. The project involves a joint effort by investigators at the Sandia Laboratories in Albuquerque and the Los Alamos Scientific Laboratory (LASL). In the LASL effort, mammalian cells are exposed in vitro (conducting medium) to 60-Hertz electric fields to evaluate possible genetic changes or perturbations of cell replication, growth, or survival. Effects on chromosome structure will also be investigated. These experimental activities will be closly integrated with a theoretical study at Sandia of rate processes in both exposed and unperturbed systems. A study of bioeffects of 60-Hertz magnetic fields will be added during the next year.
Keywords: ELECTRIC FIELDS; GENETIC EFFECTS; BIOLOGICAL EFFECTS; DNA REPLICATION; CELL CYCLE; CHROMOSOMES; LONG WAVE RADIATION; ELECTROMAGNETIC RADIATION.

87040 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:** Health effects.

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.

87041 Lung Cell Injury from NOx. Pfleger, R.C. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002491. **Contract:** EY-76-C-04-1013. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: coal(100). **R and D categories:** Health effects.

Particulate materials and the oxides of nitrogen are a few of the environmental pollutants associated with combustion of coal, NOx is known to induce lung injury. This study is designed to examine the toxicity of NOx and particulates from fluidized bed combustion following inhalation by experimental animals. Emphasis in this study is being placed on determining effects of these materials on pulmonary surfactant synthesis and their effect on lung collagen and elastin synthesis, breakdown and quantity. Correlations will be made between biochemical, morphological and physiological measurements conducted on the exposed animals. Young mature Syrian hamsters were exposed to 15 ppM NOx for eight hours. Groups of four animals were sacrificed at various times following the exposure. Pulmonary alveolar macrophages and Type II cells were isolated and incubated with radiolabeled surfactant precursor materials. The incubations were terminated and cell lipids extracted. At 1, 2, and 11 days after the insult, Type II cells incorporated much more label into surfactant type compounds than control cells. When palmitate and glycerol were incubated with macrophages, the NOx exposed cells incorporated much less label into surfactant compounds than control cells, even though the phagocytic activity of the exposed cells was considerably greater than normal macrophages.
Keywords: LUNGS; NITROGEN OXIDES; TOXICITY; PATHOLOGICAL CHANGES; METABOLISM; HEALTH HAZARDS; FLY ASH; RATS; HYDROCARBONS; RESPIRATORY SYSTEM DISEASES; INHALATION.

87042 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:** Health effects.

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 necessary 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.

87043 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:** Health effects.

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.

87044 FBC: Kinetics of Lung Cells in Response to Inhaled Effluents. Hackett, N.F. (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:** Health effects.

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.

87045 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:** Health effects.

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.

87046 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:** Health effects.

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.

87047 Toxicology of Solar Heating and Cooling Materials. Hobbs, C.H. (Lovelace Inhalation Toxicology Research Institute, 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-$135,000.
Related energy source: solar(100). **R and D categories:** Health effects.

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 buildings. 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; SOLAR HEATING SYSTEMS; SOLAR COOLING SYSTEMS; TOXICITY; TOXIC MATERIALS; HAZARDOUS MATERIALS; HYDROCARBONS; GLYCOLS; SILICONES; INGESTION; SKIN.

87050 Development of Integrated In Vivo/In Vitro Systems for the Study of Carcinogenic Effects of Energy-Related By-Products. Yuhas, J.M. (University of New Mexico, Cancer Research and TRT Center, Albuquerque, NM, 87131). **Project number:** 7446. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The objective of this project is to develop an in vitro method for studying the carcinogenic effects of energy-related pollutants. In order to do so we are presently exposing mice to carcinogenic agents and analyzing the yield of induced lung cancers by isolating their lung cells in vitro. Studies are also directed to determining the carcinogenic effects of the same agents in lung cells after their isolation in vitro. Through an understanding of the two processes it should be possible eventually to predict in vivo carcinogenic effects by studying isolated lung cells in vitro. To date we have developed a method for isolating the lung cells growing and subculturing them by exposure of these cells in vitro or by injection of carcinogenic agents in vivo followed by the isolation of the cells in vitro. We have thus far been able to produce lung cancer in a petri dish. We expect to quantitate this process, identify the types of lung cancer induced and eventually develop a quantitative and qualitative understanding of the carcinogenic effects of energy-related by-products.
Keywords: CARCINOGENESIS; HEALTH HAZARDS; MICE; LUNGS; NEOPLASMS; EARTH ATMOSPHERE; FOSSIL FUELS; NUCLEAR ENERGY; IONIZING RADIATIONS; RADIOACTIVE EFFLUENTS; CHEMICAL EFFLUENTS; BIOASSAY; BIOLOGICAL MODELS.

87532 Genetic Regulation and Nucleic Acid Chemistry. Wiberg, J.S. (University of Rochester Medical Center, Department of Radiation Biology and Biophysics, Rochester, NY, 14642). **Project number:** 000373. **Contract:** EY-76-C-02-3490. **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$114,000.
R and D categories: Health effects.

The objectives are: (1) to understand how a simple organism, the bacterial virus T4, expresses its genes; and (2) to determine the usefulness of this organism as a test organism for evaluating the responses of living cells to radiation or environmental chemicals. Using regA T4 mutants and E. coli, studies of T4 protein synthesis has been made. Purified coli ribosomes have been isolated after T4 infection. Electron microscopy of phage particles and DNA permits heteroduplex analysis. RNA and DNA synthesis have been studied in cells with ts 45, regA containing cells. Syntheis of the regA protein is self regulated. Late RNA synthesis is markedly reduced, while DNA synthesis is nearly normal in ts 45, regA containing cells.
Keywords: NUCLEIC ACIDS; BIOCHEMISTRY; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; BIOLOGICAL RADIATION EFFECTS; DNA; BACTERIA; VIRUSES; ESCHERICHIA COLI; BIOCHEMICAL REACTION KINETICS.

87539 Health Studies: Exposure to External and Internal Radiation, Low-Level Plutonium, Transplutonium and Fission Products, and Fission Products and Other Elements Studies. Rieben, M.G. (University of Utah, Radiobiology Laboratory, Building 522, Salt Lake City, UT, 84112). **Project number:** 000439. **Contract:** EY-76-C-02-0119. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$420,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The general services group is a multi-purpose division and provides the following services to the laboratory: administration, microphotography, biostatistics, computer services, and equipment development and repair. All sections of this group provide services within the group as well as to all other groups in the laboratory.
Keywords: PLUTONIUM; TRANSPLUTONIUM ELEMENTS; FISSION PRODUCTS; HEALTH HAZARDS; NUCLEAR INDUSTRY; RISK ASSESSMENT; ACTINIDES.

87540 Health Studies: Exposure to External and Internal Radiation, Low-Level Plutonium, Transplutonium and Fission Products, and Fission Products and Other Elements Studies. Jee, W.S.S. (University of Utah, Radiobiology Laboratory, Building 522, Salt Lake City, UT, 84112). **Project number:** 000441. **Contract:** EY-76-C-02-0119. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$200,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objectives are: (1) evaluation of the local dosimetry of bone-seeking radionuclides; (2) prediction of the radiation risk to humans from occupational and environmental exposure from animal data; and (3) assistance to governmental organizations on questions of the risk to man from the above bone-seeking radionuclides, especially plutonium. The microdosimetry will be evaluated of internally deposited radionuclides in beagles and rodents to the cell at risk after having determined the cells at risk in the induction of bone tumors by internally deposited radionuclides. The effect of Pu-239 in man from the observed toxicity of Ra-224 and Ra-226 in man and the ratio of Pu/Ra toxicity in beagles will be predicted using the improved dosimetry.
Keywords: PLUTONIUM 239; RADIUM 224; RADIUM 226; TOXICITY; BEAGLES; DOSIMETRY; RODENTS; SKELETON; NEOPLASMS; RADIOINDUCTION; HEALTH HAZARDS; RISK ASSESSMENT; PERSONNEL; FISSION PRODUCTS; TRANSPLUTONIUM ELEMENTS; RADIONUCLIDE KINETICS; LOW DOSE IRRADIATION; AIR POLLUTION.

87541 Health Studies: Exposure to External and Internal Radiation, Low-Level Plutonium, Transplutonium and Fission Products, and Fission Products and Other Elements Studies. Stevens, W. (University of Utah, Radiobiology Laboratory, Building 522, Salt Lake City, UT, 84112). **Project number:** 000442. **Contract:** EY-76-C-02-0119. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$130,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The function of the chemistry group is to determine the retention, distribution (whole body and intra-organ) of the various radionuclides being studied within the laboratory, especially Pu-239. Studies of the biological endpoints, acute and chronic, which occur following the injection of these various nuclides, will continue.
Keywords: PLUTONIUM; TRANSPLUTONIUM ELEMENTS; FISSION PRODUCTS; NUCLEAR INDUSTRY; HEALTH HAZARDS; RISK ASSESSMENT; RADIONUCLIDE KINETICS.

87542 Health Studies: Exposure to External and Internal Radiation, Low-Level Plutonium, Transplutonium and Fission Products, and Fission Products and Other Elements Studies. Taylor, G.N. (University of Utah, Radiobiology Laboratory, Building 522, Salt Lake City, UT, 84112). **Project number:** 000443. **Contract:** EY-76-C-02-0119. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$583,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objectives are: (1) provision of animal care and veterinary services for a beagle colony of approximately 850 animals; (2) evaluation of the health status of each animal at sufficiently frequent intervals to define the radiation induced and/or spontaneous syndromes; (3) radionuclide distribution studies in soft tissues; and (4) evaluation of liver toxicity induced by Pu-239. The required animal care will be provided so as to be able to continue the provision of experimental animals as required. The updating of the data base on the current animals in the various studies being pursued in the laboratory will be continued.
Keywords: PLUTONIUM; TRANSPLUTONIUM ELEMENTS; FISSION PRODUCTS; RISK ASSESSMENT; NUCLEAR INDUSTRY; RADIONUCLIDE KINETICS; BEAGLES.

87543 Health Studies: Exposure to External and Internal Radiation, Low-Level Plutonium, Transplutonium and Fission Products, and Fission Products and Other Elements Studies. Mays, C.W. (University of Utah, Radiobiology Laboratory, Building 522, Salt Lake City, UT, 84112). **Project number:** 000445. **Contract:** EY-76-C-02-0119. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$138,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objectives are: (1) evaluation of the retention, distribution and dosimetry of internally deposited radionuclides; (2) prediction of the radiation risk to humans from occupational and environmental exposure; (3) safe removal of radionuclides from the body; and (4) assistance to US DOE and other organizations on questions of the risk to man from radiation, especially plutonium.
Keywords: PLUTONIUM; TRANSPLUTONIUM ELEMENTS; FISSION PRODUCTS; LOW DOSE IRRADIATION; RADIONUCLIDE KINETICS; NUCLEAR INDUSTRY; RISK ASSESSMENT; MAN; BIOLOGICAL RADIATION EFFECTS; GENETIC RADIATION EFFECTS.

87548 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:** Characterization, measurement, and monitoring.

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 characteriza-

tion 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.

87549 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:** Characterization, measurement, and monitoring.

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.

87553 Combatting Detrimental Effects. Mays, C.W.; Stere. (University of Utah, Salt Lake City, UT). **Project number:** 001966. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$57,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Research on decorporation of Pu-239 and other actinides and toxic metals is directed toward two main goals: (1) improved application of known agents, and (2) development of new, more effective and more specific chelons. Research includes: the development of safer, more effective removal of actinides with possible application to non-radioactive pollutant metals; optimization of immediate therapy; safety and efficacy of prolonged treatment of fixed and massive burdens; and elimination of radiotoxins undergoing in-vivo translocation and its effect on tumor induction, acute toxicity and teratogenicity, and slow release theory. Knowledge of properties of present generation chelons will be used to design and synthesize new agents, including polyaminocarboxylic acids (PACA's) with balanced hydrophilic and lipophilic properties which can readily enter cells (alkyl- and alkyl-aryl substituted PACA's), fatty acid substituted PACA's for enhanced organ specificity, alkyl-phosphonic acid derivatives for enhanced hard tissue specificity, crown-ethers with cavities and functional groups suitable for actinide binding, and mixed ligand chelation. In-vitro and in-vivo screening of old and new chelons for efficacy will be performed.
Keywords: PLUTONIUM 239; DECONTAMINATION; ACTINIDES; METALS; THERAPY; RADIOTOXINS; REMOVAL; TRANSLOCATION; TOXICITY; TERATOGENESIS; CHELATING AGENTS.

87554 Biochemistry of SO2 in Plants. Filner, P. (Michigan State University, East Lansing, MI). **Project number:** 002191. **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:** Physical and chemical processes and effects.

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 tasks research are: (1) determine susceptibility of crop plant cultivars in order to obtain cultivars with differing sensitivity to HSO3- (SO2 dissolved in H2O); (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) using the apparatus, determine which resistant 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; BIOCHEMICAL REACTION KINETICS; TOXICITY; COAL INDUSTRY; PLANTS; METABOLISM; ENVIRONMENTAL IMPACTS; ENVIRONMENTAL EFFECTS; NITRIC ACID; SENSITIVITY; CROPS; RADIOACTIVITY.

87555 Area Program in Population Genetics. Neel, J. (University of Michigan, Ann Arbor, MI). **Project number:** 002208. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$820,000.
Related energy source: all(100). **R and D categories:** Health effects.
Keywords: POPULATION DYNAMICS; HUMAN POPULATIONS; GENETICS; REGIONAL ANALYSIS; MAN.

87557 Effects 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.A000. **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$37,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

This project investigates interactions between leukemia causing viruses and chemical carcinogens. The relationship between time of exposure to the chemical carcinogen versus the viral carcinogen will be compared. The level of immune response after exposure to chemical carcinogens and its relation to cancer development are to be evaluated, and the role of chemical carcinogens in enhancing viral leukemogenesis in what are normally viral resistant mouse strains is to be examined. The question of whether some cancer development upon exposure to chemical carcinogens may be traceable to virus-chemical interactions will be defined. The effect of chemical carcinogens on immune response will be delineated.
Keywords: LEUKEMIA VIRUS; CARCINOGENS; CHEMICAL EFFLUENTS; IMMUNOLOGY; SULFATES; HYDROCARBONS; SYNERGISM; BIOLOGICAL EFFECTS; ONCOGENIC VIRUSES; BLOOD FORMATION.

87558 Study of the Physiological Function and Histological Changes of Thyroids Irradiated with Radioactive Iodine. Dobyns, B.M. (Case Western Reserve University, 3395 Scranton Road, Cleveland, OH, 44109). **Project number:** 006014. **Contract:** EY-76-S-02-1784. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objective is to study the effects of radioiodines on the thyroids of man and animals with special emphasis on the latent effects, whether from fallout, diagnostic or therapeutic use. The behavior of therapeutic doses of radioiodine will be studied in man when given and then later the thyroid failure and the ultimate failure of cell replication will be studied. The development of tumors in patients previously so treated or in the Marshallese who have been developing tumors from radioiodines in fallout will be studied. The small doses of 131-I which produce tumors in the thyroid will be explored in animals (rats) and the nature of those tumors will be studied with special attention to the nature of their evolution. An experimental model has been discovered in rats which produces a high incidence of tumors. The inception and sequence of development of the tumors has been explored. Much has been learned of how the tumors evolve. A high incidence of breast tumors has been found incidentally in these irradiated rats. This is to be explored further. New cases of thyroid tumors are being found in studies in the exposed Marshallese each year.
Keywords: THYROID; PHYSIOLOGY; PATHOLOGICAL CHANGES; BIOLOGICAL RADIATION EFFECTS; IODINE 131; RADIONUCLIDE KINETICS; RADIOTHERAPY; MAN; ANIMALS; RATS; LOW DOSE IRRADIATION.

87564 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: fossil fuels(20); coal(40); oil shales and tar sands(10); hydroelectric(10); solar(10); other advanced(10). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

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.

87569 Metabolism of Sr-90 and of Other Elements in Man. Spencer, H. (Loyola University, Chicago, IL). **Project number:** 006048. **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:** Health effects.

The objective of this investigation in humans is to determine the metabolism of several non-radioactive substances as well as of radioactive strontium (90-Sr) which are present in the environment and enter the human food chain. The metabolism of cadmium, lead, copper, zinc, manganese, and nickel will be determined in the diet and the subsequent disposition of these elements, i.e., the pathways and the extent of the excretions in urine and stool will be determined. The effect of different intake levels of calcium and phosphorus on these excretions will be studied. Similarly, the dietary intake and the excretions of 90-Sr will be determined and the usefulness of certain methods will be explored which can inhibit the intestinal absorption of 90-Sr in man and enhance its removal from the human body.
Keywords: STRONTIUM 90; RADIONUCLIDE KINETICS; METABOLISM; HUMAN POPULATIONS; FOOD CHAINS; CADMIUM; LEAD; COPPER; ZINC; MANGANESE; NICKEL; DIET; ENVIRONMENTAL EXPOSURE PATHWAY; RADIONUCLIDE MIGRATION; CALCIUM; PHOSPHORUS; SYNERGISM; INTESTINAL ABSORPTION; INHIBITION; DECONTAMINATION; CONTAMINATION.

87575 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: conservation(100). **R and D categories:** Health effects.

This investigation of radiation 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. The asbestos samples, Canadian and Rhodesian, have been obtained from the UICC standard supply. Methylcholanthrene and phenylhydrazine will also be used in combination with radiation and with asbestos. The asbestos is injected intratracheally, intrapleurally and intraperitoneally in both rats and mice. It will be given orally to the animals treated with phenylhydrazine. We, in collaboration with others, are studying two endocrine tumors induced by radiation, one a pheochromocytoma, the other an insulinoma. These actively secrete their respective hormones and are readily transplantable in the NEDH strain of rat.
Keywords: BIOLOGICAL RADIATION EFFECTS; GENETIC RADIATION EFFECTS; CARCINOGENESIS; BIOLOGICAL MODELS; RADIOINDUCTION; MICE; RATS; LEUKEMIA; TUMOR CELLS.

87576 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:** EY-76-S-02-3380. **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$64,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objective of the project is to establish the form of the dose-response curve in radiation carcinogenesis with special reference to comparing the oncogenic effectiveness of different types of radiation and for defining as quantitatively as possible the significance of dose rate in estimating risks. The rat skin has been utilized as a reproducible model system for investigation of radiation carcinogenesis. The radiation is localized to the skin and the response pattern has been characterized for electrons, protons, and other heavy ions including argon. Experiments are designed and conducted within the context of a specific empirical model where parameters of the dose response and recovery are measured in animals. It is expected that the results will provide a better understanding of the significance of recovery processes in dose rate effects and more precise information about the magnitude of a possible linear term in the response at low doses.
Keywords: ALPHA PARTICLES; BETA PARTICLES; ELECTRON BEAMS; PROTON BEAMS; ELECTRON BEAMS; BIOLOGICAL RADIATION EFFECTS; SKIN; CARCINOGENESIS; NEOPLASMS; RADIOINDUCTION; ION BEAMS; ANIMALS; BIOLOGICAL RECOVERY; DOSE-RESPONSE RELATIONSHIPS; BIOLOGICAL MODELS.

87577 Radioactivity Studies. Wrenn, M.E. (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:** Health effects.

We will concentrate on metabolic studies of the bone-seeking radionuclides, Am-241, Cm-244, Pb-210, and Po-210 in hopes of defining the extent to which radon and radon daughter exposures contribute to the increased magnitude of uranium mining hazards. Topics in this category include: (1) measurement of the disposition and retention of Pb-210 body burdens in former uranium miners, (2) establishment of a uranium miner study group for epidemiological measurements relating adverse health effects to radiation exposure, (3) provocative chelation techniques (EDTA) for measuring Pb-210 in former uranium miners and in adult baboon, and lastly (4) Pb-210 metabolism in the adult male baboon. Health risks from future nuclear technology including breeder-type reactors which both utilize and generate potentially toxic, alpha-emitting bone-seeking actinides such as Pu, Am, and Cm will be studied.
Keywords: RADIOACTIVITY; RADIONUCLIDE KINETICS; AMERICIUM 241; CURIUM 244; LEAD 210; POLONIUM 210; NUCLEAR FUELS; FUEL CYCLE; RADON; DAUGHTER PRODUCTS; BODY BURDEN; URANIUM MINES; PERSONNEL; HEALTH HAZARDS; MINERS; CHELATING AGENTS; BIOASSAY; METABOLISM; LIVER; URANIUM; HEALTH HAZARDS.

87583 Uranium Miner Lung Cancer Study. Saccomano. (St. Mary's Hospital, Grand Junction, CO). **Project number:** 006089. **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:** Health effects.

This proposal is a continuation of Contract No. E(11-1)-1826 on the uranium miner studies and embraces the following projects: (1) continuation of sputum collection and collection of lungs from deceased miners; (2) predictive analytical study of sputum samples taken from individual miners over several years; (3) the uranium miners lung study; (4) collection of material from uranium miners known to have cancer of the lung into a tumor registry; (5) manual on pulmonary cytology; (6) regression study of sputum cytological findings in uranium miners who showed marked atypical squamous cell metaplasia and have quit smoking cigarettes, mining, or both; and (7) adjoining doctors Huth and Profio on the development of

ultraviolet fiberoptic bronchoscope which will be used with the Mayo Clinic group in the localization of early cancer of the lung. In addition, although not supported by the Department of Energy, a study on the effects of vitamin A derivative (13-CIS retinoic acid) is being conducted.
Keywords: URANIUM MINES; MINERS; LUNGS; NEOPLASMS; CYTOLOGY; DIAGNOSTIC TECHNIQUES; VITAMIN A; OCCUPATIONAL DISEASES; HEALTH HAZARDS.

87585 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, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$60,000.
Related energy source: coal(25); oil and gas(25); nuclear fuels(general)(50). **R and D categories:** Health effects.

The objective is to study the effects of potentially toxic agents on the mammalian embryo. A major portion of these investigative efforts involves studying the effects of intrauterine x-irradiation exposure on adult life expectancy and the frequency of adult malignancy. Other radiation embryologic projects include threshold determination for radiation-induced congenital malformations, the mechanisms involved in radioinduced embryonic death and embryonic malformations, the importance of yolk sack radiation and four other radiation embryology projects using in vivo and in vitro systems. Pregnant rat and mouse embryos are exposed to x-irradiation at various stages of embryonic development. Biochemical, pathological, immunological, histological and morphologic techniques are used to describe in great detail the qualitative and quantitative aspects of embryonic radiation exposure. Besides laboratory animal experiments, an in vitro embryo culture technique will be used to study the effect of embryotoxic agents during the period of organogenesis. This will permit us to better evaluate the significance of changes in the cultured embryo, since we have an extensive experience with prognostic implications of pathological findings in the embryo grown in vivo. The data from the human epidemiological study involving diagnostic radiation exposure is obtained from referrals to our research center from all over the country.
Keywords: EMBRYOS; X RADIATION; GENETIC RADIATION EFFECTS; TERATOGENESIS; RADIOINDUCTION; RADIOSENSITIVITY; RATS; MICE; LIFE SPAN; NEOPLASMS.

87592 Use of Lymphoblastoid Cells for the Estimation of Environmental Insults to DNA. 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects; Ecological/biological processes and effects.

We are interested in the response of cells exposed to low doses of activated polycyclic aromatic hydrocarbons (PAH). We want to quantitate the amount of reaction, to develop precise methods for estimating the activity of the excision repair pathways for PAH, to learn what regulates their activity, and whether the activity is affected by chronic exposure. We want to extend the observation that human cells can replicate best PAH adducts, to set quantitative limits to the amount of PAH that can be tolerated, and to learn how the bypass reactions occur and why they are associated with mutagenesis and carcinogenesis. We propose to attain these goals in part, by development of a radioimmunoassay for PAH-reacted DNA which when combined with BND cellulose method for excition repair synthesis should permit kinctic study of repair in human lymphoid cells. We also propose to adapt a method for studying mutation based on autoradiographic analysis of thioguanine resistant individual cells. We have developed the use of benzoylated naphthoylated DEAE cellulose for the estimation of excision repair activity and have shown increased repair at DNA growing points after MNNG treatment. There is a correlation between excision repair activity and capability for DNA synthesis in human lymphocytes. Nucleotide and base excision differ in that single strand breaks accumulate only in base excision-apurinic repair.
Keywords: DNA; MUTAGENESIS; POLYCYCLIC AROMATIC HYDROCARBONS; TOXICITY; ANIMAL CELLS; CHRONIC EXPOSURE; TOLERANCE; CARCINOGENESIS; BIOLOGICAL MODELS; BIOLOGICAL EFFECTS; MAN; BIOLOGICAL REPAIR; LYMPHOCYTES.

87599 NMR Studies of Radiation Damage. Box, H.C. (Roswell Memorial Park Inst., Buffalo, NY). **Project number:** 006199. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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 Dr. Box has developed 13-C nmr spectroscopy in conjunction with 13-C enrichment procedures as a means for identifying the final radiation products. Thus he now has 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. Also Dr. Box has studied alkoxy radicals which he believes should be important radiation products coming from the sugar moiety of DNA. Finally he has applied his techniques to study oxidation-reduction processes in a model of photosynthesis viz. an octahedral complex of iron.
Keywords: RADIATION INJURIES; NUCLEIC ACIDS; RADIOLYSIS; DNA; BIOLOGICAL RADIATION EFFECTS; BIOCHEMICAL REACTION KINETICS; IONIZING RADIATIONS; NUCLEAR MAGNETIC RESONANCE.

87603 Research on Human Genetics in Iceland. Fridriksso. (Genetical Committee of Iceland, Reykjavik, Iceland). **Project number:** 006208. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: all(100). **R and D categories:** Health effects.

The Icelandic demographic data are being used for various hereditary and social studies. The data consist of some 313,000 birth records covering the whole nation from 1840 as well as marriage records, the national registry, and death records. A large number of individuals have been manually linked into families. A program for arranging all the data on an IBM 370 Model 30 computer has been proposed. To the demographic data are added various information about the individual, such as blood groups, various proteins, diseases and disabilities, and cause of death. Karyotypes of over 900 individuals have also been analyzed. In a collaborative effort by various institutes, 135 first-cousin marriage families have been analyzed for chromosome linking of various genetic markers and possible inheritance of various characteristics. A study of familiality of breast cancer was continued and an investigation was started on a possible family aggregation of ischemic disease in Iceland. A study of assortative mating was carried out in relation to intelligence as indicated by mean score achieved at final examination from elementary school. Furthermore, the relation between mean scores of parents and children was investigated and the relation between intelligence and mental health was studied by comparing these records with the psychiatric register.
Keywords: ICELAND; HUMAN POPULATIONS; GENETICS; POPULATION DYNAMICS; EPIDEMIOLOGY; SOCIOLOGY; DATA ACQUISITION; DATA ANALYSIS; BEHAVIOR.

87612 Chemical and Radiation Carcinogenesis: Basic Mechanisms and Establishment of Biomedical Risk Assessment System. 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The objective is to investigate the basic mechanisms of chemical and radiation carcinogenesis so as to establish a biomedical risk assessment system for humans based on fundamental research. The biomedical risk assessment system depends on the construction of a universal biomedical risk equivalent system which, in turn, is based on 7 or 8 information matrices. These matrices are: (1) type of perturbation; (2) DNA damage; (3) alteration in organization and expression of genome; (4) somatic mutation; (5) neoplastic/malignant transformation; (6) correlation of in vitro--in vivo results; (7) hamster/human correlation; and (8) correlation between human individuals and human populations.
Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; BIOCHEMICAL REACTION KINETICS; RISK ASSESSMENT; HEALTH HAZARDS; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; BIOLOGICAL RADIATION EFFECTS; DNA; NEOPLASMS; HAMSTERS; MAN; HUMAN POPULATIONS.

87613 Chemical Study of the Effects of Radiation on Nucleic Acids and Related Compounds. 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:** Health effects.

Several years ago a laboratory study was launched which sought to understand radiobiology at a molecular level by using a novel approach. It is an attempt to establish a correlation between a particular radiation product and its biological effects. This fundamental information is essential in dealing knowledgeably with human health hazards. 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: NUCLEIC ACIDS; BIOLOGICAL RADIATION EFFECTS; X RADIATION; CHROMOSOMAL ABERRATIONS; MUTATIONS; RADIOINDUCTION; HEALTH HAZARDS; DNA; BIOSYNTHESIS; RNA; GAMMA RADIATION; MUTAGENESIS; MOLECULAR BIOLOGY; CORRELATIONS; NUCLEOSIDES; SEPARATION PROCESSES.

87631 Neutron-Induced Mutation Experiments. Abrahams, S. (University of Wisconsin, Madison, WI). **Project number:** 006312. **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:** Health effects.

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. 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. Drosophila melanogaster females will be irradiated with neutrons over the range 0.34 to 15 MeV at doses ranging from 250 to 300 rad. Brooding procedures will be used to sample cells irradiated as gonia. X-linked lethal and specific locus mutation tests will be conducted.

Keywords: MUTATIONS; RADIOINDUCTION; NEUTRONS; RBE; GERM CELLS; DOSE-RESPONSE RELATIONSHIPS; DROSOPHILA; X RADIATION; BIOLOGICAL RADIATION EFFECTS; DNA.

87637 Effects of Environmental Stress on the Community Structure and Productivity of Salt Marsh Epiphytic Communities. Lee, J.J. (City College of New York, Department of Biology, New York, NY, 10031). **Project number:** 6338. **Contract:** E(11-1)-3254. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$61,000.

Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to analyze microbial and micrometazoan assemblages in greater New York City, and to establish realistic guidelines for management of the habitat surrounding New York City. The methods employed are to: (1) characterize shallow marine aufwuchs microbial and meiofaunal community structure; (2) study theoretical and realized niches of community organisms to understand regulation of population structure, succession, energy flow, and mineral cycling; (3) construct microcosms to be used to predict and interpret changes in the detritus food web and in coastal productivity as a result of inorganic, organic, thermal, herbicide, pesticide, or industrial pollution; and (4) develop model microcosms to be used as bioassay tools for judging water quality in inshore environments. The expected results include: (1) changes to community structure due to water quality, heavy metals, organochlorides, and water insoluble fractions from crude petrochemicals; (2) evaluation of effects of food quality and paschiness on energy flow, efficiency of secondary production and competition between microherbivores and meioherbivores; and (3) assessment of role of marine nematudes, copepods and ciliates in the detrions food chain of marine marsites including mineral cycling and concentration, energy flow, biological halflife and tropic efficiency estimation, food web complexion studies and special growth factors, and biotic potential.

Keywords: BIOLOGICAL STRESS; IONIZING RADIATIONS; THERMAL POLLUTION; METALS; WATER QUALITY; ORGANIC COMPOUNDS; PETROCHEMICALS; NEW YORK CITY; MARSHES; FOOD; MINERAL CYCLING; AQUATIC ECOSYSTEMS.

87638 Radioecology of Some Natural Systems. Whicker, F.W. (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO, 80523). **Project number:** 6341. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$99,000.

Related energy source: fossil fuels(20); nuclear fission(80). **R and D categories:** Ecological/biological processes and effects.

The objective of the project is to understand and predict the behavior of plutonium (Pu) in a grassland ecosystem, cesium in a mountain lake, and lead in an alpine watershed. Field research was conducted on the distribution, transport, characterization, and ecological consequences of plutonium in the terrestrial environs of Rocky Flats, Colorado. Studies of the geochemistry of stable lead were conducted in an alpine lake and of cesium kinetics in a montane lake of the front range of the Rocky Mountains. Data show that the order of Pu concentrations in components of the grassland ecosystem is soil >> litter > plants > animals. Soil contains more than 99% of the Pu present in the ecosystem. Plutonium dispersal mechanisms were evaluated in the grassland ecosystem and the semi-arid foothills environment. Wind dispersal of Pu is the predominant mechanism, but Pu movement via soil-borne particles is negligible when a native vegetative cover is maintained on contaminated areas. Plutonium dynamics and dispersal by resident mule deer were also found to be negligible.

Keywords: PLUTONIUM ISOTOPES; RADIOECOLOGICAL CONCENTRATION; ENVIRONMENTAL TRANSPORT; TERRESTRIAL ECOSYSTEMS; RADIONUCLIDE MIGRATION; FOOD CHAINS; SOILS; PLANTS; ANIMALS; RADIOECOLOGY; CESIUM ISOTOPES; RADIONUCLIDE MIGRATION; LAKES; RADIOECOLOGICAL CONCENTRATION; FOOD CHAINS; RADIOECOLOGY; LEAD; ECOLOGICAL CONCENTRATION; WATERSHEDS; BIOGEOCHEMISTRY; LAKES; MINERAL CYCLING.

87640 Transport and Transfer Rates in Waters off the Continental Shelf. Biscaye, P.E. (Columbia University, Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 6345. **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: all(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87641 Foodchains of Transuranium Elements in the Subarctic Environment. Miettinen, J.K. (University of Helsinki, Unioninkatu 35, Helsinki). **Project number:** 6361. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

Purpose of the proposed project is to study the movement and dynamics of transuranic elements in the subarctic environment. Plutonium and americium are generally considered to cause a risk to higher animals and man only via inhalation in general environmental conditions. This is not true in communities based on raindeer economy. The reindeer obtains the bulk of these transuranium elements via fodder (lichen) and reindeer herders obtain an important part of their intake via reindeer liver and meat. This offers a unique opportunity to study a transuranium foodchain in fully natural conditions. Baltic studies will be carried out to have background values of transuranic elements in the hydrospheric foodchains of the Baltic Sea. Studies of transuranic isotopes Pu-238, Pu-239, Pu-240, and Am-241 in lichen, in organs of reindeer and in lung, liver, bone, placenta, and teeth of man will be carried out to elucidate absorption, transfer and elimination of these radionuclides in the organisms of the foodchain lichen--reindeer--man. Elk will be analyzed as comparison for reindeer. Sr-90 and Pb-210 will be analyzed in bones as markers of man-made and natural fallout. The same transuranic radionuclides will be analyzed also in marine sediment cores from the Baltic Sea. Age determination of the sediment layers will be made by the Pb-210 method

Keywords: FOOD CHAINS; CONTAMINATION; ARCTIC REGIONS; TRANSURANIUM ELEMENTS; RADIONUCLIDE MIGRATION; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM 240; AMERICIUM 241; LICHENS; DEER; RADIONUCLIDE KINETICS; MAN; STRONTIUM 90; LEAD 210; FALLOUT; SEDIMENTS; BALTIC SEA; AGE ESTIMATION; ENVIRONMENTAL EXPOSURE PATHWAY.

87643 Biogeochemistry of Trace Metals in Chesapeake Bay. Gross, M.G. (Johns Hopkins University, Chesapeake Bay Inst., Baltimore, MD, 21218). **Project number:** 6364. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The research deals with biogeochemical processes that control the distribution and abundances of certain trace metals in Chesapeake Bay water and sediment. Work is being done to develop and perfect analytical techniques for minor elements in interstitial waters with emphasis on Hg, Cd, and Cu. Particular attention will be given to processes that transport these metals across the water-sediment interface and into the overlying waters. Fine grained, slow-settling particles in bay waters will be studied to determine what fraction is derived from interstitial waters and from other sources such as power plant cooling waters or from mine drainage. Chemical composition of particulate and associated aquatic phases will be determined in order to study the effects of different sources of metals and minerals (such as coal mine wastes or steam-electric generating plants) on waters and sediments of river, estuarine and marine systems.
Keywords: CHESAPEAKE BAY; MERCURY; CADMIUM; COPPER; ENVIRONMENTAL TRANSPORT; SAMPLING; CHEMICAL ANALYSIS; COOLING; WATER; ACID MINE DRAINAGE; ENVIRONMENTAL IMPACTS; WATER POLLUTION.

87644 Phytoplankton Growth, Dissipation and Succession in Estuarine Environments. Seliger, H.H. (Johns Hopkins University, McCollum--Pratt Institute, Baltimore, MD, 21218). **Project number:** 6365. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87645 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:** 6366. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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.

87649 Nutrient Enrichment and Entrophication of Lake Michigan. Schelske, C.L. (University of Michigan, Great Lakes Research Division, Ann Arbor, MI, 48109). **Project number:** 6378. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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.

87652 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:** 6381. **Contract:** EY-76-S-02-1332. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$94,000.
R and D categories: Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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.

87653 Accumulation and Transport of Minerals by Marine Protozoa. Gold, K. (New York Aquarium, Osborn Labs. of Marine Science, New York, NY, 11224). **Project number:** 6385. **Contract:** E(11-1)-3390. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

The amounts, sizes, chemical composition and the sources of the particulate materials utilized by various species of Tintinnida in building a lorica are being determined. Among the ciliated protozoa, the agglutinated Tintinnida have the unique ability to take up mineral particles in the size range of silts and incorporate them into their shells. The ecological significance of such mineral accumulation is twofold: (1) it is a source of biological concentration that could lead to rapid cycling of radionuclides, heavy metals, or other toxic substances from the sediments or water column to the biota; (2) the types and amounts of accumulated particles are expected to be helpful where the loricae are used as biological indicators, e.g.,

water movements or special environmental perturbations. Specimens are to be studied from stressed environments for comparisons with others from relatively clean, less perturbed habitats. Included will be specimens from thermally stressed areas, polluted environments, and an estuary, to determine whether lorica development in these habitats is affected in a way that modifies its mineral burden. Scanning electron microscopy and electron probe analysis are being used extensively in this study. A variety of methods of building loricae have been observed, and the principal types of materials accumulated are being characterized for species in different habitats. Quartz particles are the kinds most commonly found on the loricae of arenaceous tintinnids along the northeastern coast of the U.S.; CaCo/sub 3/ particles were detected agglutinated to specimens collected at Eniwetok. The agglomerated species appear to take up particles randomly; they include both biogenic fragments, such as diatom frustules, protozoan shells and coccoliths, and non-biogenic grains and flakes, probably quartz.
Keywords: PROTOZOA; MINERALS; PARTICLES; METABOLISM; BIOLOGICAL INDICATORS; BIOLOGICAL ACCUMULATION; RADIONUCLIDE KINETICS; RADIONUCLIDE MIGRATION; MINERAL CYCLING; SEDIMENTS; THERMAL POLLUTION; WATER POLLUTION; BIOLOGICAL STRESS; ECOLOGICAL CONCENTRATION; RADIOECOLOGICAL CONCENTRATION.

87656 Movement of Metal Cations Through the Soil to the Plant Root Membrane. Barber, S.A. (Purdue University, Agronomy Department, West Lafayette, IN, 47907). **Project number:** 6397. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$32,000.
R and D categories: Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine the principles and mechanisms involved in the movement of metal cations through the soil to the plant root, their absorption by the root and their translocation to the shoot. The reactions between metals and soil particles that influence their rates of diffusion are investigated. The absorption characteristics of plant roots are evaluated. A mathematical model of the process is developed and a computer program is written to define all of the steps involved.
Keywords: METALS; ROOT ABSORPTION; SOILS; ENVIRONMENTAL TRANSPORT; DIFFUSION; PLANTS.

87657 Fission and Alpha-Track Study of Biogeochemistry of Pu and U. Miller, D.S. (Rensselaer Polytechnic Institute, Department of Geology, Troy, NY, 12181). **Project number:** 6398. **Contract:** E(11-1)-3462. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$23,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of the project is to define the concentration and distribution of alpha emitters (plutonium, americium, and uranium) in carbonate materials from Bikini and Eniwetok Atolls. Samples will include various corals, corralline algae, and marine cements. The resultant data will be interpreted with the hope of defining more precisely the mobility and biogeochemistry of plutonium, americium, and uranium in the natural environment. Techniques were developed in our laboratory to measure the concentration of alpha emitters in the pCi/g range and to define the location of the alpha emitters in samples within a few microns based on the alpha-track detection method using cellulose nitrate. The cellulose nitrate detector is placed directly on the sample surface to be analyzed so that the alpha particles can be detected in a manner which allows the source of the alpha particles to be recognized. An understanding of the precise location of alpha emitters in samples from Bikini and Eniwetok is sought which should lead to a better capability of defining the biogeochemistry of the alpha emitters, especially plutonium.
Keywords: BIKINI; ENIWETOK; ENVIRONMENTAL MATERIALS; CARBONATES; CORALS; ALGAE; AQUATIC ECOSYSTEMS; RADIONUCLIDE MIGRATION; AMERICIUM ISOTOPES; PLUTONIUM ISOTOPES; URANIUM ISOTOPES; BIOGEOCHEMISTRY; SEDIMENTS; FISSION TRACKS; ALPHA DETECTION; CELLULOID; RADIATION MONITORING; RADIOECOLOGICAL CONCENTRATION.

87658 Biological Research on the Volcanic Island Surtsey and its Environs. Fridriksson, S. (Surtsey Research Society, P.O. Box 1238, Reykjavik). **Project number:** 6401. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
R and D categories: Characterization, measurement, and monitoring; Ecological/biological processes and effects.

This is a long-term program dealing with the ecology of terrestrial biota on Surtsey Island which was formed during an eruption in 1963, and also the effects of the volcanic activities on Heimaey that took place in January 1973. This study's objectives are to investigate the dispersal of various life forms on Surtsey and the ability of species to colonize its inert volcanic substrate. It is proposed to continue the study of colonization and spread of the various life forms on Surtsey as well as on the new lava on Heimaey and compare it with the ecosystems on the older islands in the Vestmannaeyjar archipelago. A number of lower and higher plants and animals have established themsleves on Surtsey. In 1973 there were 1273 vascular plants on the island. Three species of birds have nested on the island, of which the newest addition is the black-backed gull.
Keywords: ICELAND; TERRESTRIAL ECOSYSTEMS; VOLCANOES; PLANTS; ANIMALS; POPULATION DYNAMICS; BIRDS; ECOLOGY; CHEMICAL COMPOSITION; ISLANDS; GEOLOGIC STRATA; LAVA; ENVIRONMENTAL EFFECTS; TIME DEPENDENCE.

87659 Population Dynamics Movement and Home Range of Black Tailed Jackrabbits in Curlew Valley. Stoddart, L.C. (Utah State University, Dept. of Wildlife Science, Logan, UT, 84322). **Project number:** 6406. **Contract:** AT(11-1)-1329. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$17,000.
R and D categories: Characterization, measurement, and monitoring; Ecological/biological processes and effects.

Population ecology of the black-tailed jackrabbit population on a 250-square-mile area in Curlew Valley, Utah, has been studied from 1962 to 1974. In spring 1975, the studies were expanded to include a 450-square-mile portion of the Idaho National Engineering Laboratory. The main objective is to describe observed changes in jackrabbit density in terms of mortality and natality rates, to relate changes in these two parameters to variation in environmental factors, and to integrate the results into a mathematical model describing population change. Jackrabbit densities are estimated in spring and fall with 160 randomly located 1-mile transects. Natality rates are calculated from litter sizes and littering frequency per female as determined from results of monthly collections and autopsy of adult females. Mortality rates are calculated for the total population from fall-spring, for the adult population from spring-fall, and for the juvenile population from birth-fall census. Prenatal mortality is also estimated from autopsy of pregnant females. Mortality and natality rates are related through mathematical models to coyote/rabbit ratios, rabbit population density, and rodent biomass. Coyote and rodent densities are estimated using trap transects, trapping grids, scat lines and scent-post lines.
Keywords: RABBITS; ECOLOGY; POPULATION DYNAMICS; MATHEMATICAL MODELS; UTAH; BIOMASS; TERRESTRIAL ECOSYSTEMS; BEHAVIOR.

87660 Exchange of Lyotropic Series Cations by Micaceous Vermiculite and Its Weathering Products Determined by Electron Microscopy and Radiochemical Analysis. Jackson, M.L. (University of Wisconsin, Department of Soil Science, 1525 Observatory Drive, Madison, WI, 53706). **Project number:** 6422. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$27,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to investigate mica weathering to vermiculite in relation to retention of radioactive cations of fission origin; relate adsorption and fixation of 137-Cs+ to layer charge and steric configuration in crystallographic wedges and of 90-Sr2+ adsorption on associated hydrous metal oxides; and trace sources of aerosolic dusts that fix 137-Cs+, other fission products, and uranium. Naturally weathered micaceous vermiculites of soils are being tested by saturation with various fixing cations (K+, Rb+, Cs+) and non-fixing control cations (Li+, Na+), and measurements of retention are being carried out by beta and gamma ray counting. Hydrous oxides of iron and aluminum, fresh and variously aged to model soils, are being tested for retention of a wide variety of divalent cations common in fission products, applied in trace amounts (10/sup -3/ to 10/sup -7/M). Marker minerals such as quartz, from dusts containing micaceous vermiculite, are being subjected to mass spectrometry of oxygen isotopes and neutron activation analysis for signature trace elements in order to learn the source of the formations and their movement in relation to past climates and possible prediction of the distant future nature of waste product disposal and nuclear plant sites.
Keywords: RADIOACTIVE WASTE DISPOSAL; MICA; WEATHERING; CESIUM 137; STRONTIUM 90; VERMICULITE; UNDERGROUND DISPOSAL; ADSORPTION; SOILS; IRON OXIDES; ALUMINIUM OXIDES; RADIONUCLIDE MIGRATION.

87661 Radioelement Studies in the Ocean. Bowen, V.T. (Woods Hole Oceanographic Institution, Woods Hole, MA, 02543). **Project number:** 6423. **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: fossil fuels(25); nuclear fission(75). **R and D categories:** Characterization, measurement, and monitoring; Physical

and chemical processes and effects; Ecological/biological processes and effects.

A long-standing study trying to lay the basis for prediction of the movements, rates and fates of long lived artificial radionuclides introduced into marine environments is conducted. This obviously requires clarification of the basic geochemical and biological processes in which they participate. Measurements are made both of soluble tracers like strontium-90 and cesium-137, and of largely particulate tracers like iron-55 and the transuranic nuclides. Samples of water (all depths), aerosols, biota and sediments are analyzed routinely for Sr-90, Cs-137, Fe-55, Pu-238, Pu-239, Pu-240, and Am-241. Special cases are also analyzed for Pu-241, Am-242m, Cm-242, Cm-244, and many others. Stable element analyses are made by a wide variety of techniques. Although most of the study refers to fallout nuclides, waste disposal situations and experimental introductions are also studied.

Keywords: STRONTIUM 90; CESIUM 137; IRON 55; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM 240; AMERICIUM 241; PLUTONIUM 241; AMERICIUM 242; CURIUM 242; CURIUM 244; METASTABLE STATES; RADIONUCLIDE MIGRATION; RADIOECOLOGICAL CONCENTRATION; TRACER TECHNIQUES; SEAWATER; AQUATIC ORGANISMS; AEROSOLS; SEDIMENTS; ATLANTIC OCEAN; CHEMICAL ANALYSIS; SAMPLING.

87663 Plutonium and Americium Concentrations Along Freshwater Food Chains of the Great Lakes. Bowen, V.T. (Woods Hole Oceanographic Institution, Department of Chemistry, Woods Hole, MA, 02543). **Project number:** 6425. **Contract:** AT(11-1)-3568. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$93,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

We will continue to measure plutonium and americium radionuclides from fallout in the water, sediments and biota of Lake Ontario; also, we will begin to investigate non-fallout sources of transuranic nuclides in this lake, and in the materials supplied from Lake Erie to the Niagara River fan. In the process of evaluating the significance of the transuranic elements to questions of public health, water quality, and environmental effects, it is important to estimate their trajectories and rates of movement from such point-sources as shore-based nuclear reactors or nuclear fuel services. It is also important to estimate more accurately the rates of back diffusion of transuranics from lake sediments, and to establish the chemistry responsible for this process. A certain number of measurements of strontium 90, cesium 137, or iron 55 have proved very useful in interpreting the distributions of the transuranic elements.
Keywords: PLUTONIUM; AMERICIUM; RADIONUCLIDE MIGRATION; RADIOECOLOGICAL CONCENTRATION; CONTAMINATION; FALLOUT; WATER POLLUTION; MONITORING; NUCLEAR INDUSTRY; ENVIRONMENTAL IMPACTS; LAKE ERIE; LAKE ONTARIO; CESIUM; FOOD CHAINS.

87664 Distribution of Some Chemical Elements Between Particulate and Dissolved Phases in Sea Water. Spencer, D.W. (Woods Hole Oceanographic Institution, Woods Hole, MA, 02543). **Project number:** 6427. **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: fossil fuels(25); nuclear fission(75). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to describe and understand the mechanisms controlling the distribution of trace elements in the ocean. A major factor in the distribution of non-conservative species is their interaction with and transfer by particulate phases both biogenic and inorganic. During the coming year, complete analyses of Pb-210, Po-210 and several stable trace elements on particulate matter and water of samples collected from the Gulf of Maine in January 1975 are planned. An attempt will be made to describe the rate at which trace elements are cycled within a silled basin in the Gulf of Maine. As a further extension of the continental shelf studies, participation in the FLEX 76 program, a major international cooperative effort to study the onset and development of a planktor bloom in the North Sea, is planned.
Keywords: SEAWATER; SEAS; TRACE AMOUNTS; LEAD 210; POLONIUM 210; GULF OF MAINE; COASTAL WATERS; DISTRIBUTION; RADIOECOLOGICAL CONCENTRATION; RADIONUCLIDE MIGRATION; PHYTOPLANKTON; AQUATIC ECOSYSTEMS; WATER POLLUTION; FOOD CHAINS; ATLANTIC OCEAN; CONTINENTAL SHELF; MATHEMATICAL MODELS.

87666 Trace Elements in Natural Waters. Turekian, K.K. (Yale University, Dept. of Geology and Geophysics, New Haven, CT, 06520). **Project number:** 6430. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87668 Atmospheric Pollution Scavenging. Semonin, R.G. (Illinois State Water Survey, Box 232, Urbana, IL, 61801). **Project number:** 6440. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this project are to determine the time and space variability of precipitation quality and deposition over a microscale region and to operate one of the eight MAP3S precipitation chemistry network sites. A network encompassing 150 square-km with event samples spaced 1 mile apart was established in central Illinois. Event and subevent precipitation and aerosol sampling for major ions and pH is conducted. Precipitation chemistry and aerosol composition data will be interpreted to improve the parameterization of precipitation scavenging in MAP3S regional transport models and to better quantify the roles of in-cloud and below-cloud scavenging processes.
Keywords: EARTH ATMOSPHERE; PRECIPITATION SCAVENGING; MATHEMATICAL MODELS; ACID RAIN; AEROSOLS; AIR POLLUTION; CHEMICAL COMPOSITION; METEOROLOGY; CLOUDS.

87669 Global Transport Processes and Interactions with Trace Constituents. Newell, R.E. (Massachusetts Inst. of Technology, Department of Meteorology, Cambridge, MA, 02139). **Project number:** 6443.. **Contract:** EY-76-S-02-2195. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

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.

87670 Rain Scavenging Studies. Dingle, A.N. (University of Michigan, Department of Meteorology and Oceanic Science, Ann Arbor, MI, 48109). **Project number:** 6447. **Contract:** EY-76-S-02-1407.A001. **Supported by:** Department of Energy, Washington, DC

(USA). Office of Health and Environmental Research. **Funding:** DOE-$33,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objectives of this work are to improve the capability to parameterize precipitation scavenging into numerical cloud physics and atmospheric transport models and to apply and test these models to various meteorological situations to predict precipitation removal of pollutants.
Keywords: RAIN; PRECIPITATION SCAVENGING; MATHEMATICAL MODELS; AIR POLLUTION; ENVIRONMENTAL TRANSPORT; METEOROLOGY; REMOVAL.

87671 Electrical Charging of Small Particles at Low Pressures. Liu, B.Y.H.; Whitby, K.T. (University of Minnesota, Mechanical Engineering Department, Particle Technology Laboratory, Minneapolis, MN, 55455). **Project number:** 6448. **Contract:** EY-76-S-02-1248. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$42,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objectives of this project have been to develop a better understanding of the role of electrical charges on the dynamics of aerosols, their role in aerosol generation and their basic applicability to sampling and analysis instrumentation. The current effort will emphasize further development of a new concept, the Aerosol Mobility Chromatograph, which, using previously developed theory and principles, will result in an improved instrument with increased size and mass sensitivity for the detection of sulfate aerosols.
Keywords: AEROSOLS; ELECTRIC CHARGES; MECHANICS; AIR POLLUTION; CHROMATOGRAPHY; SULFATES; AIR POLLUTION MONITORS.

87672 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). **Project number:** 6450. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 > 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.

87676 Dosimetry of Ionizing Radiation, Radiation Physics, and Radiobiology. Rossi, H.H. (Columbia University, New York, NY). **Project number:** 006459. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$449,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The total program is directed toward understanding the effect of ionizing radiation, principally neutrons and atomic and molecular ions, on biological materials at the cellular level. It is a closely-coupled radiological physics and radiation biology program, with the physics oriented to the experimental and theoretical study of the deposition of energy on a scale of fractions of micrometers, i.e., cellular dimensions. The radiobiology addresses cell-killing and transformations using experiments that are well-defined energetically and spatially through the physics program. The principal practical goals are radiation protection, carcinogenesis, and therapy. The main source of radiation is the Radiological Research Accelerator Faculty (RARAF) at Brookhaven.
Keywords: DOSIMETRY; IONIZING RADIATIONS; RADIOBIOLOGY; NEUTRON BEAMS; MOLECULES; ION BEAMS; ATOMS; BIOLOGICAL MATERIALS; BIOLOGICAL RADIATION EFFECTS; PHYSIOLOGY; RADIATION PROTECTION; CARCINOGENESIS; RADIOTHERAPY; STANDARDS; ENERGY ABSORPTION.

87677 High-Purity Germanium Gamma Detector. Hall, R.N. (General Electric Company, Schenectady, NY). **Project number:** 006462. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$28,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective is to advance the scientific understanding of residual defects and process-related phenomena in high purity germanium so that gamma detectors with improved spectral resolution and reliability can be constructed. Previous work under this contract has led to the commercial availability of single-crystal germanium suitable for making large-volume gamma detectors without requiring lithium compensation. Further work has revealed the presence of residual defects which affect spectrometer performance. The properties of these defects are under study and methods for their elimination are being developed. Hole trapping in Ge detectors results from defects associated with SiO/sub x/ precipitates and from the 0.08 eV vacancy complex. The latter has been eliminated by annealing using special procedures to prevent Cu contamination. Energy levels and hole emission rates have been measured for these defects using Hall effect and DLTS experiments.
Keywords: RADIATION DETECTORS; HIGH-PURITY GE DETECTORS; TECHNOLOGY ASSESSMENT; GAMMA RADIATION; RADIATION MONITORING.

87679 Theory of Relative Biological Effectiveness. Katz, R. (University of Nebraska, Lincoln, NE). **Project number:** 006471. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$63,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

Studies of the relative biological effectiveness of radiations of different linear energy transfer will be continued in relation to the unified track theory developed in these investigations. Newly discovered many-hit emulsion-developer combinations, and other many-hit detectors (supralinear TLD's), having the potential to mimic the response of human tissue to radiations of different quality will be investigated. Their radiosensitivity parameters will be measured and adjusted by manufacturing and processing condition variations. We continue to study the underlying meaning of the parameters of the theory, in biological and physical detectors, and the manner in which these new physical detectors can be used as a modeling system for biology.
Keywords: RBE; THEORETICAL DATA; LET; RADIOSENSITIVITY EFFECTS; RADIATION DETECTORS; TISSUES; RADIOSENSITIVITY.

87680 Interaction of Radiation With Matter. Brandt. (New York Univ., New York, NY). **Project number:** 006473. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$335,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The project consists of four areas of investigation. In the area of high energy radiation, studies will be made on the origin of supertails found in the alpha-particle induced damage profile in anthracene. The supertail is produced by recoil protons, but the calculated defect yield for the recoils is anomalously high. Studies will also be made of alpha- and beta-irradiation of organic crystal alloys to determine the role of heterogeneity and restricted domain size on scintillation properties. In the area of exciton dynamics, magnetic field studies will be made on triplet exciton fusion in organic crystal alloys. Singlet--singlet annihilation in these systems will also be investigated, including the effect of added quenchers. The role of percolation in these alloys will be evaluated. In the area of photophysics and photochemistry of PAH interaction, the interaction of positive carriers in anthracene with HsO3--In aqueous systems will be investigated. The effect of Fe2+, Fe3+, O2, and NOx will be evaluated. In the area of heavy ion physics, the following topics will be investigated: (1) partition rule of stopping power (penetration measurements with ion clusters will give first direct evidence of this basic phenomenon of many-body physics); (2) molecule formation by clusters emerging from solid surfaces; (3) radiation-inducted carbon formation on solid surfaces; and (4) theory of electron capture cross sections for innershell excitations and surface-ion interactions.
Keywords: ANTHRACENE; ALPHA PARTICLES; PHYSICAL RADIATION EFFECTS; RECOILS; PROTONS; ALPHA PARTICLES; CRYSTALS; SCINTILLATIONS; BETA PARTICLES; ORGANIC COMPOUNDS; PHYSICAL RADIATION EFFECTS; EXCITONS; MAGNETIC FIELDS; ORGANIC COMPOUNDS; CRYSTALS; ANNIHILATION; INTERACTIONS; POLYCYCLIC AROMATIC HYDROCARBONS; PHOTON COLLISIONS; PHOTOCHEMISTRY; CHARGE CARRIERS; ANTHRACENE; AQUEOUS SOLUTIONS; IRON IONS; OXYGEN; NITROGEN OXIDES; SULFURIC ACID;

STOPPING POWER; IONS; TRANSMISSION; RANGE; SOLID CLUSTERS; CHEMICAL RADIATION EFFECTS; SURFACES; CARBON; ELECTRON CAPTURE; CROSS SECTIONS; INNER-SHELL IONIZATION; K SHELL; L SHELL; ION COLLISIONS; EXCITATION; MOLECULES.

87683 **Special Problems in Nuclear Instrumentation.** Spokas, J.J. (Illinois Benedictine College, Lisle, IL). **Project number:** 006481. **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:** Characterization, measurement, and monitoring.

The various mixtures of polypropylene, Nylon-II, and carbon black prepared last year will be evaluated relative to their suitability to application in radiation dosimetry. The electrical conductivity will be studied directly and also under the peculiar conditions obtaining in ionization chambers. Other conducting plastic formulations will be considered both theoretically and experimentally. The cable study initiated last year will be concluded. Previously proposed advancements in vibrating-fiber electrometers will be reduced to practice in the form of an operating precision laboratory and field instrument.
Keywords: REACTOR INSTRUMENTATION; REACTOR MATERIALS; PERFORMANCE TESTING; IONIZATION CHAMBERS; DOSEMETERS; POLYPROPYLENE; NYLON; CARBON BLACK; ELECTRIC CABLES.

87684 **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:** Characterization, measurement, and 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.

87685 **Fast Neutron Dosimetry.** Moran, P.R. (Univ. of Wisconsin, Madison, WI). **Project number:** 006488. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$74,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

We will investigate thermocurrent (TC) and thermoluminescent (TL) dosimeters applied to fast neutron dosimetry. Direct fast neutron response and response to secondary charged particles will be measured. Dosimeters with thin sensitive regions prepared by selective doping or etching will be studied for recoil charged particle response. We will study the applicability of the Bragg--Gray theory to fast neutron irradiated ion chambers with Te, graphite, and magnesium walls and various filling gases. The three-chamber technique for n-gamma dosimetry will be compared with other promising techniques. Direct estimates of the Kerma factors for C, N, and O in selected fast neutron spectra will be obtained from ionization measurements in a large chamber.
Keywords: FAST NEUTRONS; DOSIMETRY; THERMOLUMINESCENT DOSEMETERS; CHARGED-PARTICLE REACTIONS; KERMA; SPECTRA; IONIZATION.

87687 **Energy Generation and the Sulfur Cycle: Organic Sulfur Compounds.** Brock, T.D. (Wisconsin University, Dept. of Bacteriology, 1550 Linden Drive, Madison, WI, 53705). **Project number:** 6515. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

Anaerobic oxidation of methane and aliphatic hydrocarbons in lake sediments will be studied using 14C-labelled methane and hexadecane. A mechanism for anerobic oxidation via methyl mercaptan is proposed and has been partially tested. The importance of rests and grassland soils as sources of atmospheric sulfur gases will : tested, using 35S-labelled sulfate. It is proposed that sulfate- ..duction to H2S occurs in anaerobic microenvironments in normal soils, the reaction being driven by the large amounts of organic matter present in such soils. On a global basis, it is considered that sulfate reduction in soil may greatly exceed sulfate reduction in water as a source of atmospheric sulfur gases. The approach will be to sample lake sediments and analyze them for methane and sulfur compounds. Aspects of sulfur cycle in freshwater lakes and decomposition of organics to produce methane will be described.
Keywords: ENERGY; POWER GENERATION; SULFUR DIOXIDE; ORGANIC SULFUR COMPOUNDS; WASTE MANAGEMENT; AIR POLLUTION; METHANE; EARTH ATMOSPHERE; ECOLOGICAL CONCENTRATION; ANAEROBIC CONDITIONS; CHLORINATED ALIPHATIC HYDROCARBONS; BIODEGRADATION; OXIDATION; LAKES; LABELLED COMPOUNDS; TRACER TECHNIQUES; REACTION KINETICS; ENVIRONMENTAL TRANSPORT; TERRESTRIAL ECOSYSTEMS; CHEMICAL EFFLUENTS; FORESTS; SOILS.

87693 **Energetic-Neutron Spectrometry.** Madey, R. (Kent State University, Kent, OH). **Project number:** 006629. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$13,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this research include the development, testing, and evaluation of a spectrometer for measuring neutrons in the energy region from a few MeV to several hundred MeV, and the demonstration and utilization of this instrument in applications pertinent to DOE programs. In the forthcoming year, it is proposed to develop the capability for utilizing the spectrometer as an on-line neutron beam monitor and to demonstrate the feasibility of utilizing the spectrometer to measure neutron spectra at particle accelerators with low duty cycles such as the Los Alamos Meson Physics Facility (LAMPF).
Keywords: NEUTRON SPECTROMETERS; DESIGN; PERFORMANCE TESTING.

87694 **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:** 6639. **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:** Ecological/biological processes and effects.

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.

87696 **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:** 6656. **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.
R and D categories: Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The investigator will complete as a government report the presentation of the quantitative shrub data, collected in 1963 and 1975 on undisturbed Mojave, transition, and Great Basin study sites at the Nevada Test Site. The analysis of recovery of desert vegetation, using all plant data collected over a 12-year period from ground zeros, burned, bladed, and other disturbed sites will continue.
Keywords: NUCLEAR EXPLOSIONS; TESTING; NEVADA TEST SITE; DESERTS; TERRESTRIAL ECOSYSTEMS; BIOLOGICAL RADIATION EFFECTS; PLANTS; RODENTS; ENVIRONMENTAL EFFECTS; ECOLOGY; CLIMATES; SOILS; NEVADA TEST SITE; SHRUBS; REVEGETATION.

87700 **Effects of Mesoscale Weather Disturbances on Contamination Concentrations.** Kreitzberg, C.W. (Drexel University, Dept. of Physics and Atmospheric Science, Philadelphia, PA, 19104). **Project number:** 6675. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective is to determine the effect of mesoscale weather disturbances and typical East Coast mesoscale circulations on contamination concentrations. The specific tasks include continued development of an efficient three dimensional primitive equation model to include detailed boundary layer calculations over irregular terrain with dynamic assimilation of the latest most detailed data.
Keywords: REGIONAL ANALYSIS; CLIMATES; WEATHER; FORECASTING; ATMOSPHERIC PRECIPITATIONS; AIR POLLUTION; MATHEMATICAL MODELS; CLIMATES; COMPUTER CODES; ENVIRONMENTAL TRANSPORT; METEOROLOGY; WEATHER.

87713 Sorption of Pollutant Gases by Soils. Bremner, J.M. (Iowa State University of Science and Technology, Department of Agronomy, Ames, IA, 50011). **Project number:** 6789. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87715 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:** 6796. **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: fossil fuels(50); nuclear fission(50). **R and D categories:** Ecological/biological processes and effects.

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.

87716 Effect of Mountain-Valley Terrains on Dispersion of Pollutants. Kao, S.K. (University of Utah, Dept. of Meteorology, Salt Lake City, UT, 84112). **Project number:** 006811. **Contract:** EY-76-S-02-2455. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$47,000.
Related energy source: fossil fuels(30); oil shales and tar sands(30); nuclear fuels(general)(30); geothermal(10). **R and D categories:** Physical and chemical processes and effects.

This research will investigate the meteorological and topographical factors for the dispersion and transport of pollutants in valleys and terrains of the western United States. Field experiments on turbulent dispersion of polluants in the planetary boundary layer in valleys will be conducted, and models for turbulent diffusion will be constructed. This research will provide information which is essential in the establishment of optimum site selections for oil shale plants in mountain-valley terrains of the western United States. Field experiments on diffusion of pollutants in mountain-valley terrains will be conducted. Models for turbulent diffusion in mountain-valley terrains will be constructed for this investigation. Analyses of diffusion characteristics in the planetary boundary layer will be made. Analyses of the mean and turbulent motions in the planetary boundary layer in mountain-valley terrains will be made.
Keywords: CHEMICAL EFFLUENTS; AIR POLLUTION; DIFFUSION; SURFACE AIR; BOUNDARY LAYERS; METEOROLOGY; TOPOGRAPHY; MATHEMATICAL MODELS; WIND; TURBULENCE; MOUNTAINS; REGIONAL ANALYSIS; PARTICLES; ENVIRONMENT; POLLUTION; ENVIRONMENTAL TRANSPORT; HYDROCARBONS; EARTH ATMOSPHERE; SULFUR DIOXIDE.

87717 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:** 6815. **Contract:** EY-76-S-02-2463. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

87725 Combined Toxicity Effects of Chlorine, Ammonia, and Temperature on Marine Plankton. 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to investigate the combined and synergistic effects of chlorine, temperature, ammonia, and other organic wastes upon marine plankton organisms that may be subject to these multiple stresses within the cooling water system and the nearby receiving waters of power generating stations located in estuarine and coastal marine waters. The organisms to be studied will include phytoplankton, zooplankton and both invertebrate and fin fish larvae. The latter two categories will include indigenous species that are important for commercial or recreational values. The studies will be experimental in nature, making use of the new Environmental Systems Laboratory of the Woods Hole Oceanographic Institution. Rapidly-growing species (i.e., phytoplankton) will be studied in continuous culture while the planktonic animals will be studied in continuous flow-through systems. Survival, growth, behavior and other biological criteria will be used to assay both immediate and long-term effects of the environmental stresses produced on the organisms by chlorine, temperature, and ammonia, singly and in combination.
Keywords: CHLORINE; AMMONIA; TEMPERATURE EFFECTS; PLANKTON; COOLING SYSTEMS; COASTAL WATERS; ESTUARIES; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS; POWER PLANTS; THERMAL EFFLUENTS; CHEMICAL EFFLUENTS; TOXICITY; POLLUTION; AQUATIC ECOSYSTEMS; FISHES; INVERTEBRATES.

87727 Plutonium and Cesium Radionuclides in the Hudson River Estuary. Simpson, H.J. (Columbia University, Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 6855. **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: all(100). **R and D categories:** Physical and chemical processes and effects.

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.

87728 Physiological Stress of Acidification in Fishes and Its Manifestation. Gerking, S.D. (Arizona State University, Dept. of Zoology, Tempe, AZ, 85282). **Project number:** 6866. **Contract:** 79 EV02498.000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$41,000.
Related energy source: coal(100). **R and D categories:** Ecological/biological processes and effects.

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; REPRODUCTION; PHYSIOLOGY; ACID RAIN; HYDROGEN IONS; POPULATION DYNAMICS; POWER PLANTS; PH VALUE; BIOLOGICAL ADAPTATION; ACIDIFICATION; BIOLOGICAL STRESS.

87736 Immunological and Viral Aspects of Radiation-Induced Tumors. Reif, A.E. (Mallory Institute of Pathology Foundation, Boston City Hospital, Boston, MA, 02118). **Project number:** 006940. **Contract:** EY-76-S-02-2539.A000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$27,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

Strontium-90 is one of the hazardous products of both peaceful and military use of nuclear energy. While high doses (1 microcurie/g body) is highly carcinogenic in man (on analogy with the effects of radium), the human population comprises individuals with dissimilar genetics and susceptibility to cancer. The objective of this study is to test strontium-90 carcinogenesis at various doses in mice with different susceptibility to cancer and carrying different types of tumor viruses. Also, the therapy of osteogenic sarcoma by immunological means will be investigated. Strontium-90 carcinogenesis will be studied at different doses in various strains of mice. Mice of a healthy strain will also receive immunosuppression by different means to determine if this will influence the final incidence of tumors by strontium-90. Especially whole-body irradiation will be studied in this connection. Immunotherapy trials will be run on tumors induced in inbred mouse strains by strontium-90 and by FBJ osteocarsoma virus. The relationship between the tumors induced by these two agents will be investigated. An experiment with 701 female C57BL/6 mice is in progress with 19 separate treatment groups. The treatments consisted of various doses of strontium-90, and in addition some groups were given 300 rad total body irradiation, innoculated with active or inactive mouse osteosarcoma virus (FBJ), or immunized with irradiated syngeneic (C57BL/6) osteosarcoma tumor. Results of the experiment to date are reported in our third annual report, and were updated in our contract renewal request dated May 15, 1978, submitted to our contract officer, Dr. George E. Stapleton. The experiment will be completed within 12 months.
Keywords: NEOPLASMS; RADIOINDUCTION; IMMUNOLOGY; VIRUSES; STRONTIUM 90; MICE; RADIUM; CARCINOGENESIS; RADIONUCLIDE KINETICS.

87737 Effects of Sublethal Levels of Oil on the Behavior of Aquatic Animals. Atema, J. (Boston Univ. Marine Program, Marine Biological Lab., Woods Hole, MA, 02543). **Project number:** 6967. **Contract:** E(11-1)-2546. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$59,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective is to describe and, where possible, explain the sublethal effects of oil fractions on the behavior of marine snails and lobsters. The approach is to: (1) measure alterations in feeding and social behavior of the organisms to determine pollutant effects; and (2) monitor changes in neurophysiological responses of chemorecptors to understand the mechanism of action on the organism. The pollutants studied include No. 2 fuel oil, whole oil and oil fractions at concentrations from 10 ppB to 50 ppM. The snail will be exposed to oil in a 1 hour static system with 1 to 14 days flowthrough. The lobster will be exposed to oil in a 5 day system with a one-time oil application. Theoretical models have been proposed in the course of our earlier studies and these are now being tested to determine basic mechanisms of interference. Changes in behavior may be the essential areas to be reflected at the population level and effects on chemo-reception may be generalized across different species. If such a generalized model of oil interference proves to be valid, realistic safety standards can be set up based on these experimental data.
Keywords: BEHAVIOR; AQUATIC ORGANISMS; PETROLEUM; HYDROCARBONS; METABOLISM; BIOLOGICAL MODELS; TOXICITY; LOBSTERS; SEAFOOD; FISHES; SNAILS.

87740 Revegetation Following Artificial Disturbance. Fraley, L. Jr. (Colorado State University, Dept. of Radiology and Radiation Biology, Fort Collins, CO, 80523). **Project number:** 6989. **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/biological processes and effects.

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.

87743 Strip Mine Reclamation: An Island Biogeographical and Ecosystem Energetic Approach. Carrel, J.E. (University of Missouri, 407 Tucker Hall, Columbia, MO, 65201). **Project number:** 6998. **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/biological processes and effects.

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; SURFACE MINING; LAND RECLAMATION; AERIAL MONITORING; REVEGETATION.

87744 Physiological Studies on Environmental Pollutants. Lengemann, F.W. (Cornell University, College of Veterinary Medicine, Department of Physical Biology, Ithaca, NY, 14853). **Project number:** 007050. **Contract:** E(11-1)-2784. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: coal(25); nuclear fission(75). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

This study is designed to identify, quantify and describe processes whereby hazardous waste products from energy production processes are transferred through milk to humans. One objective of these studies is to look at the transfer of heavy elements into milk. Among these will be members of the actinide series. Among the procedures to be used will be oral and I.V. doses of a radio tracer to lactating animals. When it is determined that an element transfers across the mammary gland an attempt will be made to look at the transfer constants across the mammary epithelium. Information has been developed on transfer to the milk of the goat of lead, polonium, bismuth and thallium. The effect of temperature on iodine secretion into milk was determined and information developed on the metabolism of zinc by the lactating goat.
Keywords: MILK; MAN; FOOD CHAINS; ACTINIDES; LEAD; POLONIUM; BISMUTH; THALLIUM; IODINE; ZINC; GOATS; ENVIRONMENTAL EXPOSURE PATHWAY; TRANSLOCATION; ENVIRONMENTAL TRANSPORT; ME-

TABOLISM; RADIONUCLIDE MIGRATION; CONTAMINATION.

87746 Molecular Mechanisms of the Epithelial Transport of Toxic Metal Ions. Wasserman, R.H. (New York State College of Veterinary Medicine, Department of Physical Biology, 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-$77,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

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: CADMIUM; TOXICITY; MAN; METABOLISM; VITAMIN D; CALCIUM; INHIBITION; ZINC; SYNERGISM.

87748 Determination of Sulfur Speciation in Industrial Aerosols. Eatough, D. (Brigham Young University, Thermochemical Institute, Provo, UT, 84602). **Project number:** 7048. **Contract:** E(11-1)-2988. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$102,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to conduct field sampling in the environs of smelters and power plants in the west and in the MAP3S region to obtain data to test hypotheses concerning sulfite--sulfate relationships in ambient air. Appropriate measurement techniques with emphasis on calorimetric titration and ESCA techniques will be developed. The stability of sulfur (IV) aerosol species with time will be determined. The trace metal content humidity and temperature will be correlated with the sulfur (IV) species and attempts will be made to devise an explanatory mechanism.
Keywords: AEROSOLS; AIR POLLUTION; MONITORING; QUANTITATIVE CHEMICAL ANALYSIS; TITRATION; CALORIMETRY; ELECTRON SPECTROSCOPY; HUMIDITY; TEMPERATURE DEPENDENCE; METALS; POWER PLANTS; SULFATES; SULFUR COMPOUNDS.

87756 SIMS Three Year Study on Statistics and Environmental Factors in Health. Thomsen, D. (SIAM Institute for Mathematics, New Canaan, CT). **Project number:** 007134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$83,000.
Related energy source: coal(100). **R and D categories:** Health effects.

SIMS will continue to coordinate the study with respect to publication and communication and will also maintain appropriate liaison with the review panel, the first meeting of which was held October 1976 together with members of the Columbia and Stanford groups. The object of the Columbia University group is to develop statistical methods and models for describing the effects of the environment, measured by pollution and weather variables, on respiratory diseases. Work in the following areas is underway: alternatives to multiple regression, time series models, methods for detecting clusters of cases, measuring pollution levels for an entire geographic area, and the association between air pollution and mortality. The Stanford University group has been investigating the time and space variability of pollutant concentrations. Topics of investigation have included maximum concentration of a pollutant concentration time series as related to the maximum of a subseries, spatial autocorrelation of station measurements, interpolation of pollutant concentrations between monitoring stations, and relation of geographic distribution of a mortality or morbidity index to the distribution over the same geographic region of an index of air pollution.
Keywords: RESPIRATORY SYSTEM DISEASES; ENVIRONMENTAL IMPACTS; AIR POLLUTION; MATHEMATICAL MODELS; MORTALITY; HEALTH HAZARDS; DISTRIBUTION; AIR POLLUTION; HUMAN POPULATIONS.

87757 Determination of 239-Pu Concentrations in New York City Autopsy Tissue Samples. Eisenbud, M. (University of New York, Medical Center, New York, NY). **Project number:** 007156. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$51,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Now that the methodology for the assay of plutonium in tissue samples has been developed to optimum state-of-the-art accuracy and precision, we propose to continue making these measurements at an accelerated rate during the coming year. Our proximate goal is the determination of the Pu-239/Pu-240 concentrations in the bone, lymph nodes, lung, liver and kidney of each of 50 cases of accidental death occurring in residents of the New York City area. In addition to measurement of plutonium and stable calcium in these samples, we will attempt to determine, in a limited subset of these samples, the content of other manmade and natural radionuclides when sample size permits. These other alpha emitters in order of priority include Am-241, Th- (alpha emitters) and, when possible, Pb and Po-210. From this information, and from the trace metal contents previously determined, we hope to examine models relating source terms to body burden thereby providing estimates of the variation of internal burdens of these materials as a function of their content in the environment. In addition, we will be able to examine transport models of these materials in the environment and their metabolism and kinetics in the body. Finally, we wish to establish accurate baseline values for these radionuclides in the body to act as a reference point for assessing the impact of increased sources of intake. Analysis of fallout plutonium is essential in defining those parameters used to estimate the transfer of plutonium from the environment to humans. In order to assess the temporal change in Pu alpha content of human tissues, additional tissue samples may be collected during the year.
Keywords: PLUTONIUM 239; TISSUES; LUNGS; LIVER; KIDNEYS; LYMPH NODES; SKELETON; ENVIRONMENTAL TRANSPORT; RADIONUCLIDE KINETICS; ALPHA SPECTROSCOPY; CHEMICAL ANALYSIS; NEW YORK CITY; AUTOPSY; ENVIRONMENTAL EXPOSURE PATHWAY; MAN.

87761 Scale Model Experiments for Environmental and Safety Control Assessments of Energy Material Shipping Containers Systems. Robins, R.A. (Battelle Columbus Labs., Columbus, OH). **Project number:** 800045. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$386,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

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.

87765 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:** 7293. **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(50); oil and gas(25); oil shales and tar sands(25). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

This project has the goal of chemically identifying and genetically characterizing each of the organic combustion products associated with the combustion of fossil fuel, with emphasis on coal and coal-derived fuels. In this fiscal year, some eighty separate polycyclic aromatic hydrocarbon products identified in kerosene soot (about eighty percent of the polycyclic fraction) were characterized for their ability to induce forward mutation to drug resistance in a bacterial assay. The mutagenicity of the mixed polycyclic fraction could be accounted for in terms of strictly additive mutagenicities of the individual chemical components. This demonstration promises to simplify the task of evaluating these complex mixtures and to permit comparison of novel combustion systems on the basis of chemical

composition of effluents. The project continues with the more technically demanding task of evaluating our bacterial mutation findings in our human cell mutation assay. Our goals are to provide the first human cell data base in the area of fossil-fuel-related combustion products and to develop an even more rapid and reliable means to use diploid human cells in the determination of genetic risk to humans.
Keywords: COMBUSTION PRODUCTS; SOOT; POLYCYCLIC AROMATIC HYDROCARBONS; HEALTH HAZARDS; TOXICITY; CARBON COMPOUNDS; COAL; CARCINOGENS; MUTAGENESIS; COAL INDUSTRY; ENVIRONMENTAL IMPACTS; HUMAN POPULATIONS; LYMPHOCYTES; COMBUSTORS; PARTICLES; AEROSOLS; AIR POLLUTION; CELL CULTURES; GENETIC EFFECTS; FOSSIL FUELS; CHEMICAL ANALYSIS; MUTAGEN SCREENING.

87768 Comparative Evaluation of Effects of Ozonated and Chlorinated Thermal Discharges. Guerra, C.R. (Public Service Electric and Gas Co., 80 Park Place, Newark, NJ, 07101). **Project number:** 7215. **Contract:** EE-77-C-02-4384. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$102,000.
Related energy source: oil and gas(50); nuclear fission(50). **R and D categories:** Ecological/biological processes and effects.

The work proposed involves three kinds of evaluation, using side-by-side ambient, chlorinated and ozonated effluents from an experimental condenser system. The kinds of studies proposed are as follows: (1) test organisms for this work will represent typical estuarine and freshwater fishes; (2) acute (96 hour) and chronic (28 day) toxicity studies will be conducted in flow-through proportional dilution toxicity systems; and (3) stress study will be conducted to detect effects of the treated effluents at concentrations below those which elicit the type of behavioral avoidance response evaluated in the behavior portion of the program.
Keywords: CHLORINE; OZONE; THERMAL EFFLUENTS; BIOLOGICAL EFFECTS; ENVIRONMENTAL IMPACTS; ORGANIC HALOGEN COMPOUNDS; EPOXIDES; TOXICITY; AVOIDANCE; BEHAVIOR; FISHES; BIOLOGICAL FOULING; CONDENSATES; CONTROL; INTERCHANGEABILITY; BIOLOGICAL STRESS; PATHOLOGICAL CHANGES; MICROORGANISMS.

87769 Mixed Liquid Therapy for Plutonium and Toxic Metals from Energy Power Production. Schubert, J. (Hope College, Holland, MI). **Project number:** 007478. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective is to substantially improve plutonium removal from exposed animals as compared to the commonly used chelating agents, EDTA and DTPA. The approach utilizes the formation of mixed ligand chelates of Pu and Th. For example, when two chelants are employed such as DTPA or EDTA (L1) and a secondary chelant (L2), a properly chosen L2 chelant also becomes incorporated in the coordination sphere, e.g., L1--Pu--L2. The chemical binding of Pu or Th by selected mixed chelate systems exceeds that of DTPA by factors of 10/sup 11/ to 10/sup 15/. The investigations include a low pressure ultrafiltration screening procedure in which tissues from mice or rats previously injected with soluble Pu salts are removed and homogenized in the presence of single and mixed chelants. The Pu in the homogenates does not normally appear in the ultrafiltrate except in the presence of the chelant test systems. The most promising systems are tested in vivo.
Keywords: PLUTONIUM; METALS; LIGANDS; REMOVAL; THERAPY; THORIUM; CHELATING AGENTS; DTPA; EDTA; BINDING ENERGY; MICE; RATS; POWER GENERATION; HAZARDS.

87774 Temporal Aspects of Tumor Response to Individual and Mixed Carcinogen Exposures. Albert, R.E. (New York University, Institute of Environmental Medicine, 550 First Avenue, New York, NY, 10016). **Project number:** 008001. **Contract:** EY-76-S-02-2737. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$117,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The time patterns of tumor induction in mouse and rat skin and hamster lung are being studied when two or more carcinogens are present simultaneously or sequentially for long periods of time. Various carcinogens, such as, ionizing radiation, ultraviolet light, benzo(a)pyrene, nitroquinolinoxide, beta propriolactone and diepoxybutane will be applied directly or topically to skin either alone or in combination with one other carcinogen. A powerful tumor promoter, phorbol myristate acetate, will then be applied repeatedly in order to accelerate the apperance of the tumors. The carcinogenic effect of BaP and electron radiation given repeatedly for long periods will be analyzed in terms of a model that relates the weekly dose rate (d) to the 50% induction time T50 in accordance with the formula dT50/sup w/ - constant and the utility of promotion as an indicator of potential carcinogenicity will be determined.
Keywords: RATS; MICE; HAMSTERS; SKIN; LUNGS; SYNERGISM; IONIZING RADIATIONS; ULTRAVIOLET RADIATION; BENZOPYRENE; ORGANIC COMPOUNDS; ORGANIC NITROGEN COMPOUNDS; CARCINOGENESIS; BIOLOGICAL MODELS; BIOLOGICAL EFFECTS; BIOLOGICAL RADIATION EFFECTS.

87775 Repair of DNA Treated with Gamma-Irradiation and Chemical Carcinogens. Goldthwait, D.A. (Case Western Reserve University, Dept. of Biochemistry, Cleveland, OH, 44106). **Project number:** 008013. **Contract:** EY-76-S-02-2725. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$35,000.
R and D categories: Health effects; Ecological/biological processes and effects.

The isolation, purification and characterization of DNA repair enzymes in E. coli is a major objective of this laboratory. Further work is required to clarify previous studies on endonuclease II and VI of E. coli. An examination of specific N-glycosylases for alkylated bases is planned as well as a search for exchange reactions. Further work on b-propiolactone derivatives of DNA, their structure, and repair will be done. A second major research effort involves a search for N-glycosylases in mammlain tissue. Current studies involve rat liver and placenta. With a repair enzyme which recognizes alkylated DNA, a study of the removal of alkylated bases from chromatin and nucleosomes will be started. Finally a cell culture system will be identified in which a careful kinetic study of repair of DNA alkylated by MNU can be done with the possibility of trying to eventually integrate in vitro and in vivo findings.
Keywords: GAMMA RADIATION; BIOLOGICAL RADIATION EFFECTS; CARCINOGENS; BIOLOGICAL EFFECTS; DNA; BIOLOGICAL REPAIR; ENZYMES; BIOCHEMISTRY.

87784 Mineral Metabolism and Physical Biochemistry. Neuman, W.F. (University of Rochester Medical Center, Department of Radiation Biology and Biophysics, School of Medicine and Dentistry, Rochester, NY, 14642). **Project number:** 002499. **Contract:** EY-76-C-02-3490. **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$91,000.
R and D categories: Health effects.

The objectives are: (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 (lead, strontium, radium, lanthanides, fluorides, arsenates) 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. The metabolism of parathyroid hormone, calcium and glucose have been studied; detailed studies of metabolite types show the patterns of appearance and disappearance in various tissues. Calcium and phosphorus efflux is determined by the solubility of the mineral phase; but this solubility is dependent on both the current in vitro conditions and the treatment of the tissue during the previous few hours. Glycolysis rates are also strikingly dependent on the treatment of the tissue.
Keywords: METABOLISM; BIOCHEMISTRY; LEAD; STRONTIUM; RADIUM; RARE EARTHS; FLUORIDES; ARSENATES; BONE TISSUES; MINERALS; RADIONUCLIDE KINETICS; CALCIUM; GLUCOSE; PARATHYROID GLANDS; PARATHORMONE.

87786 Environmental Consequences of Atmospheric Kr-85. Boeck, W. (Niagara University, Buffalo, NY, 14109). **Project number:** 7214. **Contract:** EE-77-02-4364. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$7,000.
Related energy source: nuclear fission(100). **R and D categories:** Physical and chemical processes and effects.

The proposed study will examine the possibility that Kr-85 may lead to inadvertent weather modification through perturbation of the atmospheric electric climate. Such perturbations may result in changed electric fields, changed precipitation patterns, and other anomalies related to increased ionization. Calculations of the role of Kr-85 ionization on the earth's electrostatic field will be made and the related change in ion concentration determined and related to the role of charge in precipitation processes, through modification of the atmospheric condensation nuclei budget.
Keywords: EARTH ATMOSPHERE; KRYPTON 85; ENVIRONMENTAL EFFECTS; ELECTRIC FIELDS; DISTURBANCES; WEATHER; MODIFICATIONS; ATMOSPHERIC PRECIPITATIONS; CONDENSATION NUCLEI.

87787 Impact of Atmospheric SO/sub 2/ and CO/sub 2/ on the Ecophysiology and Competitiveness of Plants. Bazzaz, F.A. (Univ. of Illinois, Department of Botany, Urbana, IL, 61801). **Project number:** 7232. **Contract:** EE-77-S-02-4329. **Supported by:** Department of

Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$47,000.
Related energy source: fossil fuels(50); solar(25); biomass(25). **R and D categories:** Ecological/biological processes and effects.

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 SO/sub 2/ and CO/sub 2/ 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 CO/sub 2/ 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 CO/sub 2/. SO/sub 2/ fumigation experiments using the species mentioned above have begun and will be followed by other experiments which will elevate the concentrations of SO/sub 2/ and CO/sub 2/ 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.

87788 Air Pollution Effects on Food Quality. Pell, E.J. (Pennsylvania State University, 211 Buckhout Lab., University Park, PA, 16802). **Project number:** 7234. **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:** Ecological/biological processes and effects.

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.

87789 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:** 7297. **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/biological processes and effects.

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.

87791 Genetic and Developmental Study of Complex Locus in the House Mouse. Bennett, D. (Sloan Kettering Institute for Cancer Research, 425 East 68 Street, New York, NY, 10021). **Project number:** 7380. **Contract:** EE-77-02-4159. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$44,000.
R and D categories: Health effects.

This is a broad program of study and maintenance of mutant alleles at T locus on chromosome 17 of the mouse. Its objectives are the maintenance of a complete panel of different types of mutant alleles at the T-locus of the mouse on chromosome 17, as well as other known marker genes of that chromosome; and the genetic study of these genes with special reference to their interactions with one another and the fine structure of the portion of chromosome occupied by the T-region. The maintenance and inbreeding of 35 stocks of mice carrying different mutations in the T/t region of chromosome 17 will continue. Detailed genetic analysis of these mutations and their interrelationship with one another will be performed with particular emphasis on (1) experiment designed to map T/t locus mutations and their marker relative to one another; (2) embryological and cytogenetic analysis of two dominant T-like factors that may be chromosome deletions; and (3) the genetic and embryological analysis of new t-alleles that arise in the laboratory by mutation or are found in the wild populations.
Keywords: MICE; MUTANTS; CHROMOSOMAL ABERRATIONS; ANIMAL BREEDING; LABORATORY ANIMALS; MUTAGENESIS; BIOLOGICAL MODELS.

87792 Assessment of Energy Alternatives for New England. Sievers, W.E. (Mitre Corporation, 1820 Dolly Madison Blvd., McLean, VA, 22101). **Project number:** 7452. **Contract:** EP-78-C-02-4626. **Supported by:** Department of Energy, Washington, DC (USA) Div. of Regional Assessments. **Funding:** DOE-$320,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

Many of the critical problems of U.S. energy policy are manifested in the New England region in a magnified form. The region entered the period of energy shortages and increasing prices in an economically declining condition. With essentially no indigenous energy resources, New England is an energy importing region. The future supply of energy to the region is critically dependent on energy resource policies, and the implementation of strategies and technologies for alleviating dependence on oil. While there exist various regional organizations and activities to resolve its problem, New England has no real plan or policy to achieve a dependable, adequate, economical, and environmentally acceptable energy supply.
Keywords: USA; ENERGY POLICY; REGIONAL ANALYSIS; NORTH ATLANTIC REGION; ENERGY SHORTAGES; ENERGY SUPPLIES; CHARGES; ENERGY SOURCES.

87793 Chemical Composition of Precipitation in Minnesota. Gorham, E. (University of Minnesota, Department of Ecology and Behavioral Biology, St. Paul, MN, 55108). **Project number:** 7439. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87794 Regional Integrated Alternative Fuels and Energy Supplies and Environmental Control for Riverside, California. Allen, C.M. (Battelle Memorial Institute, 505 King Avenue, Columbus, OH, 43201). **Project number:** 7470. **Contract:** ENG-0092. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$199,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

A phased systematic study of the energy demands of the City of Riverside, California, as a physical model to identify clean fuel and energy systems that are not reliant on natural gas and oil. The first year study is a combination of data collection and methodologies development for effective pathway of implementing alternative energy supplies. The next phases will include: detailed technical and economic analysis and design of demonstration systems; demonstration of energy facilities on stream in Riverside and expanding concept and experiences into the South Coast Air Basin and the California region.
Keywords: CALIFORNIA; ENERGY MODELS; ENERGY SUPPLIES; SOCIOLOGY; TECHNOLOGY ASSESSMENT.

87795 Uptake of Sulfuric Acid Mist by Plant Canopies. Wedding, J.B. (Colorado State Univ., Dept. of Civil Engineering, Ft. Collins, CO, 80523). **Project number:** 7476. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87796 Trace Elements in Oil Shale. Chappell, W. (University of Colorado, Boulder, CO). **Project number:** 7098. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$357,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

87797 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:** 7100. **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 shales and tar sands(100). **R and D categories:** Ecological/biological processes and effects.

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.

87798 Comparative Study of Effluents and Their Control from Four Dry Ash Lurgi Gasification Plants. Somerville, M.H. (University of North Dakota, Engineering Experiment Station, Box 8103, Grand Forks, ND, 58202). **Project number:** 800134. **Contract:** EY-76-S-02-4035.A001. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-.$121,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The project objectives are: (1) to identify and characterize the effluents from and control methods utilized in four (ANG, Natural, El Paso, and Wesco) gasification facilities; (2) to identify the cost of controlling the projected effluents; (3) to identify the approach of the different designs to the controlled effluent limits; and (4) to identify existing and possible future regulations. Primary sources were reviewed for technical and financial data. These data were extended through technical analysis to provide detailed projections of effluent characteristics and effluent control costs. The Environmental Protection Agency's (EPA) gasification effluent characterization program was reviewed, as were the regulations and work being conducted in North Dakota and New Mexico.
Keywords: COAL GASIFICATION PLANTS; LURGI PROCESS; POLLUTION CONTROL; WASTE MANAGEMENT; COMPARATIVE EVALUATIONS; ENVIRONMENTAL IMPACTS; POLLUTION REGULATIONS; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; HYDROCARBONS; PARTICLES; ORGANIC COMPOUNDS; POLLUTION CONTROL EQUIPMENT; RELIABILITY.

87800 Maintenance of a Rural Precipitation Chemistry Center at Whiteface Mountain. Kedlecek, J.; Mohnen, V. (State University of New York, Atmospheric Sciences Research Center, Albany, NY, 12222). **Project number:** 7099. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

87802 Environmental Control Technology Requirements in Solid Waste Processing and Energy Recovery Facilities. Young, J.C. (Ames Laboratory, Ames, IA). **Project number:** 800121. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: conservation(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

87803 Study of By-Products and Potential Pollutants from High Temperature Entrained Flow Gasifiers. Lee, M.L. (Brigham Young University, Chemistry Department, Provo, UT, 84602). **Project number:** 800162. **Contract:** EE-77-S-02-4377. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE.

Related energy source: coal(100). **R and D categories:** Environmental control technology.

A detailed characterization of pollutants associated with a high-temperature, entrained gasification process has been performed. Samples were taken from the cooled and water-scrubbed product gas stream, the scrubber effluent water, the gas evolved on depressurization of the scrubber water, and the particulate matter filtered from the scrubber water. Five process parameters were varied: coal type, coal feed rate, reactor pressure, oxygen to coal ratio, and steam to coal ratio. The compositions of these samples were determined using the analytical techniques of gas chromatography, gas chromatographic mass spectrometry, proton-induced x-ray emission spectroscopy, thermometric titrimetry, ion chromatography, and atomic absorption spectrometry. Effluent streams were found to be extremely clean compared to those of other gasifiers. The water-scrubbed gaseous effluent contained only CO, H2, CO2, N2, CH4, and traces of H2S and HCN. The gas obtained by depressurization of the scrubber water contained trace amounts of SO2 in addition to these other seven gases. Polycyclic aromatic hydrocarbons, the only nonvolatile organic compounds found in the scrubber water, were completely adsorbed on the particulate matter. Most of the H2S produced in the gasifier became oxidized to elemental sulfur and also appeared in the scrubber water as particulate matter. The concentrations of elemental and inorganic species were found to be below the level of environmental concerns. Statistical analysis is presently done to determine the effects of the process parameters.

Keywords: COAL GASIFICATION PLANTS; ENTRAINMENT; BY-PRODUCTS; FUEL GAS; PURIFICATION; SCRUBBERS; WASTE WATER; PARTICLES; SAMPLING; CHEMICAL ANALYSIS; GAS CHROMATOGRAPHY; MASS SPECTROSCOPY; ABSORPTION SPECTROSCOPY; POLYCYCLIC AROMATIC HYDROCARBONS; HYDROCARBONS; EMISSION; ENVIRONMENTAL EFFECTS; CHEMICAL EFFLUENTS; GASEOUS WASTES; HYDROGEN SULFIDES.

87804 Preliminary Assessment of Environmental Control Options for Noise. Keast, D.N. (Bolt, Bernack and Newman, Inc., 50 Moulton Street, Cambridge, MA, 02138). **Project number:** 800160. **Contract:** EE-77-C-02-4389. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$27,000.

Related energy source: all(100). **R and D categories:** Environmental control technology.

The objective of this study has been to survey the developing energy technologies to determine the existing and/or anticipated environmental control needs for noise control. The approach is to identify practical noise-control procedures and/or process modifications to mitigate the impact of noise where appropriate. Essential products of the survey have been the identification of areas where existing environmental noise control is inadequate and the development of recommendations for programs to address such inadequacies.

Keywords: TECHNOLOGY ASSESSMENT; NOISE POLLUTION CONTROL; NOISE POLLUTION ABATEMENT; ENERGY SOURCE DEVELOPMENT.

87805 Evaluation of Lurgi Gasifier Two-Stage Quench for Water Pollution Control. 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). Div. of Environmental Control Technology. **Funding:** DOE-$179,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

87806 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). Div. of Environmental Control Technology. **Funding:** DOE-$70,000.

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

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.

87808 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). Div. of Environmental Control Technology. **Funding:** DOE.

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

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.

87809 Assessment of Environmental Control Aspects of Treatment of EOR Wastewaters Using Membranes. 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). Div. of Environmental Control Technology. **Funding:** DOE-$35,000.

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

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.

87810 Evaluation of the Effect of Coal Cleaning on Fugitive Elements. Boyer, J.F. Jr.; Ford, C.T. (Bituminous Coal Research, Inc., 350 Hochberg Road, Monroeville, PA, 15146). **Project number:** 800236. **Contract:** EE-77-S-02-4427. **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$183,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

87811 Treatment of Synthane Gasification Wastewaters. Haynes, W.P. (Pittsburgh Energy Technology Center, 4800 Forbes Avenue, Pittsburgh, PA, 15213). **Project number:** 800238. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$200,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

87812 Evaluation of H/sub 2/S Control Technology for Geothermal Energy Sources. Ananth, K.P. (Midwest Research Institute, 425 Volker Boulevard, Kansas City, MO, 64110). **Project number:** 800143. **Contract:** EE-77-C-02-4255. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$36,000.
Related energy source: geothermal(100). **R and D categories:** Environmental control technology.

The objective of this study was to define the status and evaluate the H/sub 2/S control technologies applicable to geothermal energy sources. Of the geothermal sources, vapor dominated (dry steam) and liquid dominated (hot brine) categories were emphasized. Control technology, as defined here, included add-on devices as well as integrated process technology, with both demonstrated and developmental systems being evaluated. Most of the information required for this study was obtained from an in-depth literature review, which was supplemented by site surveys and contacts with industry personnel. The control technology evaluation was conducted using a grid which took into account the removal efficiency of the control technique, capital cost, annualized cost, operating conditions, state of development, energy requirements, potential cross-media impacts, etc. Based on the study, several recommendations were made.
Keywords: HYDROGEN SULFIDES; GEOTHERMAL SYSTEMS; AIR POLLUTION CONTROL; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL EFFECTS; GEOTHERMAL ENERGY; EVALUATION; ECONOMICS; RECOMMENDATIONS.

87820 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:** Characterization, measurement, and monitoring.

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.

87821 Evaluation of Carbon Monoxide in Blood Samples from the Second Health and Nutrition Survey. Redfor, E.P. (University of Pittsburgh, Pittsburgh, PA). **Project number:** 007590. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$19,000.
Related energy source: coal(100). **R and D categories:** Health effects.

This is a continuation of a study of carbon monoxide (CO) in the blood of human subjects participating in the Second National Health and Nutrition Survey (HANES II), a detailed study of health indicators in sample populations of many communities throughout the US. The purpose of this aspect of the survey is to evaluate the levels of blood carboxyhemoglobin in over 6,000 normal individuals of all ages in typical US communities, from whom accurate histories and clinical studies are available. Two main results are anticipated from this work. First, values from non-smokers will indicate the extent to which absorption of CO from community air pollution is present in the US. Second, the data will provide an objective measure of current inhalation exposure to tobacco smoke in smokers, an important addition to clinical evaluation of health effects from smoking.
Keywords: CARBON MONOXIDE; ECOLOGICAL CONCENTRATION; BIOLOGICAL ACCUMULATION; BLOOD; CHEMICAL ANALYSIS; HUMAN POPULATIONS; NUTRITION; PUBLIC HEALTH; AIR POLLUTION; TOBACCO SMOKES; HEALTH HAZARDS; UPTAKE.

87827 Microbiological Air Quality: Ames Southwestern Disposal. Kniseley. (Ames Laboratory, Ames, IA). **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:** Characterization, measurement, and monitoring.

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.

87838 Mapping Project on Energy with the Social Sciences. Gould, L. (Yale University, Institute for Social and Policy Studies, 111 Prospect Street, New Haven, CT, 06520). **Project number:** 7412. **Contract:** EE-77-S-02-4287. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$136,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The project will bring together a group of Yale faculty members, Institute for Social and Policy Studies (ISPS) staff members, and graduate students meeting weekly to discuss topics in energy and the social sciences and to study and evaluate existing and potential social science energy projects.
Keywords: ENERGY; SOCIOLOGY; SOCIO-ECONOMIC FACTORS; ECONOMIC POLICY; DATA COMPILATION; INFORMATION NEEDS.

87847 Succession in Weedy Communities. Knight, C. (University of Wyoming, University Station, WY, 82070). **Project number:** 7218. **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/biological processes and effects.

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.

87849 Environmental Policy Analysis: Water Quality and Quantity Issues that Affect DOE Programs. Fry. (Energy Resources Company, Cambridge, MA). **Project number:** 007435. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$260.000.
Related energy source: all(100). **R and D categories:** Integrated 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.

87850 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, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE-$25,000.

One of the most sensitive and variable control mechanisms in biological systems is that of conformational transitions. 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 disperion, 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:** NUCLEIC ACIDS; PROTEINS; BIOLOGICAL FUNCTIONS; CONFORMAL MAPPING; CONFORMAL INVARIANCE; TRITIUM; RADIONUCLIDE KINETICS.

88002 Controlled Environmental Release Test (CERT) Program. Alvarez, J. (Health Services Laboratory, 550 Second St., Idaho Falls, ID, 83401). **Project number:** 527. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects.

The processes whereby airborne contaminants are deposited on and removed from natural and manmade surfaces are investigated in a wind tunnel and in field experiments. Dry deposition velocities and resuspension factors for species as a function of surface characteristics and meteorological conditions will be obtained.
Keywords: NUCLEAR FUELS; RADIOACTIVE AEROSOLS; DEPOSITION; PLANTS; RADIONUCLIDE KINETICS; FOOD CHAINS; RADIONUCLIDE MIGRATION; AEROSOL MONITORING; AIR CLEANING.

88004 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:** 983. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

88005 INEL Site Ecological Studies. Markham, O.D. (Idaho National Engineering Laboratory, Health Services Laboratory, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** 988. **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:** Ecological/biological processes and effects.

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.

88006 Radiation Measurement Technology. Helmer. (Idaho National Engineering Lab., Idaho Falls, ID). **Project number:** 001352. **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:** Characterization, measurement, and monitoring.

The purpose of this program is to provide a technology base for the DOE Division of Biomedical and Environmental Research to assure that new advances in technology associated with radiation measurements will be assessed and utilized. In the present period of significant growth in the energy industries, nuclear and others, the need for development of well documented measurement techniques and proven instrumentation for environmental assessment is expanding at a rapid rate. The majority of the applications which involve radiation and radioisotopes are related to techniques for the identification and assay of radioisotopes by gamma-ray spectrometry. In order to successfully apply these techniques on the scale which will be required in various parts of the nuclear fuel cycle, these spectrometers must assume the form of satellite units which are capable of remote operation, internal calibration, and continuous verification of performance. It is proposed that a prototype satellite unit be developed which is based upon the LSI microprocessor concept to permit operation from a dedicated processor or plant computer system employing advanced concepts in telecommunications.
Keywords: RADIATION MONITORING; TECHNOLOGY ASSESSMENT; RADIOISOTOPES; GAMMA SPECTROSCOPY; NUCLEAR INDUSTRY; FUEL CYCLE; COMMUNICATIONS; TELEMETRY; GAMMA SPECTROMETERS; SATELLITES.

88007 INEL Site Radioecology Program. Markham, O.D. (Department of Energy, Health Services Laboratory, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** 1390. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

88501 Marshallese Natives at Rongelap: Radiological Studies. Conard, R.A. (Holmes and Narver, Inc., Los Angeles, CA). **Project number:** 000472. **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:** Health effects.

This program provides logistical and other support to the Brookhaven National Laboratory for medical surveys of the Marshallese who were accidentally exposed to fallout radiation in 1954. The BNL program provides for the medical and radiological examinations of the residents of Bikini, Rongelap, and Utirik. Support includes transportation between Hawaii and the Marshall Islands, subsistence support for a doctor stationed at Kwajalein, and the logistical effort necessary to move selected Marshallese to the continental east coast for more extensive medical exams.
Keywords: MARSHALL ISLANDS; HUMAN POPULATIONS; MONITORING; FALLOUT; BIOLOGICAL RADIATION EFFECTS; BIKINI; HAWAII.

88502 Editing Publication--Atmospheric Science and Power Production. Randerson, D. (National Weather Service, Western Region, P.O. Box 14985, Las Vegas, NV, 89114). **Project number:** 542. **Contract:** E-99-9-9999. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$45,000.
Related energy source: all(100).

The objective is to prepare state-of-the-art document on the relation between atmospheric science and power production. The approach has been to obtain the most knowledgeable people to prepare chapters in their area of expertise.
Keywords: EARTH ATMOSPHERE; ENERGY; ENVIRONMENTAL EFFECTS; ELECTRIC POWER; POWER GENERATION; AIR POLLUTION; AIR QUALITY.

88504 Management: Mid-Pacific Marine Laboratory--Marshall Islands. Reese, E. (University of Hawaii, Hawaii Institute of Marine Biology, P.O. Box 1346, Kaneohe, HI, 96744). **Project number:** 0661. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

88508 Logistical Support. Morrow, A.F. (Reynolds Electric and Engineering Co., Inc., Las Vegas, NV, 89114). **Project number:** 805. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$103,000.
Related energy source: nuclear fission(100).

The objectives of this project are to provide a base of operations and administrative and logistical support to investigating organizations conducting funded and approved environmental research projects at the Nuclear Test Site (NTS). Facilities and support services are used by principal investigators, permanently-assigned project technicians and lab helpers, seasonal personnel, and participating visitors.
Keywords: NEVADA TEST SITE; RADIATION MONITORING; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; RADIONUCLIDE MIGRATION; RADIOECOLOGY; RESEARCH PROGRAMS; MANAGEMENT.

88509 Computer Support--CETO (Civil Effects Test Operations). (Computer Science Corporation, P.O. Box 15390, Las Vegas, NV, 89114). **Project number:** 807. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$5,000.
Related energy source: nuclear fission(100).

The project objective is to provide computer support at DOE/Nevada Central Computer Facility to Civil Effects Test Operations (CETO).
Keywords: COMPUTER CALCULATIONS; DATA PROCESSING; CIVIL DEFENSE; HUMAN POPULATIONS; NUCLEAR ENERGY; ENVIRONMENTAL EFFECTS; MATHEMATICAL MODELS; DATA ANALYSIS.

88511 Research Vessel Operations. Ray. (Holmes and Narver, Inc., Honolulu, HI). **Project number:** 001168. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$513,000.
Related energy source: nuclear fission(100).

The objective of this project is to provide logistical support to research projects in the Marshall Islands. DOE maintains an ocean-going vessel to provide transportation, living and other support necessary to conduct research studies in Marshall Islands.
Keywords: MARSHALL ISLANDS; SHIPS; RESEARCH PROGRAMS.

88513 Bioenvironmental Transport of Transuranium Elements: Metabolism of Curium and Neptunium in Ruminants. Potter, G.D. (Environmental Protection Agency, P.O. Box 15027, Las Vegas, NV, 89114). **Project number:** 1325. **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:** Ecological/biological processes and effects.

The objective is to determine the biological uptake, physiological transport, tissue retention and rates of excretion for the transuranic nuclides in large animals. Neptunium and curium will be introduced to goats and cows with the transport mechanisms monitored to determine rates and effects.
Keywords: NUCLEAR ENERGY; ENVIRONMENTAL EFFECTS; UPTAKE; BIOLOGICAL EFFECTS; PHYSIOLOGY; RADIONUCLIDE MIGRATION; RADIOACTIVE EFFLUENTS; RADIOISOTOPES; NEPTUNIUM ISOTOPES; CURIUM ISOTOPES; COWS; GOATS; FOOD CHAINS; FOOD; INGESTION; RADIONUCLIDE KINETICS.

88514 Hydrogeochemistry of Eniwetok. Buddlmeir, R.W. (Hawaii Institute of Marine Biology, P.O. Box 1346, Kaneoke, HI, 96744). **Project number:** 1521. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

88515 NTS National Environmental Research Park Activity. Campbell, E.D. (Nevada Operations Office, P.O. Box 14100, Las Vegas, NV, 89114). **Project number:** 991. **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:** Ecological/biological processes and effects.

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.

88517 Circulation and Chemistry of the Eniwetok Atoll Lagoon. Smith, S.V.; Stroup, E.D. (University of Hawaii, Institute of Marine

Biology, Kaneohe, HI, 96744). **Project number:** 2571. **Contract:** EY-76-C-08-0703. **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:** Physical and chemical processes and effects.

The objective is to determine the physical circulation of the Eniwetok Atoll lagoon and the flux of carbon, phosphorus and nitrate across the atoll's reef flats. A field measurement program will be conducted of physical properties using current meters and drogues and of selected nutrient chemical properties by sampling and analysis.
Keywords: ENIWETOK; FLUID FLOW; SEAWATER; CARBON; PHOSPHORUS; NITRATES; PHYSICAL PROPERTIES; NUTRIENTS; SAMPLING; CHEMICAL ANALYSIS; MONITORING; COASTAL WATERS; ENVIRONMENTAL TRANSPORT; MINERAL CYCLING.

88532 Design Experimental Test Facilities for Liquefied Fuels Safety Program. Jones, W. (Holmes and Narver, Orange, CA, 92666). **Project number:** 800265. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$153,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

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.

89002 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, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$85,000.
Related energy source: fossil fuels(20); nuclear fuels(general)(80). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives are: (1) to make interspecies comparisons of late somatic effects, quantify differences among species in sensitivity to chemical carcinogens from coal liquifaction processes, and study factors that influence relative carcinogenic effect; and (2) to isolate and define the chemical composition and biological properties of a potent hemostatic agent from the aortas of aged burros, and to quantify species differences in sensitivity to platelet activation and aggregation by this hemostatic agent. Experiments or examination of data are planned and underway to: (1) make interspecies comparisons of late somatic effects of external whole-body radiation, based in part on data collected during our past experiments on swine, cattle, and burros; (2) make interspecies comparisons of chemical carcinogens; (3) isolate, purify and characterize the newly-discovered aortic hemostatic agent (acid extraction-pepsin digestion procedure will be used to isolate and purify the structural collagenous protein, its amino acid composition will be determined, and the collagen species identified); and (4) make interspecies comparisons of hemostatic activity of the new collagen, quantify sensitivity of platelets from various species, and quantify the action of heavy metals and polycyclic hydrocarbons from coal conversion processes.
Keywords: COAL LIQUEFACTION; CARCINOGENS; BIOLOGICAL EFFECTS; BURROS; COMPARATIVE EVALUATIONS; BIOLOGICAL RADIATION EFFECTS; METALS; POLYCYCLIC AROMATIC HYDROCARBONS; HEALTH HAZARDS; CARCINOGENESIS; CATTLE; SWINE; SOMATIC MUTATIONS.

89008 Atmospheric Turbulence and Diffusion Research. Gifford, F.A. (National Oceanic and Atmospheric Administration, Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN, 37830). **Project number:** 532. **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: all(100). **R and D categories:** Physical and chemical processes and effects; Integrated 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.

89009 Marine Pollution Studies. Gonzales, J. (Puerto Rico Univ., Marine Ecology Div., Center for Environment Research, Mayaguez, PR, 00708). **Project number:** 615. **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: fossil fuels(90); ocean thermal(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

89010 Terrestrial Ecology Program. Clements, R.G. (Puerto Rico Nuclear Center, Caparra Heights Station, San Juan, PR, 00935). **Project number:** 616. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$275,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to provide baseline ecological data for future environmental assessment studies at the local and regional levels and to determine through an ecosystem approach, management alternatives for the wise utilization of energy, water and land resources. The study will describe the interrelationships among climate, vegetation, soils, animals and man and their combined influence upon the hydrologic cycle of the drainage basin both at the local and regional level. Programmed research will be ordered by a five year comprehensive research plan.
Keywords: TERRESTRIAL ECOSYSTEMS; ECOLOGY; MANAGEMENT; ENERGY SOURCES; WATER RESOURCES; LAND USE; CLIMATES; PLANTS; SOILS; ANIMALS; DATA ACQUISITION; ENVIRONMENT; FORESTS.

89011 Radiation and Chemical Effects on Viral Transformation and Tumor Antigen Expression. 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, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$19,000.
Related energy source: fossil fuels(33); nuclear fission(67). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective of this research is to define the role of low level irradiation combined with DNA containing viruses known to exist in the human population to determine the potentiating effects of irradiation on viral induced neoplasms. The second aspect of the work is to define the role of low levels of chemical carcinogens, particularly hydrocarbons, in potentiating the oncogenic properties of viruses. The primary focus of a large portion of the work will center around determining whether or not it is possible to detect the earliest signs of virally or chemically induced tumors, potentiated by hydrocarbons or irradiation through the monitoring of cells or the immune response of the host to tumor associated antigens which appear to be of embryonal or fetal origin. The approach being used is to detect the earliest transformed cells that appear in cultures of cells exposed to cocarcinogens as reflected by their ability to grow on an unusual test culture surface, polyacrylamide, which seems to have the unique

property of excluding the growth of normal cells while potentiating the growth of cancer cells. Cells which become adherent to the acrylamide will be monitored for the expression of embryonic antigens which are common to tumors of the same histologic type. The results expected should allow us to determine whether embryonal or fetal immunologic markers can be used to detect the earliest evidence of chemically or virally induced carcinogenesis which can be potentiated by low level irradiation. We anticipate that our results will be in hand in the coming three years.
Keywords: ANTIGENS; DNA; NEOPLASMS; CARCINOGENESIS; VIRUSES; ONCOGENIC VIRUSES; BIOLOGICAL INDICATORS; BIOLOGICAL RADIATION EFFECTS; SYNERGISM; CHEMICAL EFFLUENTS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL EFFECTS.

89014 Portable XRF Survey Meter and Personal Sample Reader for Elemental Dosimetry of Industrial Atmosphere. Rhodes, J. (Columbia Scientific Industries, Austin, TX). **Project number:** 007465. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and 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.

89015 Fate of Chlorine in Seawater. Wong, G.T.F. (Old Dominion University, Department of Oceanography, Norfolk, VA, 23508). **Project number:** 7616. **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: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

89017 Marine Research Boat Operation. Gonzales, J.G. (Puerto Rico University, Marine Ecology Div., Center for Environmental Research, Mayaguez, PR, 00708). **Project number:** 01326. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: fossil fuels(90); ocean thermal(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The research boat, Sultana, was purchased during FY76. This boat will serve as the primary field platform and base station for the work done by the Marine Ecology Division.
Keywords: WATER QUALITY; MONITORING; ECOLOGY; AQUATIC ECOSYSTEMS; OCEANOGRAPHY; SHIPS; AVAILABILITY; EQUIPMENT.

89019 Environment Research Park. Clements, R.G. (Univ. of Puerto Rico, Center for Energy and Environment Research, College Station, Mayaguez, PR, 00708). **Project number:** 1629. **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: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

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 radon 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.

89020 Global Effects of Increasing Levels of CO2. Rotty, R. (Oak Ridge Associated Universities, Institute for Energy Analysis, Oak Ridge, TN, 37830). **Project number:** 2932. **Contract:** EY-76-C-05-0033. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$202,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to develop, coordinate, and implement a national, then an international, program of research and assessment to provide confident estimates of social, political, economic and environmental costs of increasing levels of atmospheric carbon dioxide from the combustion of fossil fuels. The processes used are to: (1) determine future atmospheric concentrations of CO2; (2) determine climate effects of increasing CO2; (3) determine environmental impacts of climate change; (4) determine social, political, and economic costs of environmental changes; and (5) determine strategies and technological fixes to alleviate impacts.
Keywords: CARBON DIOXIDE; CLIMATES; ENVIRONMENTAL EFFECTS; ECOLOGICAL CONCENTRATION; SOCIOECONOMIC FACTORS; RISK ASSESSMENT; FOSSIL FUELS; COMBUSTION PRODUCTS; ENVIRONMENTAL IMPACTS; MATHEMATICAL MODELS; AIR POLLUTION ABATEMENT; AIR POLLUTION CONTROL; EARTH ATMOSPHERE.

89025 Coal-Related Disease Detection. Hubner, K. (Oak Ridge Associated Universities, Oak Ridge, TN, 37830). **Project number:** 001928. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: coal(100). **R and D categories:** Health effects.

It is proposed to study occupational diseases associated with the coal industry, particularly chronic lung diseases. The methods used will be nuclear medical procedures to evaluate subtle and obvious changes in lung function and cytologic techniques on sputum, to evaluate premalignant changes and to detect early malignancy. Emphasis will also be placed on chronic obstructive pulmonary disease. In addition to work on black lung disease the program will examine methods of detecting minimal effects on workers to polynucleated aromatic hydrocarbon in an operational coal liquefaction pilot plant. The possibility of using cytogenetic technology will be investigated. The potential for using positron emitters with a computerized transaxial tomograph will be investigated.
Keywords: COAL; OCCUPATIONAL DISEASES; COAL INDUSTRY; RESPIRATORY SYSTEM DISEASES; LUNGS; NUCLEAR MEDICINE; DIAGNOSIS; NEOPLASMS; POLYCYCLIC AROMATIC HYDROCARBONS; PERSONNEL; COAL LIQUEFACTION PLANTS.

89030 Health Impact of Hydroelectric Power Research. Jobin, W. (Center for Energy and Environment, San Juan, PR). **Project number:** 001941. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: conservation(100). **R and D categories:** Health effects.

Ths study will investigate the ecology of existing hydroelectric reservoirs in Puerto Rico to determine the factors which cause or prevent health problems related to the reservoirs. The major health problem to be investigated is schistosomiasis. Existing reservoirs in Puerto Rico are primarily for hydroelectric power and irrigation. The 28 major reservoirs will be studied for one year to select six which represent various ages, sizes, and levels of eutrophication. For the following two years, the six reservoirs will be studied to determine water temperature, volume and quality, algal productivity, and productivity of macroscopic vegetation. Number and species for predicting water temperature, algal productivity, and mollusk populations will be calibrated with data from the first year of observation and then used to predict the second year. Field measurements will then be used to validate the models for the

second year data. These models will then be available for predictions and for other reservoirs proposed for Puerto Rico and other Caribbean sites.
Keywords: PUERTO RICO; WEST INDIES; HYDROELECTRIC POWER PLANTS; WATER RESERVOIRS; HEALTH HAZARDS; HUMAN POPULATIONS; SCHISTOSOMIASIS; DATA ACQUISITION; TEMPERATURE DISTRIBUTION; WATER QUALITY; AQUATIC ORGANISMS; ALGAE; MOLLUSCS; PRODUCTIVITY; EUTROPHICATION; DATA ANALYSIS; MATHEMATICAL MODELS; FORECASTING; EPIDEMIOLOGY; ECOLOGY.

89032 Transport Interactions of Environmental Pollutants with Essential Nutrients. Chertok, R.J. (UT-DOE Comparative Animal Research Laboratory, 1299 Bethel Valley Road, Oak Ridge, TN, 37830). **Project number:** 002204. **Contract:** EY-76-C-05-0242. **Supported by:** Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$450,000.
Related energy source: coal(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective of this program is to investigate, in a systematic manner with a variety of species, the gastrointestinal absorption, distribution, retention and excretion of pollutants that constitute a potential environmental hazard from fossil fuel combustion under a variety of nutritional and physiological stresses. To accomplish this objective, experiments are planned or underway to: (1) examine the transport kinetic interactions between cadmium and essential nutrients, metals and metabolites in the intestine, and examine subcellular and molecular components of the processes involved; (2) investigate the competition between iron and heavy metals for absorptive and transfer sites in various organ systems and determine the requirements for inhibition of the absorption of these pollutants or to decrease body burdens; (3) examine the movements and interactions of metals with essential nutrients during prenatal development; and (4) determine the interrelationships among heavy metals and essential nutrients for intestinal absorption and tissue metabolism.
Keywords: ENVIRONMENTAL TRANSPORT; POLLUTION; NUTRIENTS; GASTROINTESTINAL TRACT; INTESTINAL ABSORPTION; CADMIUM; IRON; METALS; METABOLISM; MERCURY; TOXICITY; CALCIUM; PHOSPHORUS; FOSSIL FUELS; DIGESTIVE SYSTEM; TOXICITY.

89038 Study of Immune Tolerance. Hyde, R.M. (University of Oklahoma, Health Sciences Center, Microbiology Dept., Oklahoma City, OK, 73190). **Project number:** 006075. **Contract:** AT(40-1)-3792. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
R and D categories: Health effects.

The research proposed will investigate the nature of the intracellular events which result in the loss of immunologic responsiveness to soluble human gamma globulin (sHGG) in mice. CBF1 mice will be placed on high dose regimens of various drugs, injected sHGG and used as T cell donors 4 to 48 hours later in immunologic reconstitution experiments. Syngeneic irradiated recipients will be injected with normal bone marrow cells plus thymus cells from animals treated with metabolic modulators and sHGG. Thymus cells will be cultured for short periods of time in vitro and the metabolic events which occur during the development of immune tolerance will be monitored. Attempts will be made to reverse tolerance by trypsin treatment to remove bound antigen. Suppressor cells will be isolated and the mechanism of the immunosuppressive activity will be investigated by the use of metabolic inhibitors.
Keywords: IMMUNE REACTIONS; MICE; GLOBULINS-GAMMA; GENETIC CONTROL; BIOLOGICAL RADIATION EFFECTS; DRUGS; IMMUNOSUPPRESSION; MAN; IMMUNITY.

89039 Studies in Iodine Metabolism. Middleton. (University of Tennessee, Knoxville, TN, 37917). **Project number:** 006096. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$54,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

We are testing techniques to hasten the release of radioiodine from thyroid glands. Major determinants of thyroidal retention of radioiodine are individual differences among otherwise similar rats. To seek a determinant of these differences, we will relate the biological half-life of thyroidal radioiodine to the total iodine in the thyroid gland of animals fed comparable diets. Total thyroidal iodine will be measured in vivo by isotopic equilibrium of 125I and 127I; the biological half-life will be measured in the same animals by use of 131I. We will utilize sucrose gradient ultracentrifugation and paper chromatography of hydrolysates to examine the abnormal thyroglobulin found in newborn rats derived from dams fed low iodine diets. We will also evaluate the delayed pregnancy which we have found in rats fed low iodine diet. We will continue weekly measurements of 131I and radium daughters in thyroids from cattle and sheep from USA, England, Germany, Japan, Formosa, Australia, New Zealand, and possibly Nigeria.
Keywords: IODINE 125; METABOLISM; IODINE 127; IODINE 131; THYROID; RETENTION; BIOLOGICAL HALF-LIFE; ULTRACENTRIFUGATION; THYROGLOBULIN; MEASURING METHODS; CHROMATOGRAPHY; PREGNANCY; RATS; RADIUM; DAUGHTER PRODUCTS; CATTLE; SHEEP; RADIONUCLIDE KINETICS.

89048 Biohazards Risk Analysis. Totter, J. (Oak Ridge Associated Universities, Oak Ridge, TN, 37830). **Project number:** 002555. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$220,000.
Related energy source: all(100). **R and D categories:** Health effects.

This program is conducted by a study group of the ORAU Institute for Energy Analysis which concentrates on biological problems associated with alternative energy technologies. The biohazards posed by radiation associated with the nuclear fuel cycle have been previously addressed by laboratory experimentation and epidemiological studies without producing many answers for contemporary energy policy. Much past work has been performed by ad hoc committees meeting for short periods of time to address specific issues. It has become increasingly obvious that future problems of risk estimate and standard setting will be beyond the expertise of biologists and health physicists and call for the services of engineers, political scientists, economists, sociologists, and others devoted to the resolution of short and long-range energy problems. The IEA proposes to utilize permanent staff members, consultants, and visiting scholars in the study of these problems.
Keywords: ENERGY SOURCE DEVELOPMENT; HEALTH HAZARDS; HUMAN POPULATIONS; RISK ASSESSMENT.

89052 Mutagenic Effect of Radionuclides Incorporated into DNA of Drosophila melanogaster. Lee, W.R. (Louisiana State University, Baton Rouge, LA, 70803). **Project number:** 006226. **Contract:** EY-76-S-05-3728. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$34,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objective of the project is to measure the genetic effect of tritium incorporated into specific sites in DNA or protein of Drosophila melanogaster spermatozoa. Work on this project 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 determine the genetic effect of tritium labeling in other positions within DNA and in a non-DNA molecule. Tritium is incorporated into specific sites in DNA or nuclear protein by feeding male larvae of D. melogaster precursors labeled with tritium. The amount of tritium per cell will be determined by liquid scintillation methods. The genetic tests for the effect of tritium disintegrations will be for (1) loss of Y or X chromatin, and (2) sex-linked recessive lethals observed as completes in the F-2 and as mosaics in the F-3. Temperature-sensitive sex-linked recessive lethal mutations and mutations at the Adh locus will be detected.
Keywords: TRITIUM; INTERNAL IRRADIATION; UPTAKE; DNA; PROTEINS; LABELLING; GENETIC RADIATION EFFECTS; DROSOPHILA; LETHAL MUTATIONS; RECESSIVE MUTATIONS; RADIOINDUCTION; MUTATION FREQUENCY; SPERMATOZOA; MUTAGENESIS.

89054 Repetitious Nature of Repaired DNA in Mammalian Cells. Meltz, M.L. (Southwest Foundation for Research and Education, P.O. Box 28147, San Antonio, TX, 78284). **Project number:** 006255. **Contract:** EY-76-S-05-4761. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE; SWF-$2,000.
R and D categories: Health effects.

The objectives are: (1) comparison of the extent of repair replication occurring in three different lines of human lymphoblastoid cells, a normal cell line (WIL2-A3) and the RAJI and EB-3 lines of Burkitt's lymphoma, upon ultraviolet light (uv) or methyl methane-sulfonate (MMS) treatment; (2) for the optimal conditions of induced DNA repair, an examination of the kinetic reassociation of the DNA undergoing MMS as compared to uv-induced repair; (3) determination in mouse L-929 cells, if, immediately or at different times after uv irradiation, the DNA synthesized semi-conservatively is representative of all classes of repetitious frequency, or whether synthesis of only one class continues after irradiation; and (4) initiation of studies on DNA single strand breakage as related to mutagenesis. The relative extents of DNA repair in the three cell lines were compared using cesium chloride--cesium sulfate density gradient procedures to isolate pre-existing repair replicated DNA. The extent of repair in EB-3 cells appears to be less than in the other two lines, after uv and MMS treatment. The DNA repair occurring in lymphoblastoid cells after uv irradiation, as measured by the DNA/DNA cot technique, is uniform; however, after MMS treatment, the reassociation of unique repair replicate DNA can be differentiated from that of semi-conservatively synthesized DNA. DNA semi-

conservatively synthesized immediately or at later times after uv irradiation, even though occurring at a reduced rate, is uniformly distributed throughout the genome.
Keywords: DNA; ANIMAL CELLS; BIOLOGICAL REPAIR; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; CARCINOGENS; MUTAGENESIS; BIOSYNTHESIS; METHYL METHANESULFONATE; MAMMALS.

89059 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, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$27,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are to understand the role of cellular repair processes in mutagenesis induced by chemical carcinogens and radiation. To determine the kinds of genetic toxicity induced by carcinogens in bacteria having various defective repair processes, the Salmonella/microsomal activation, Bacillus subtilis and Escherichia coli prophage induction, partially diploid recombination test systems will be employed. Radiation repair defective mutants and bacterial lysogens have provided evidence of genetic toxicity for carcinogens which give little or no evidence of gene mutagenicity. Mutations are induced in transforming DNA in vitro only when the donor strain of Bacillus subtilis carried the affected genes in a partially diploid state.
Keywords: MUTATIONS; MUTAGENS; CARCINOGENS; RADIOSENSITIVITY; BACTERIA; BIOLOGICAL REPAIR; DNA; GENETIC RADIATION EFFECTS; BACILLUS SUBTILIS; ESCHERICHIA COLI.

89060 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:** Health effects; Ecological/biological processes and effects.

The objective of the project is to characterize the events leading from the absorption of radiation energy to the expression of damage at the cellular level. DNA and intact bacterial cells will be irradiated with x rays in the presence and absence of selected chemical agents to determine how these additives affect radiation sensitivity. Spores of B. megaterium will be used in uptake studies with some of these agents and in studies on radiation-induced chemical events leading to cell death; DNA (isolated from B. subtilis) will be used to study the effects these additives have on radiation-induced, in vitro loss of transforming ability. Pulsed electrons will be used to study the chemical yields and reaction rates of chemical products of irradiation with the chemistry studies being done under conditions as closely identical to the biological studies as possible. Results of such studies when correlated with the biological results should give information on the chemistry involved in radiation damage and the actions of environmental contaminants (metals) in affecting the radiation response.
Keywords: X RADIATION; IRRADIATION; BACTERIAL SPORES; BACILLUS MEGATERIUM; BIOLOGICAL RADIATION EFFECTS; CELL KILLING; DNA; CHEMICAL RADIATION EFFECTS; BIOCHEMICAL REACTION KINETICS; METALS; RADIOSENSITIVITY EFFECTS; IN VITRO; IN VIVO; CADMIUM; COPPER.

89064 Ecological Behavior and Effects of Energy Related Pollutants. Platt, R.B. (Emory University, Department of Biology, Atlanta, GA, 30322). **Project number:** 6351. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine how plant communities respond to sustained periods of exposure to sulfur dioxide. Tree, grass, shrub, and weed species native to the Copper Basin will be surveyed at different distances from the pollution source. Plants will be exposed to varying concentrations of sulfur dioxide in chambers and classified according to susceptibility.
Keywords: SULFUR DIOXIDE; ENVIRONMENTAL TRANSPORT; METABOLISM; PLANTS; TERRESTRIAL ECOSYSTEMS.

89066 Ecology of South Florida Estuarine Systems. 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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 lead 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.

89069 Dynamics of the Recovery of Damaged Tundra Vegetation. Amundsen, C.C. (University of Tennessee, Knoxville, TN, 37916). **Project number:** 6402. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

89070 Geochemistry of Uranium and Thorium Series Nuclides and of Plutonium in the Gulf of Mexico. Scott, M.R. (Texas A and M Univsersity, Dept. of Oceanography, College Station, TX, 77843). **Project number:** 6403. **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: all(100). **R and D categories:** Physical and chemical processes and effects.

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.

89071 Studies of Drosophila Dispersal and Species Packing. Richardson, R.H. (University of Texas at Austin, Dept. of Zoology, Austin, TX, 78712). **Project number:** 6404. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$33,000.
R and D categories: Ecological/biological processes and effects.

The objectives are to: (1) investigate population structure in rapidly evolving and/or ecologically disrupted population; (2) determine if isolated sub-populations within a single area are representing incipient or actual species; (3) relate evolving isolated sub-populations to species packing, to community complexity, and to community stability; and (4) relate behavioral processor 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.

89073 Investigation of the Unusual Behavior of Cesium-137 and Other Radionuclides in the Florida Environment. Gamble, J.F. (University of Florida, Botany Department, 2177 McCarty Hall, Gainesville, FL, 32611). **Project number:** 6438. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.
Related energy source: nuclear fusion(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of this project is to establish fallout cesium-137 levels in compartments of selected managed and natural ecosystems in Florida. Emphasis is on dairy and beef-forage and mesic hardwood forest. The mechanism(s) responsible for the concentration of Cs-137 were determined and an analog model for the cycling of Cs-137 in Floirda is under development. Major compartments of selected ecosystems were sampled and Cs-137 activity levels were determined using low-level radioassay techniques in combination with Cs specific, ion exchange resins for concentrating Cs-137. Low level (mu-Ci) radiotracer Cs-134 was used in field and greenhouse experiments. Results are inconclusive and the project is in its terminal year.
Keywords: FLORIDA; TERRESTRIAL ECOSYSTEMS; RANGELANDS; FORESTS; RADIONUCLIDE MIGRATION; FALLOUT DEPOSITS; CESIUM 137; RADIOECOLOGICAL CONCENTRATION; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; COMPARATIVE EVALUATIONS.

89074 Atmospheric Tritium. Ostlund, M.G. (University of Miami, 4600 Richenbacker Causeway, Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL, 33149). **Project number:** 6446. **Contract:** EY-76-S-05-3944. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

89075 Biophysical Studies Related to Energy Generation. Gree, A.E.S. (University of Florida, Gainesville, FL). **Project number:** 006461. **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:** Characterization, measurement, and monitoring.

We will continue to develop our understanding of the physical stage of the interaction of radiation with inert matter and living organisms. We will extend our efforts on dose-response relationships especially related to energy generation. In particular our proposed work includes: (1) continued fundamental work on the spatial and energy aspects of charged particle deposition, (2) continued atomic and molecularly charged particle and photon cross-sections needed in radiation physics, (3) further development of microscopic models of cell damage and carcinogenesis induced by ultraviolet and charged particle radiation, (4) further development of macroscopic dose-response models applicable to public policy methodologies for the abatement of environmental pollutants related to energy generation, and (5) a small effort toward testing of the Disaggregated Cost/Benefit Decision Model developed in the ICAAS/Florida Sulfur Oxides Study by analysis of simpler situations.
Keywords: POWER GENERATION; BIOLOGICAL RADIATION EFFECTS; CHARGED PARTICLES; DEPOSITION; BIOLOGICAL EFFECTS; CROSS SECTIONS; CARCINOGENESIS; BIOLOGICAL MODELS; ULTRAVIOLET RADIATION; DOSE-RESPONSE RELATIONSHIPS; ENVIRONMENTAL POLICY; AIR POLLUTION ABATEMENT; DECISION MAKING; SULFUR OXIDES.

89076 Electronic Properties of Liquids. Painter, L. (University of Tennessee, Knoxville, TN). **Project number:** 006484. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$32,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

Techniques have been developed for measuring the electronic structure of condensed materials. This technique consists of measuring the reflectances from the surfaces of solids in the visible and ultraviolet spectral region as a function of the angle of incidence of the light. Such data are analyzed to yield the real and imaginary parts of the dielectric constants, epsilon(1) and epsilon(2), and the energy loss function, -im(1/epsilon). The possibility of utilizing such a technique in the study of the electronic properties of liquids was examined first by the contractor during the years 1966 to 1968 wherein she was able to determine the dielectric response of pure water in the region from 2000 to 1050 Angstrom. Under the present contract a new open-dish windowless reflectometer with movable monochromator was constructed in order to extend the studies on liquid water to shorter wavelength (high energy). Reflectance measurements on water with the new cell have been taken in the spectral region from 1350 to 500 Angstrom and the data analyzed to yield the optical and dielectric constants of the liquid. Similar techniques have been used in the study of two silicon diffusion pump oils, Dow Corning 704 and 705 (tetramethyltetraphenytrisiloxane and trimethylpentaphenytrisiloxane, respectively) two linear hydrocarbons, tetradecane and heptadecane, on glycerol, bovine albumin, and DNA. Similar studies have been made on solutions of fucose, cholesterol and the phospholipid lecithin.
Keywords: ELECTRONIC STRUCTURE; LIQUIDS; SILOXANES; ALKANES.

89078 Development of a Diving and Hyerbaric Information Center. Shilling, C. (Undersea Medical Society, Inc., 9650 Rockville Pike, Bethesda, MD). **Project number:** 007150. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$10,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.

Under the auspices of the Undersea Medical Society and cosponsored by NIOSH, NOAA, EPA and NHLI, a series of workshops were held with representatives of the academic community, diving industry, US Navy and US Coast Guard. These workshops were specifically to formulate a national plan for research on medical problems relating to diving.
Keywords: DIVING OPERATIONS; MEDIUM PRESSURE; HEALTH HAZARDS; OCCUPATIONAL SAFETY; BIOLOGICAL EFFECTS; INFORMATION CENTERS; PHYSIOLOGY; MAN; OFFSHORE OPERATIONS.

89080 Energy Analysis of Models of the United States. Odum, H. (University of Florida, Department of Environmental Engineering Sciences, Gainesville, FL, 32611). **Project number:** 6608. **Contract:** S054398. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

This is a renewal proposal to continue developing and evaluating an analysis model of the United States including energy sources, sectors of the economy and environmental interaction. Included in this year's objectives are transportation alternatives, potentials of a wood economy, air conditioning, shaft-mined coal, health care, air pollution, energy analysis of disasters of earthquake, hurricane, tornado, etc., the simulation of a state energy model (Florida), the calculation of energy quality of natural gas, peat, wood, soil, land, and other main components of the U.S. systems. The methods we use differ in several ways from those used by others. A special effort will be made to review reports and publications on net energy and energy analysis by other groups making energy analysis diagrams with their data for comparing, locating and showing what differences there are in what is included and how these differences make conclusions different. Energy quality evaluations will be used to make maps of U.S. energy expressed in equivalent units and from these a map of combined energy potentials for the country. Eight questions of energy theory will be explored.

Keywords: USA; ENERGY ANALYSIS; ENERGY QUALITY; NET ENERGY; ECONOMIC ANALYSIS; MATHEMATICAL MODELS; ENERGY SOURCES; ENVIRONMENTAL EFFECTS; FLORIDA; ENERGY MODELS; NATURAL GAS; PEAT; WOOD; SOILS; EVALUATION; ENERGY SOURCE DEVELOPMENT; ENERGY CONSERVATION.

89082 Biodegradation of Organo Sulfur Compounds in High Sulfur Crude Oil. Rigau, J.J. (Center for Energy and Environmental Research, San Juan, PR, 00935). **Project number:** 002649. **Contract:** EY-76-C-05-1833. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$77,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The upgrading of heavy and extraheavy crude oils today represent a technological problem and a strategically invaluable source of energy. To help reduce the environmental impacts involved in the commercialization of such new sources, it is proposed to optimize the microbial degradation of organosulfur compounds in high sulfur crude oil. The technical approach involves: (1) selection of microorganisms; (2) determination of the optimal growth conditions for mass culture; (3) definition of optimal reaction conditions; and (4) performance of laboratory scale demonstration. Pseudomona aeruginosa PRG I, an isolate from oil-contaminated soils degraded benzothiophene (BT), in a basal medium containing yeast extract. The simultaneous presence of glucose and BT in the basal medium containing yeast extract led to diauxic growth. The characterization of this system is being explored. Potential organosulfur degrading organisms have been isolated from various locations in Puerto Rico and Venezuela. A bench scale continuous fermentor which uses anthracite coal as a support is being used for the growth of selected organisms.
Keywords: RESIDUAL FUELS; PROCESSING; ORGANIC SULFUR COMPOUNDS; BIODEGRADATION; PSEUDOMONAS; ENVIRONMENTAL IMPACTS; THIONAPHTHENES; PETROLEUM.

89083 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Ecological/biological processes and effects.

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.

89084 Seagrass Community Processes in Coastal Zones of the Semitropics and Tropics. Thorhaug, A. (University of Miami, 600 Grapetree Drive, Key Biscayne, FL, 33149). **Project number:** 006700. **Contract:** AT(40-1)-4493. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$47,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Ecological/biological processes and effects.

The objectives are to assess energy related pollutant impact on nearshore semitropical seagrass communities (specifically, the effects of heat, high salinity, heavy metals and radionuclides --Zn, Cf, Pd, Co, etc.--on the survival and productivity of the plant community and elements of the animal community) and to find alternatives, such as restoring plant communities, to the pollution effects. Combined laboratory and field studies on the major plants in the ecosystem, including seagrasses, especially the dominant Thalassia testudinum, macroalgae, microalgae (epiphytes), and phytoplankton, are conducted. Field measurements include effect of heat, salinity, silt, heavy metals and radionuclides on standing crop and productivity. Laboratory measurements include defining lethal limits and effects of temperature, high salinity, light, heavy metals and radionuclides.
Keywords: COASTAL REGIONS; ARID LANDS; GRASS; COMMUNITIES; SALINITY; BIOLOGICAL EFFECTS; HEAT; TEMPERATURE EFFECTS; METALS; ZINC; COBALT ISOTOPES; CALIFORNIUM ISOTOPES; PALLADIUM ISOTOPES; RADIONUCLIDE KINETICS; TOXICITY; BIOLOGICAL RADIATION EFFECTS.

89089 Interaction of Slow Electrons with High-Pressure Gases (Quasi-Liquids). Christ, L.G. (University of Tennessee, Knoxville, TN, 37916). **Project number:** 006842. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$48,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

Our work on the interaction of slow electrons with molcules in dense gases will continue with emphasis on atmospheric pollutants such as CO2, H2S, NO2. Accurate measurements of the rates and the cross sections for attachment of slow electrons to molecules at various pressures and in various media will provide effective ways to elucidate the collision kinetics of electron-molecule interaction processes. Such information is necessary for understanding physicochemical reaction pathways in the atmosphere and helpful in unifying the modeling of gas-phase phenomena with those in the condensed phase. In addition, knowledge on slow electron-molecule interactions, especially on negative-ion states, is synthesized.
Keywords: ELECTRON-MOLECULE COLLISIONS; GASES; CARBON DIOXIDE; HYDROGEN SULFIDES; NITROGEN DIOXIDE; CROSS SECTIONS; ELECTRON ATTACHMENT; PRESSURE DEPENDENCE; REACTION KINETICS; EARTH ATMOSPHERE; CHEMICAL REACTIONS; AIR POLLUTION.

89090 Development and Application of Some Fast Neutron Dosimetry Techniques Utilizing P and ASTIC Trace Detectors. Sohrabi, M. (Georgia Institute of Technology, Atlanta, GA). **Project number:** 006871. **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:** Characterization, measurement, and monitoring.

The amplified track-etch detector work at Georgia Institute of Technology has attracted widespread interest in health physics and radiotherapy centers throughout the world. The track-etch detector work is focused on fast neutron dosimetric problems and will include fast neutron dosimetry intercomparison, applications to neutron radiography, radiobiological applications and the exploration of some improved track reading techniques. Controlled electrochemical etching amplification of recoil particle tracks in polymer file dosimeters and neutron radiographs should make major breakthroughs in these technologies possible.
Keywords: DIELECTRIC TRACK DETECTORS; FAST NEUTRONS; NEUTRON DOSIMETRY; ETCHING; PARTICLE TRACKS; RECOILS; NEUTRON RADIOGRAPHY; PERFORMANCE.

89091 Environmental Aspects of Coal Production in the Appalachian Region. Minear, R.A. (University of Tennessee, Department of Civil Engineering, Knoxville, TN, 37916). **Project number:** 7010. **Contract:** EY-76-S-05-4946. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$218,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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, climatological 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 mining effects. Biological effects and recovery behavior after strip mining have been evaluated.
Keywords: COAL MINING; ENVIRONMENTAL EFFECTS; HYDROLOGY; METEOROLOGY; SPOIL BANKS; METALS; PARTICLE SIZE; WATER QUALITY; REGIONAL ANALYSIS; COST BENEFIT ANALYSIS; SURFACE MINING; CHEMICAL EFFLUENTS; ECOSYSTEMS; TOXINS; WATER; SEDIMENTS.

89093 Coordination: Gulf of Mexico Studies. Treadwell, T.K. (Texas A and M University, College Station, TX, 77843). **Project number:** 7075. **Contract:** 76-S-05-5017. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated 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.

89095 DTPA Chelation Therapy. Lushbaugh. (Oak Ridge Associated Universities, Oak Ridge, TN, 37830). **Project number:** 002496. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: all(100). **R and D categories:** Health effects.

The main objective is to provide impetus to develop DTPA for safe clinical usage in decorporation of transuranic contaminants as part of the broad DOE program focused on reducing health risks of workers in nuclear power technology. It provides the best chelator drug available for Pu decorporation to U.S. physicians responsible for occupational medicine in DOE plants and contractor facilities; annual surveillance of their clinical experience with the drug pentamil (Cana-3-DTPA) for FDA; and scientific overview assistance to the BER technical staff responsible for providing research support aimed at the development of more efficient chelating drugs, as well as support of a development of more efficient chelating drugs. It also provides support of a DTPA steering committee and short-term pragmatic research needed for quick looks at potentially hazardous situations as identified by the committee.
Keywords: NUCLEAR INDUSTRY; RADIATION HAZARDS; HEALTH HAZARDS; RADIOLOGICAL PERSONNEL; CONTAMINATION; PLUTONIUM ISOTOPES; RADIONUCLIDE KINETICS; EXCRETION; DTPA; BIOLOGICAL EFFECTS; US ERDA; US DOE; RESEARCH PROGRAMS; THERAPY; CHELATES.

89099 Benthic Community Metabolism on the Continental Shelf of the Northern Gulf. Pamatmat, M.M. (Auburn University, Agricultural Experiment Station, Auburn, AL, 36830). **Project number:** 007103. **Contract:** EE-77-S-05-5465. **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/biological processes and effects.

The objective is to provide background to assess the impacts of oil-gas activities in the Gulf of Mexico. Seasonal studies of benthic community metabolism along transects on the continental shelf of Florida, Alabama, Mississippi and Louisiana will be conducted. Measurements will include total O2 uptake, uptake after formaldehyde poisoning (to measure chemical oxidation), assay of dehydrogenase activity and ATP levels (anaerobic metabolism), estimation of respiratory quotient and analyses of sediment for pH, Eh, reduced substances, organic carbon and nitrogen, plant pigments and their degradation products, silt and clay content. The same measurements will be taken around an existing oil rig in the Gulf. Direct calorimetry will be applied in order to make a comparative study of metabolic heat release, dehydrogenase activity and ATP concentrations.
Keywords: GULF OF MEXICO; CONTINENTAL SHELF; COASTAL WATERS; AQUATIC ECOSYSTEMS; SEASONAL VARIATIONS; AQUATIC ORGANISMS; BENTHOS; BIOMASS; RESPIRATION; OXIDATION; METABOLISM; SEDIMENTS; ANAEROBIC CONDITIONS; ENZYMES; BIOCHEMICAL REACTION KINETICS; OIL WELLS; OFFSHORE DRILLING; OCEANOGRAPHY; ENVIRONMENTAL EFFECTS; BASELINE ECOLOGY; FLORIDA; ALABAMA; MISSISSIPPI; LOUISIANA.

89103 Effects of Fossil Fuel Pollutants. Jobin, W. (Center for Energy and Environment, San Juan, PR). **Project number:** 002512. **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:** Health effects.
Keywords: FOSSIL FUELS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; AIR POLLUTION; WATER POLLUTION; BIOLOGICAL EFFECTS.

89106 Conference on Ecological Effects of Hydrocarbon Spills in Alaska. Hobbie, J.E. (Woods Hole Oceanographic Institution, Marine Biological Laboratory, Woods Hole, MA, 02543). **Project number:** 8006. **Contract:** EY-76-S-02-2989. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
Related energy source: oil and gas(100). **R and D categories:** Ecological/biological processes and effects.

A symposium will be held to present information on the ecological effects of hydrocarbon spills in Alaska. Papers will be prepared before the meeting and scientists from outside the project will provide review at the meeting. The result will be a series of reviewed papers ready for publication. This will provide rapid publication of data and conclusions from a number of research projects. It is expected that these papers will be published together.
Keywords: ALASKA; OIL SPILLS; HYDROCARBONS; MEETINGS; ECOSYSTEMS; BIOLOGICAL EFFECTS.

89107 Oil Spill Training Curriculum. Gilchrist, R. (Texas A and I University, Corpus Christi, TX, 78411). **Project number:** 800064. **Contract:** EY-76-S-05-4995. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A program is conducted to provide a trained manpower base to respond to the needs of the nation in controlling the problems created by oil spills. The program comprises development of a curriculum for training key personnel of companies, organizations and government units to effectively and adequately contend with oil spill emergencies. Training aids and instructional materials were completed and classes were conducted.
Keywords: OIL SPILLS; MANAGEMENT; PERSONNEL; EDUCATION; MANPOWER; CONTROL.

89108 Puerto Rico Energy Model: An Aid for the Decision Process in Regional Environmental Policy Formation. Lugo, S. (University of Puerto Rico, Center for Energy and Environmental Research, San Juan, PR). **Project number:** 2647. **Contract:** EY-76-C-05-1833. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$150,000.
Related energy source: fossil fuels(25); nuclear fuels(general)(25); solar(25); conservation(25). **R and D categories:** Integrated assessment.

The objectives are to develop quantitative tools leading to improvement of our understanding of the energy system and to improve energy policy analysis for decisionmaking related to the selection of strategies and goals. The methods employed are to: (1) develop and evaluate the Econometric Growth Model of Puerto Rico; (2) document and assess the demographic submodel; (3) assess demand submodels for each sector; and (4) determine relation of environmental impact (particularly in relation to the air contaminants and associated epidemiological incidence). The results expected are: (1) assessment of the predictive capacity of the econometric Growth Model; (2) use of the atmospheric dispersion model for the industrial areas of Guarjanilla and Catano; (3) completion of primary sources data bank; and (4) completion of alternate energy source profiles. A synposis of the energy situation of Puerto Rico in 1976 was completed April 1977. Evaluation of economic models and applications was completed September 1975. The development of energy model was completed January 1977. A system for energy was fully implemented September 1976 and models were completely implemented August 1977.
Keywords: ENERGY MODELS; ENERGY POLICY; PUERTO RICO; DECISION MAKING; AIR POLLUTION; HUMAN POPULATIONS; ECONOMETRICS; POPULATION RELOCATION; EPIDEMIOLOGY.

89112 Health and Mortality Study. Tompkins, E. (Oak Ridge Associated Universities, Oak Ridge, TN, 37830). **Project number:** 002493. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$560,000.

Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective of the DOE health and mortality study is to evaluate on a continuing basis the disability and mortality experience of persons with a history of employment in selected installations associated with the nuclear industry. The primary purpose of the study is to determine if such employment histories are associated with an increase in age-sex-specific mortality in general, or with an increase in age-sex-specific mortality due to selected causes of death. Some determinant factors to be studied are: the adequacy of comparison populations to predict the expected mortality experience of the defined study population; the type, level, and dose rate of radiation exposure of the study population; and the length of time elapsed from first employment in a nuclear industry to morbidity and mortality.

Keywords: MORTALITY; NUCLEAR INDUSTRY; RADIOLOGICAL PERSONNEL; OCCUPATIONAL DISEASES; AGE DEPENDENCE; SEX DEPENDENCE; HUMAN POPULATIONS; DOSE RATES; HEALTH HAZARDS.

89113 Physical and Chemical Properties of a Geothermal Submarine Spring. Pyle, T.E. (University of South Florida, Department of Marine Science, St. Petersburg, FL, 33701). **Project number:** 7367. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

89115 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:** Health effects.

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.

89116 Management of the Red Cockaded Woodpecker, an Endangered Species. Jackson, J.A. (Mississippi State University, Dept. of Zoology, State College, MS, 39762). **Project number:** 7241. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$34,000.

Related energy source: biomass(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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. Continuing studies of habitat use by Red-Cockaded Woodpeckers (Picoides borealis) on the Savannah River Plant in Aiken and Barnwell Counties, South Carolina, will include intensive study of three clans whose habitat is very similar and whose home ranges are nearly contiguous and two clans whose habitats differ and whose home ranges are not contiguous with other Red-Cockaded Woodpecker clans. A grid consisting of 100 one hectare squares has been centered on each colony site along north-south, east-west lines and will provide an arbitrary sample area in which to evaluate differential habitat use by each clan. (Such a grid approximates the normal home range size of a clan.) Vegetation and arthropod population parameters of each grid square are being measured and will ultimately be related to the activities of the Red-Cockaded Woodpeckers. Once habitat use data have been collected for one year, randomly selected grid squares exhibiting differing habitat features will be treated by various means of forest management and continuing observations will be made in order to ascertain the effects of management on habitat use by the birds. In addition to this approach at habitat use analysis, we will also evaluate the effect of removing trees that crowd cavity trees or potential cavity trees on cavity tree abandonment rate and cavity start initiation rate. Results of this study and data on other aspects of the ecology of Red-Cockaded Woodpeckers collected incidental to this study will further our understanding of the needs of this endangered species and hopefully facilitate management to restore the species to a non-endangered status.

Keywords: BIRDS; MANAGEMENT; ENDANGERED SPECIES; FOOD; FORESTS; WILD ANIMALS; POPULATIONS; HABITAT.

89117 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:** 7158. **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: all(100). **R and D categories:** Physical and chemical processes and effects.

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.

89119 Development of Transport Models. Spalding, G.E. (UT-DOE Comparative Animal Research Lab., 1299 Bethel Valley Road, Oak Ridge, TN, 37830). **Project number:** 002287. **Contract:** EY-76-C-05-0242. **Supported by:** Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$387,000.

Related energy source: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Health effects; Ecological/biological processes and effects.

Mathematical modeling of transport data is needed in order to enhance our ability to extrapolate experimental data to man and to strengthen our ability to predict the result of as yet unperformed (or unperformable) experiments. To satisfy this need, CARL has developed a major biomodeling program to ascertain mammalian uptake, transport and distribution of heavy metal pollutants resulting from fossil fuel combustion. The program involves strong interaction

between data collection and data analysis efforts, the objective being to develop whole-body pollutant-transport models for several species in various developmental stages. The ultimate goal is to apply the model to man through interspecies comparisons of model structure and parameters. An important step in meeting this goal is the production of a "unified model" applicable to various mammalian species at several developmental stages. Current studies include those on gastrointestinal uptake and transport of cadmium, mercury, calcium and iron, and limited studies on the actinides.
Keywords: ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; METABOLISM; BIOLOGICAL MODELS; MAMMALS; UPTAKE; METALS; ECOLOGICAL CONCENTRATION; FOSSIL FUELS; COMBUSTION PRODUCTS; HEALTH HAZARDS; DATA ANALYSIS; DATA ACQUISITION; BIOLOGICAL PATHWAYS; EXPERIMENT PLANNING; BIOCHEMISTRY; POLLUTION; CADMIUM; MERCURY; CALCIUM; IRON; ACTINIDES; RADIONUCLIDE KINETICS; RADIONUCLIDE MIGRATION.

89130 Radiation Emergency Assistance Center. Lushbaug, C. (Oak Ridge Associated Universities, Oak Ridge, TN, 37830). **Project number:** 001404. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$741,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objectives of this program in nuclear occupational medicine emanate from our continuing needs for direct observations of man's radiosensitivity and of his early and late diseases resulting from prompt large and small protracted radiation exposures. To meet national goals for optimum projection of health while new and old means for producing energy are being developed and expanded, programs such as this one are needed to help keep our systems of medical surveillance up to date and train new cadres of physicians in accident management. At the same time, because existing therapy for radiation injuries is largely symptomatic and expensive in terms of the time involved, improvements are needed. Specifically, the objectives are to improve US medical readiness for radiation accidents by re-education of medical personnel in this field to develop a living registry for the preservation and study of records of human radiation injuries, and improvement of chelation therapy of plutonium contamination, to provide indepth medical follow-up studies (including modern cytogenetic studies) to determine the ultimate fate of overexposed persons, and to help improve therapy of specific radiation-induced lesions by experimental study.
Keywords: NUCLEAR MEDICINE; RADIOSENSITIVITY; RADIATION DOSES; RADIATION PROTECTION; ENERGY SOURCES; MEDICAL PERSONNEL; RADIATION INJURIES; RADIATION ACCIDENTS; PLUTONIUM; THERAPY; MAN; HEALTH HAZARDS.

89133 Mutagenesis in the Long-Lived Mammal. Erickson, B.H. (UT-DOE Comparative Animal Research Laboratory, 1299 Bethel Valley Road, Oak Ridge, TN, 37830). **Project number:** 002654. **Contract:** EY-76-C-05-0242. **Supported by:** Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$380,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objective of this project is to evaluate potential chemical mutagenic risk from coal conversion products and thereby develop a broadened base for accurate extrapolation of risk data to man. It is necessary to: (1) identify, describe, and determine temporal limits of various gametogenic stages in long- and short-lived species; (2) determine, as functions of gametogenic stage and species, effects of these mutagens on germ cell quantity and quality; and (3) relate these germ cell studies to readily-measured mutational events in somatic cells. Specific experiments include studies of germ cell survival, reproductive performance, and germ and somatic cell cytogenetics. Our studies demonstrated that primitive stem germ cells in swine are more vulnerable to cell-killing effects of radiation than those of rat or mouse. Are long-lived mammals' germ cells also more vulnerable to mutation. To find out, we examine cytotoxicity and mutagenicity in the oogonium, preleptotene oocyte, mitotically active gonocyte, interphase gonocyte, and definitive stem spermatagonium of swine, cattle, mouse, and rat. Species differences in resistance to chromosome damage are known, but the factors causing such differences are not adequately identified. Studies of several species closely resembling man (in size, physiology, metabolic rate, etc.) and comparisons of their sensitivity to chromosome damage will provide basic knowledge of the mechanisms leading to chromosome defects.
Keywords: COAL; COMBUSTION PRODUCTS; MUTAGENESIS; TERATOGENESIS; CATTLE; MICE; RATS; SWINE; GERM CELLS; CHROMOSOMAL ABERRATIONS; MUTATIONS; REPRODUCTION; TOXICITY; COMPARATIVE EVALUATIONS; RISK ASSESSMENT.

89134 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, Oak Ridge, TN (USA). Oak Ridge Operations Office. **Funding:** DOE-$315,000.
Related energy source: fossil fuels(15); biomass(75); conservation(10). **R and D categories:** Ecological/biological processes and effects.

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.

89135 Long-Term Mortality Study of Workers Occupationally Exposed to Elemental Nickel at the Oak Ridge Gaseous Diffusion Plant. Thompkins, E.A. (Oak Ridge Associated Universities, Oak Ridge, TN, 37830). **Project number:** KY-01-02-01-4. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office; International Nickel Co., Inc., New York (USA). **Funding:** DOE-$100,000; INCO-$100,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objective is to evaluate the health effects of handling nickel powder and to help in determining whether a recent NIOSH proposal to reduce tolerable airborne nickel levels by a factor of 200 is necessary with regard to elemental nickel. The project includes an epidemiologic study of ORGDP workers exposed to nickel with an examination of environmental exposures and associated industrial hygiene monitoring.
Keywords: ORGDP; HEALTH HAZARDS; NICKEL; BIOLOGICAL EFFECTS; PERSONNEL; MORTALITY; MAXIMUM PERMISSIBLE CONCENTRATION; INHALATION; EPIDEMIOLOGY; TOXICITY.

89501 AEC Health Study, Chronic Radiation Exposure: Correlation of Radiation Exposure with Biological Effect. Kirkli, C.W. (Hanford Environmental Health Foundation, Richland, WA). **Project number:** 000408. **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:** Health effects.

This project is to determine the long-range effect of low-level long-term occupational radiation exposure on man. The Department of Energy Richland Location (DOE-RL) contractors employees' health, radiation exposure, and job assignment records have been compiled and organized in a data file dating from 1944. This, with other data, is being studied to develop relationships between radiation exposure and mortality. Data accumulation includes (1) employee identification data, (2) employment history, (3) sibling control groups, (4) occupational radiation exposure (internal and external), (5) medical x-ray exposure, (6) medical examination data, (7) environmental exposure other than radiation, and (8) mortality data.
Keywords: CHRONIC IRRADIATION; RADIATION DOSES; NUCLEAR INDUSTRY; DATA COMPILATION; MORTALITY; PERSONNEL; OCCUPATIONAL DISEASES; MEDICAL PERSONNEL; BIOMEDICAL RADIOGRAPHY; HEALTH HAZARDS; BIOLOGICAL RADIATION EFFECTS.

89502 U.S. Transuranium Registry of DOE Contractor and Licensee Employees. Nororo, J.A. (Hanford Environmental Health Foundation, Richland, WA, 99352). **Project number:** 000409. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The U.S. Transuranium Registry was established in 1968 to study the internal deposition of transuranic elements in workers occupationally exposed to these substances. An important aspect has been to compare transuranic deposition estimates made during life with tissue distribution and concentration in autopsy specimens.

Investigation of the health status, longevity and causes of death among transuranic workers is also a goal of the registry. Fourteen thousand transuranium workers have been identified at DOE contractor and NRC licensee plants; 855 prearranged autopsy permissions have been obtained and 66 autopsies completed. In general, smaller systemic and larger lung depositions of plutonium have been found than were predicted by antemortum health physics estimates. Efforts are in progress to increase participation in the USTR by sites employing transuranic workers, and to improve autopsy procedures and tissue preparation.
Keywords: TRANSURANIUM ELEMENTS; DEPOSITION; TISSUE DISTRIBUTION; PERSONNEL; DOCUMENTATION; AUTOPSY; LICENSING; LUNGS; PLUTONIUM; RADIATION HAZARDS.

89508 Solute Drag and Membrane Transport. Van Bruggen, J.T. (University of Oregon Health Sciences Center, Portland, OR, 97201). **Project number:** 006263. **Contract:** EY-76-S-06-2226. **Supported by:** Department of Energy, Richland, WA (USA). Richland Operations Office. **Funding:** DOE-$10,000.
R and D categories: Characterization, measurement, and monitoring.

This laboratory discovered a new physical phenomena associated with the interaction (collision) of molecules in solution. When molecules collide in free solution the diffusion coefficients of one each of the pair are influenced. In general, free solution interaction reduces the diffusion coefficient and there is no useful effect of such collisions. When a membrane separates two solutions and the processes of transmembrane diffusion is being studied, molecular (solute) interaction can lead to a large unidirectional effect. The large asymmetric flux of a second solute caused by the presence of a hyperosmotic agent (first solute) on one side of the membrane has been given the descriptive name solute drag. The present studies are directed to defining the specifics of molecular structure, molecular size, etc. of the solute drag. We are attempting to guantitate the phenomena and to describe conditions under which solute drag may be put to practical use. Details of the approach have been described in a series of publications from this laboratory, the latest of which was entitled "Solute Flux Coupling in a Homopore Membrane." This appeared in the J. Gen. Physiol. 83, 639-656(1974). The usual experiment involves following the flux of a radioactive tracer as it moves from one chamber to another across a selected membrane. Solutes other than the tracer are added to the solutions in appropriate amounts to elicit solute-solute interaction and solute drag.
Keywords: AQUEOUS SOLUTIONS; MEMBRANES; MOLECULES; MEMBRANE TRANSPORT; DIFFUSION; IN VITRO; TRACER TECHNIQUES; MOLECULAR BIOLOGY; METABOLISM; SEPARATION PROCESSES.

89513 Trace Metal Associations in Sub-Arctic Fjord Environments. Burrell, D.C. (University of Alaska, Fairbanks, AK, 99701). **Project number:** 6324. **Contract:** E(45-1)-2229, Task 1. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$58,000.
Related energy source: fossil fuels(50); oil and gas(50). **R and D categories:** Physical and chemical processes and effects.

The identification and characterization of physical and chemical processes responsible for transporting, immobilizing, remobilizing and transfering between constituent phases, heavy metals in Alaskan ecosystems, particularly fjord estuaries. A multi-faceted basic research program currently emphasizing the role of copper will be used. The approach includes: (1) laboratory studies on chemical speciation in saline solutions; (2) exchange between natural solid inorganic phases and estuarine waters; (3) remobilization and migration at and from the sediment-water interface; (4) transport processes (advection and diffusion within fjords); and (5) development of the analytical methods required for the previous objectives.
Keywords: AQUATIC ECOSYSTEMS; ESTUARIES; ALASKA; ENVIRONMENTAL TRANSPORT; COPPER; TRANSLOCATION; WATER POLLUTION; MEASURING METHODS.

89520 Mechanisms of Transfer of Energy and Biomass in Marine Coastal Ecosystems of the Pacific Northwest. Anderson, G.C. (University of Washington, Department of Oceanography, Seattle, WA, 98195). **Project number:** 6511. **Contract:** AT(45-1)-2225 No. 26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$281,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The goals include a better understanding of the communities of organisms, including the processes governing them, in the water column, on the sea bed, and in the surf zone. The investigations concentrate on the algal producers of organic matter with emphasis on the formation and maintenance of subsurface maximum layers, the subsequent consumption by herbivorous zooplankton and its growth, and the fate of the organic matter that reaches the sea bed. The role of benthic organisms in nutrient recycling and resultant effect on the plankton of the continental shelf is being studied, and investigations are proposed to assess mechanisms and species involved in controlling community structure and function. Quantitative models of plankton production are under development in cooperation with the physical circulation studies as part of a long-term program to improve our quantitative understanding of the system. The project is an extension of a multidisciplinary study begun in 1961 on the effects of the Columbia River on the Northeast Pacific Ocean and includes, in addition to biological studies, investigations of the physics, chemistry, and geology of the river effluent area. Since 1971, the biological research has functioned as a separate contract as have the physical oceanography and geochemistry programs.
Keywords: AQUATIC ECOSYSTEMS; COASTAL REGIONS; COMMUNITIES; PHYTOPLANKTON; BIOLOGICAL MODELS; ZOOPLANKTON.

89521 Physical Oceanography and Sediment Transport on the Washington Continental Shelf. Smith, J.D.; Hickey, B.M. (University of Washington, Dept. of Oceanography, Seattle, WA, 98195). **Project number:** 6512. **Contract:** E(45-1)-2225, No. 25. **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:** Physical and chemical processes and effects.

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.

89522 Chemical and Geochemical Studies off the Coast of Washington. Carpenter, R. (University of Washington, Dept. of Oceanography, Seattle, WA, 98195). **Project number:** 6513. **Contract:** E(45-1)-2225, No. 24. **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:** Physical and chemical processes and effects.

The objective is to develop a scientific base for predicting and testing the behavior and fate of various trace chemicals in coastal and estuarine areas. Laboratory and field studies will be performed off the Washington coast north of Columbia River including: (1) surface chemical studies of scavenging of various species dissolved in seawater by well characterized natural particulates; (2) studies of uptake and transfer of several isotopes in particularly well defined parts of the marine food web; and (3) studies of the behavior of Pb-210 and Po-210 in sediments off the Washington coast and the application of Pb-210 dating to determine sediment accumulation rates over the past 100 years.
Keywords: COLUMBIA RIVER; WASHINGTON; SEAWATER; LEAD 210; POLONIUM 210; ISOTOPE DATING; UPTAKE; RADIOECOLOGICAL CONCENTRATION; FOOD CHAINS; AQUATIC ORGANISMS; SEDIMENTS; RADIONUCLIDE MIGRATION; TRACE AMOUNTS; FORECASTING.

89523 *Studies on the Concentration of Iron-55 in the South* Pacific Ocean. Jennings, C.D. (Oregon College of Education, Dept. of Natural Science, Monmouth, OR, 97361). **Project number:** 6593. **Contract:** E(45-1)-2231. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to learn the fate and mechanism of transport of iron-55 in the marine environment. It is planned to explore the problem of selective concentration of iron-55 in marine organisms by sampling seawater, zooplankton, fish and sediments from the same locations and to study mechanisms of vertical transport, considering both biological and physical mechanisms of transport. Causes of selective concentration of iron-55 will be studied by various chemical extractions of iron-55 and stable iron from naturally labeled sediments and by allowing organisms to remove iron-55 from naturally labeled sediments.
Keywords: IRON 55; ENVIRONMENTAL TRANSPORT; SEAWATER; PACIFIC OCEAN; CHEMICAL ANALYSIS; SEDIMENTS; PLANKTON; FISHES; AQUATIC ORGANISMS; RADIOECOLOGICAL CONCENTRATION; SOLVENT EXTRACTION; TRACER TECHNIQUES; RADIONUCLIDE MIGRATION.

89525 Determination of Diffusion Coefficients and Distribution Ratios of Americium, Curium and Neptunium in Soil Aquatic Environments. Sheppard, J.C. (Washington State University, Department of Chemical Engineering, Pullman, WA, 99163). **Project number:** 6781. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of the proposed research are to determine distribution ratios and diffusion coefficients of Am3+, Cm3+, and NpO2/sup +/ 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/sup +/ 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, sub-microcurie 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/sup +/ 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.

89526 Reproductive Biology of Trout in a Thermally Enriched River: The Firehole River of Yellowstone National Park. Kaya, C.M. (Montana State University, Biology Department, Bozeman, MT, 59717). **Project number:** 006843. **Contract:** EY-76-S-06-2228. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: fossil fuels(25); nuclear fuels(general)(50); geothermal(25). **R and D categories:** Ecological/biological processes and effects.

The objective of the project is to determine effects of heated water discharged from natural, geothermal sources into a stream on reproduction of the resident brown and rainbow trout. Temperatures of the river were monitored above and below the heated discharge areas, and trout were sampled from heated and unheated areas to determine occurrence and timing of reproduction and normality of histological gonadal development. Other aspects related to reproductive success were investigated as well as movements of trout via electrofishing mark-and-recapture methods, and thermal resistance of young trout via laboratory temperature tolerance tests. Downstream river temperatures are increased by about 10.5 degrees C by the heated discharges, which is comparable to the temperature increase of cooling water used by nuclear powered electrical generating plants. Reproduction of brown trout is adversely affected in the altered environment, with high incidences of undeveloped or atretic gonads observed. Rainbow trout reproduce successfully, but their spawning season is in late fall, instead of spring. Many, but not all, trout appear to move out of the warmest part of the river during summer. The young do not appear to have greater resistance to high temperatures than do those obtained from hatchery sources.
Keywords: YELLOWSTONE NATIONAL PARK; RIVERS; HOT-WATER SYSTEMS; THERMAL WATERS; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS; TROUT; REPRODUCTION; GAMETOGENESIS; BEHAVIOR; TEMPERATURE EFFECTS; MEDIUM TEMPERATURE; TOLERANCE; JUVENILES.

89528 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:** 7002. **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/biological processes and effects.

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.

89529 Survey of Viability of Indigenous Grasses, Forbs, and Shrubs: Techniques of Initial Acquisition and Treatment for Propagation in Preparation for Future Land Reclamation in the Ft. Union Basin. Eddleman, L.E. **Project number:** 7003. **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/biological processes and effects.

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.

89534 Hydrocarbon Studies in Puget Sound and off the Washington Coast. Carpenter, R. (University of Washington, Dept. of Oceanography, Seattle, WA, 98195). **Project number:** 8014. **Contract:** E(45-1)-2225, No. 40. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$170,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to define in samples of organisms and sediments from the study area the naturaly occurring patterns of aliphatic and aromatic and S-containing hydrocarbons, the extent of contamination by fossil fuel hydrocarbons at this time, and the transfer of both natural and fossil fuel hydrocarbons through parts of the marine food web. The methods are to: collect samples of phytoplankton, zooplankton, neuston, and sediment cores; extract hydrocarbons from the samples; and apply the techniques of gas chromatography, high pressure liquid chromatography, ultraviolet fluorescence spectroscopy, mass spectroscopy, combined gas chromatograph/mass spectrometry, and 14C/12C and 13C/12C ratios.
Keywords: WASHINGTON; PUGET SOUND; AQUATIC ECOSYSTEMS; COASTAL REGIONS; AQUATIC ORGANISMS; SEDIMENTS; HYDROCARBONS.

89540 Transport Exhibit Operations: Norous. Valett, B. (Department of Energy, Richland Operations Office, Richland, WA). **Project number:** 800184. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$71,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

An exhibit titled Transporting Radioactive Cargoes was shown at six different meeting conferences in FY 1978. Total attendance at the showings was 86,630, including safety inspectors, military personnel, and state legislators. The exhibit shows how package designs for radioactive material of various sizes are tested and used for shipments.
Keywords: RADIOACTIVE WASTES; TRANSPORT; RADIOISOTOPES; INFORMATION.

89541 Alaska Regional Energy Planning Project. McConkey, W.C. (Alaska State Energy Office, 338 Denali Street, Anchorage, AK, 99501). **Project number:** 7189. **Contract:** C061002. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$100,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The project is designed to provide Energy Environmental Planning aid to Alaska. Alaska is identifying options for energy

development that include coal, oil and gas, geothermal and other technologies. The project focuses on assessment of alternatives, locations and time phasing. It attempts to consider social and environmental costs of alternatives.
Keywords: ALASKA; SOCIO-ECONOMIC FACTORS; ENVIRONMENTAL IMPACTS; ENERGY SOURCE DEVELOPMENT; COAL; PETROLEUM; NATURAL GAS; GEOTHERMAL ENERGY; SITE SELECTION; PLANNING; TIME RESOLUTION; ECONOMICS; COMPARATIVE EVALUATIONS; ENERGY POLICY; ENERGY SOURCES.

89544 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:** 7224. **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/biological processes and effects.

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.

89545 Cycling of Transuranic Radionuclides in the Columbia River, Its Estuary and the North Pacific Ocean. Beasley, T.M. (Oregon State University, School of Oceanography, Corvallis, OR, 97331). **Project number:** 7205. **Contract:** EY-76-S-06-2227. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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 lead-210 method. Aquaria experiments using plutonium-237 tracer will be conducted with the aquatic and marine organisms.
Keywords: COLUMBIA RIVER; ESTUARIES; PACIFIC OCEAN; SEDIMENTS; RADIONUCLIDE MIGRATION; PLUTONIUM; TISSUE DISTRIBUTION; TRANSURANIUM ELEMENTS; AQUATIC ECOSYSTEMS; RADIONUCLIDE KINETICS; MIGRATION; AQUATIC ORGANISMS; DRILL CORES; ALPHA SPECTROSCOPY; AGE ESTIMATION; SAMPLING; MATHEMATICAL MODELS.

89546 Mesoscale Studies of Flow Regimes and Fluxes of Particulate Matter in Coastal Waters. Pak, H. (Oregon State Univ., School of Oceanography, Corvallis, OR, 97331). **Project number:** 7240. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to characterize the optical properties of suspended particulate matter (spm) accounting for where possible the ratio of organic to inorganic matter; and to characterize the distributional patterns of spm in an oceanic area including the nonconservative behavior of the biogenic fraction. In a small area off the Oregon coast measurements will be taken of wind speed and direction, current profile, CTD profile, light scattering profile, particle size distribution, physical properties of particles, nutrient profile, pigment composition profile, C/N profile, carbon productivity profile, zooplankton density profile, and zooplankton species profile. A first stage numerical model of time-space distribution of suspended particulate matter in near-coastal region has been developed.
Keywords: COASTAL WATERS; PARTICLES; WATER QUALITY; SUSPENSIONS; DIFFUSION; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; CARBON; OREGON; METEOROLOGY; OPTICAL PROPERTIES; PHYSICAL PROPERTIES; ZOOPLANKTON; POPULATION DYNAMICS.

89548 Precipitation Scavenging Studies. Slinn, W.G.N. (Oregon State University, Atmospheric Science Dept., Corvallis, OR, 97331). **Project number:** 7350. **Contract:** EY-76-S-06-2227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$54,000.
R and D categories: Physical and chemical processes and effects.

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.

89550 CTD (Clorinity, Temperature, Density) Maintenance for West Coast Contractors. Small, L.F. (Oregon State University, School of Oceanography, Corvallis, OR, 97331). **Project number:** 7409. **Contract:** EE-76-S-06-2227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$7,000.
R and D categories: Characterization, measurement, and 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.

89667 Effects of Atmospheric Variabilty on Energy Utilization and Conservation. Reiter, E.R. (Colorado State Univ., Dept. of Atmospheric Sciences, Solar House 3, Ft. Collins, CO, 80523). **Project number:** 6436. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated 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.

90001 Physiological Systems and Their Response to Energy-Related Toxic Agents. Patt, H.M.; Werb, Z.; Maloney, A.; Phillips, T.L. (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: fossil fuels(45); nuclear fuels(general)(25); hydroelectric(10); geothermal(10); solar(10). **R and D categories:** Health effects.

Methods and models are being developed to characterize the growth and balance of organized mammalian cell populations and the abnormal states that may be associated with exposure to toxic byproducts of energy technologies. The areas of interest are: (1) mechanisms underlying acute and chronic inflammatory responses; (2) organization and regulation of blood-forming tissue, which is not

only a critical target but also the source of a variety of cells that play a central role in injury and repair phenomena; (3) evaluation of relative sensitivities of vital tissues and organs at risk. Studies are performed in vitro with cells derived from animals and man, and in vivo with mice and rabbits, using biochemical, physiological, cytological, and specific lethal endpoints in conjunction with a variety of induced perturbations to identify unifying principles applicable to man. Present experiments have provided, or are expected to provide: (1) important insight into the effects of energy-related toxic agents on the modulation of connective tissue environments by fibroblasts and macrophages, and on the dynamics of hematopoietic stem cells; (2) an experimental model for study of slowly evolving hematopoietic defects that are attributable to environmental contaminants; (3) methods for quantification of low-dose effects of cytotoxic pollutants in specific tissues and organs; and (4) an assessment of the sister chromatid exchange test as a predictor of susceptibility to cancer induction by environmental agents in man.
Keywords: ANIMAL CELLS; BIOLOGICAL MODELS; BIOLOGICAL REPAIR; MAN; ANIMALS; MICE; RABBITS; TISSUE CULTURES; TISSUES; CELL CULTURES; STEM CELLS; DYNAMIC FUNCTION STUDIES; POPULATION DYNAMICS; BIOCHEMICAL REACTION KINETICS; CHEMICAL EFFLUENTS; BY-PRODUCTS; CARCINOGENESIS; TOXINS; TOXICITY.

90002 DNA Replication and Repair. Painter, R.B.; Cleaver, J.E. (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: fossil fuels(45); nuclear fuels(general)(25); hydroelectric(10); geothermal(10); solar(10). **R and D categories:** Health effects.

This project is concerned with the effects of energy-related toxic agents on the organization and replication of eukaryotic DNA. These effects are manifested in DNA repair responses of various kinds (excision repair, photoreactivation, and postreplication repair), in changes in RNA and protein synthesis, and in mutagenesis and carcinogenesis. After mammalian cells in culture are exposed to agents suspected or known to damage DNA, the response of the normal DNA replicative system and of the systems that repair damage are monitored by isopycnic centrifugation, velocity sedimentation, gel electrophoresis, autoradiography, and other techniques along with radioisotopic tracers. Viability and mutation rates are also measured in some studies. Excision repair of uv-induced damage has been shown to occur more slowly in DNA associated with nucleosomes (a protein subunit of chromatin containing two each of four histones) than in internucleosomal (non-protein-containing) regions of mammalian DNA. Extant models of postreplication repair are in doubt and it is suggested that perturbations in normal semiconservative synthesis can explain most or all of the phenomena ascribed to postreplication repair in eukaryotes. Three well-known carcinogens that damage DNA in very different ways all inhibit initiation of human cell replicons. A new method for measuring replicon sizes, using x-rays to inhibit replicon initiation and photolysis of bromouracil-substituted DNA, has been developed.
Keywords: DNA REPLICATION; BIOLOGICAL REPAIR; DNA; CARCINOGENESIS; MUTAGENESIS; TOXINS; BIOCHEMICAL REACTION KINETICS; ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; BIOASSAY; X RADIATION; MEASURING METHODS; GENETIC EFFECTS.

90003 Elucidation of Chromosome Damage. Wolff, S.; Blumenthal, A.B. (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: fossil fuels(45); nuclear fuels(general)(25); hydroelectric(10); geothermal(10); solar(10). **R and D categories:** Health effects.

The objectives are to study the structure and duplication of eukaryotic chromosomes, mechanisms of chromosome breakage by energy-related toxic agents, repair of chromosome damage, and mechanisms of chromosome exchanges. Sister chromatid exchanges (SCEs) are under intense study because they are very sensitive indicators of damage induced by mutagenic carcinogens. Chromosomal replication intermediates and DNA replication enzymes in Drosophila are studied to correlate replication defects with known genetic markers. For studies on SCEs, damaging agents are incubated with cultures of human, Chinese hamster, or other mammalian cells, and SCE induction is determined as a function of dose, environmental conditions, etc. In the Drosophila studies, electron microscopy, immunochemical and column techniques are used to characterize DNA replication intermediates and DNA polymerases. With Cleland's reagent or beta-mercapmethanol, "reverse" staining of sister chromatid exchanges occurs in bromouracil-containing chromosomes, suggesting that differential interaction of protein with DNA is the basis of the staining reaction. Sister chromatid exchanges are induced by saccharin and by vinyl-containing gaseous anaesthetics. In chick embryo cells, sister chromatid exchanges are not dependent on pyrimidine dimers. Three forms of DNA polymerase have been isolated from Drosophila. Because all three can be converted by mild enzymatic treatment to a single type, these seem to be basically the same protein, but with different protein "subgroups" attached.
Keywords: CHROMOSOMAL ABERRATIONS; STRAND BREAKS; DNA REPLICATION; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL MODELS; GENETIC EFFECTS; SACCHARIN; VINYL MONOMERS; CHICKENS; JUVENILES; DROSOPHILA; MAN; HAMSTERS; ANIMAL CELLS; TOXINS.

90005 Somatic Effects of Protracted Low Dose 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:** Health effects.

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.

90008 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:** Health effects.

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.

90012 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: nuclear fission(100). **R and D categories:** Health effects.

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 or acting synergistically with radiation; and extent of cellular repair in normal human lymphocytes following exposure to radiation or energy related toxic chemicals. The research is aided by use of ESR spectroscopy and pulse radiolysis to identify and observe reactions of short-lived intermediate free radicals.
Keywords: ALPHA PARTICLES; BETA PARTICLES; GAMMA RADIATION; COAL; PETROLEUM; OIL SHALES; TOXIC MATERIALS; BIOLOGICAL REPAIR; NEOPLASMS; THERAPY; NUCLEOPROTEINS; LYMPHOCYTES; RADIATION INJURIES; METALS; BIOLOGICAL EFFECTS; BIOLOGICAL RADIATION EFFECTS.

90013 Sub-Cellular Radiobiology. Ward, J.F. (University of California at Los Angeles, Los Angeles, CA). **Project number:** 000455. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$160,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objectives of this research are to determine what damaging effects are produced by the interaction of ionzing radiation (both low and high LET) and energy related pollutants with significant biomolecules. Eventually it is hoped that in-vivo effects can be explained on a molecular basis. Currently available assays will be employed to determine types of DNA damage produced at low dose in cells, and the cells' response to the damage. Two routes will be taken: (1) determination of initial damage in DNA either by direct product assay (chromatography) or serologic assay of base alteration, followed by examination of effects of tertiary structure of DNA or damage types, e.g., nucleosomes; and (2) measurement of damage in DNA before and after treatment with cell free extracts (containing repair endo- and exonucleases). Work has just begun and promising results have already been obtained on attempts to explain the oxygen effect and the shouldered survival curves of cells. High LET work on DNA damage will continue with assays of gross-damage (double strand-breaks and cross-links) already developed. Berkeley Bevalac Group will provide the source of high LET radiation.
Keywords: IONIZING RADIATIONS; POLLUTION; MOLECULES; DNA; MOLECULAR BIOLOGY; LOW DOSE IRRADIATION; ANIMAL CELLS; CHEMICAL ANALYSIS; MOLECULAR STRUCTURE; SURVIVAL CURVES; LET; BIOLOGICAL RADIATION EFFECTS; BIOLOGICAL EFFECTS.

90027 Dynamics of Trace Elements in Desert 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:** 650. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of this study is to determine the accumulation, movement, and availability of trace elements from coal fly ash in the soil, litter, plants and rodents of a desert environment. Chemical analysis of samples taken at different distances from power plants and after application of fly ash is performed. Measurements of litter fall and decomposition rate are being made.
Keywords: ARID LANDS; PLANTS; PLANT GROWTH; REPRODUCTION; FLY ASH; ENVIRONMENTAL IMPACTS; COAL INDUSTRY; POWER PLANTS.

90028 Chemical Problems. Wood, R.A. (UCLA, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 653. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90029 Distribution and Interrelationship to Trace Elements in Biological Systems. Alexander, G.W. (UCLA, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 657. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$51,000.
Related energy source: coal(60); geothermal(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The primary research objective 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 analytical methods which will produce accurate results. An optical emission spectrometric system has been developed for the simultaneous determination of 29 elements important to the study of biological tissues.
Keywords: ELEMENTS; TISSUES; EMISSION SPECTROSCOPY; METALS; CHEMICAL ANALYSIS; UPTAKE; LEAD; BIOLOGICAL MATERIALS; POLLUTION; ANIMALS; MAN; PLANTS.

90030 Ecophysiology of Desert Arthropods. Edney, E.B. (UCLA, Lab. of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 682. **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:** Ecological/biological processes and effects.

The objectives are to determine the nature and function of soil arthropods, their distribution and their role in degradation of detritus; to determine the environmental parameters governing population densities, including relationship to plants, soil temperature and moisture, salinity, etc.; to determine effects of heavy metals and of fly ash and of salinity on populations; and to determine possible evolutionary response to long term exposure to heavy metals and salinity from natural environment. The approach will include: (1) sampling over long periods together with recording of abiotic data; (2) experimental manipulation of conditions including temperature, moisture, salinity and pollutants concentrations; (3) measurement of degradation in presence and absence of various faunal components; and (4) field and laboratory studies on these questions.
Keywords: METALS; FLY ASH; SALINITY; ENVIRONMENTAL EFFECTS; ARTHROPODS; POPULATION DENSITY; PLANTS; SOILS; DESERTS; TERRESTRIAL ECOSYSTEMS; FOSSIL-FUEL POWER PLANTS; GEOTHERMAL POWER PLANTS; POLLUTION.

90031 Radionuclide and Stable Element Cycling. Romney, E.M. (UCLA, Lab. of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 683. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90032 Physiology and Ecology of Desert and Other Plants. Wallace, A. (UCLA, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 692. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$112,000.
Related energy source: fossil fuels(30); nuclear fission(40); geothermal(30). **R and D categories:** Ecological/biological processes and effects.

The main objective of the project is to provide baseline data for soil and plant processes in the desert ecosystem representative of the southwestern U.S.A. These complement with other on-going studies in the division to provide a reasonably complete ecosystem approach. The information is vital to programs leading to both preservation and restoration of natural systems associated with energy generation programs. Other objectives are: (1) to support the major objective with laboratory studies of trace metal and radionuclide effects and transport rates in the soil-plant system; and (2) to respond to needs of DOE with environmental assessments research in solving problems related to fossil fuel, nuclear, geothermal, or other technologies. Photosynthesis, transpiration, nitrogen and mineral cycling, carbon budget, population dynamics, and root growth and activity were studied in desert plants. Laboratory and field studies were made of trace metal uptake and translocation rates and effects. Special emphasis was given to the determination of the threshold acute and chronic toxicity levels of various trace metals in plants. These studies are supported by emission spectrography, N-15 spectrometry, and neutron activation work done in the laboratory.
Keywords: USA; TERRESTRIAL ECOSYSTEMS; DESERTS; FOSSIL-FUEL POWER PLANTS; NUCLEAR POWER PLANTS; GEOTHERMAL POWER PLANTS; ENERGY SOURCE DEVELOPMENT; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS; METALS; TRACE AMOUNTS; PLANTS; PHYSIOLOGY; BASELINE ECOLOGY; PHOTOSYNTHESIS; TRANSPIRATION; NITROGEN CYCLE; MINERAL CYCLING; ACUTE EXPOSURE; POPULATION DYNAMICS; PLANT GROWTH; ROOT ABSORPTION; BIOLOGICAL RADIATION EFFECTS; CHRONIC EXPOSURE; TOXICITY; EMISSION SPECTROSCOPY; ACTIVATION ANALYSIS; NEUTRON REACTIONS; RADIOISOTOPES; RADIOECOLOGICAL CONCENTRATION; SOILS; RADIONUCLIDE MIGRATION; ECOLOGICAL CONCENTRATION.

90033 Vertebrate Physiological Ecology. Nagy, K.A. (Univ. of California at Los Angeles, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 694. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$84,000.
Related energy source: all(100). **R and D categories:** Ecological/biological processes and effects.

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.

90034 Membrane Oxidation. Mead; Tiern. (University of California at Los Angeles, 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:** Health effects.

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.

90036 Soil Chemistry of Transuranic Elements. Nishita, H. (University of California at Los Angeles, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** 1023. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90037 Genetic Studies with Cultured Mammalian Embryos. Pedersen, R.A. (University of California at San Francisco, Laboratory of Radiobiology, San Francisco, CA, 94143). **Project number:** 001336. **Contract:** EY-76-C-03-1012. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$82,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objectives are to evaluate radiation damage and repair in mammalian germ cells and embryos. In vitro culture of pre-implantation and early post-implantation embryos allows direct assessment of the effects of radiation damage on gametogenesis and early embryonic development in the absence of maternal factors. Mouse embryos are cultured from the 2-cell to the blastocyst stage, and then to attachment and outgrowth stages that resemble post-implantation growth in utero. DNA repair capability is assessed by autoradiography. Experiments are designed with large numbers of embryos grown under defined conditions so that damage to germ cells or embryos can be assessed rapidly and accurately. Repair of damaged sperm DNA occurs in oocytes after the entrance of the male pronucleus containing damaged DNA. Sensitivity of embryos to 3H-thymidine increases from the 2-cell to the morula stage. After differentiation, trophectoderm cells become resistant to 3H-dThd whereas inner cell mass cells remain extremely sensitive.
Keywords: MAMMALS; EMBRYOS; EMBRYONIC CELLS; CELL CULTURES; GENETICS; BIOLOGICAL RADIATION EFFECTS; IN VITRO; THYMIDINE; TRITIUM; LABELLED COMPOUNDS.

90040 Lifetime Effects CFI-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:** Health effects.

Iodine-129, with a physical half-life of 16 million years, must be considered to be important in the long-term processing, handling,

torage and disposal of spent fuel rods from light-water fission eactors. 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.

90041 Growth of Bone Marrow in Modified 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

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.

90042 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:** Health effects.

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 ıvailable for experimental purposes) could substitute for TF funcion.
Keywords: LYMPHOCYTES; CELL PROLIFERATION; THYMUS; DOGS; IMMUNE REACTIONS; HORMONES; BIOLOGICAL EFFECTS.

90043 Health Hazards Associated with Fossil Fuel Effluents. 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:** Health effects.

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.

90045 Development of Mammalian Embryo Culture Systems for Analysis of Environmental Toxicity. Pedersen, R.A.; Spindle, A.I. (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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects.

The objective is to develop criteria for analyzing the effects of fossil-fuel and other energy-related pollutants on early differentiation of mammalian embryos. To study mechanisms of embryo toxicity under controlled conditions, the reliable culture period for mouse blastocysts will be extended to the beginning of organogenesis, and embryos perturbed by model teratogenic compounds or genetic abnormalities will be examined. The results should provide an in vitro system for observing mechanisms of action of energy-related toxic agents, and may in addition provide a screening technique for teratogenic compounds. Experiments are carried out with replicated block and factorial designs. Treatment effects are assessed by culturing embryos for 5 to 8 days beyond blastocyst and observing their morphology, cell number, and capacity for DNA, RNA, and protein synthesis. In addition to measuring quantitative effects on embryo growth, we expect to determine whether there are qualitative changes in gene expression by using sensitive one-dimensional and two-dimensional gel-electrophoresis techniques to study the proteins being synthesized by the embryos.
Keywords: MAMMALS; EMBRYOS; TOXICITY; MICE; GENETIC EFFECTS; TERATOGENESIS; BIOLOGICAL MODELS; NUTRITION; ANIMAL GROWTH; BENZOPYRENE; MUTAGEN SCREENING; DNA; REPRODUCTION.

90046 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:** 1915. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$32,000.
R and D categories: Ecological/biological processes and effects.

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, presumably man-made, 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 sectioncd material.
Keywords: DESERTS; PLANTS; TRANSPIRATION; PHOTOSYNTHESIS; ARID LANDS; ENVIRONMENTAL EFFECTS; BIOLOGICAL STRESS; TERRESTRIAL ECOSYSTEMS.

90047 Pulse Radiolysis Studies. Myers, L.S. (University of California at Los Angeles, Los Angeles, CA). **Project number:** 001920. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$62,000.
Related energy source: coal(20); nuclear fission(80). **R and D categories:** Health effects.

The immediate goals of this work are to conduct fast time resolved experiments needed as part of a larger program to evaluate the hazards of long-term low-level exposure of living organisms to ionizing radiation associated with fission energy, and to maintain and improve the equipment needed for the experiments. A further goal is to develop techniques needed to make time resolved studies of effects of hazardous chemicals associated with fossil energy technologies such as coal conversion, oil, and shale. The pulse equipment permits radiolysis of a sample with 2 to 100 nanosecond pulses of 13 MeV electrons and observation of transient species formed by the radiation over a period of 100 nanoseconds to several milliseconds. Solution conditions can be varied to study independently reactions of the strong reducing agents, hydrated electrons and hydrogen atoms, the strong oxidizing agent, hydroxyl free radicals, and of organic free radical intermediates in the reactions leading to damage of nucleoprotein by radiation. By suitable modification of conditions it should be possible to investigate reactions of compounds produced by fossil energy technologies, such as metal ions and organic pollutants, which have been activated by oxidation or reduction processes.
Keywords: RADIOLYSIS; PULSED IRRADIATION; ELECTRON BEAMS; MEV RANGE 10-100; SOLVATED ELECTRONS; HYDROXYL RADICALS; REACTION INTERMEDIATES; NUCLEOPROTEINS; HAZARDOUS MATERIALS.

90068 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 PA No. 21. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Health effects.

There are three major objectives of this project. Signal Identity Reevaluation will be conducted through (1) generation of the RS free radical in a solid state adamantane matrix under isotropic conditions by photolysis, (2) continuous flow system studies using ceric ion oxidation, and (3) steady-state and flash pyrolysis ESR studies and reaction mechanisms. The second objective includes biochemical modeling by means of a gas-liquid interface flow system for ESR studies, as well as designs of the ESR gas-liquid flow mixing cell prototype. The third objective consists of in vivo studies using an extracorporeal blood loop-ESR technique and includes (1) in vivo ESR detection of free radicals using an extracorporeal blood loop technique, and (2) preliminary studies of the effects of toxic pollutant gases on free radicals detected via the extracorporeal blood loop-ESR technique, as well as some effects of the SO2/HSO3/sup -/ redox system.
Keywords: THIYL RADICALS; ELECTRON SPIN RESONANCE; SULFUR DIOXIDE; CATIONS; RADICALS; RADIOBIOLOGY; PHOTOLYSIS; ADAMANTANE; SULFIDES; GASEOUS WASTES; CHEMICAL EFFLUENTS; BLOOD; PHOTOCHEMICAL OXIDANTS; IONIZING RADIATIONS; BIOLOGICAL RADIATION EFFECTS.

90071 Research on the Marine Food Chain. Eppley, R.W. (Scripps Institution of Oceanography, Institute of Marine Resources, La Jolla, CA, 92093). **Project number:** 006329. **Contract:** EY-76-03-0010 No. 20. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$655,000.
Related energy source: nuclear fission(25); solar(75). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives are to measure the standing stocks, growth and activities of planktonic organisms of the coastal waters of the Southern California Borderland; to measure the significance of the plankton in marine food webs; to measure spatial and temporal variations of plankton; and to measure the modulation by both physical and biological processes, including human activities, of plankton stocks. In part, we view as our charge the definition and assessment of potential effects on plankton of the use of seawater for cooling by coastal power stations in this region. Studies of microbial activities in surface sediments will be added in 1976--1977. A program of quarterly cruises has been carried out since September 1974 in support of these objectives. The shipboard measurements, using the methods of modern biological oceanography, are supported by laboratory studies of processes of interest carried out with cultures of bacteria, phytoplankton and zooplankton.
Keywords: FOOD CHAINS; COASTAL WATERS; ZOOPLANKTON; AQUATIC ECOSYSTEMS; PHYTOPLANKTON; BACTERIA; NUCLEAR POWER PLANTS; GROWTH; POPULATION DYNAMICS; COOLING SYSTEMS; THERMAL EFFLUENTS; METABOLISM; TEMPERATURE EFFECTS.

90072 Study of Dynamic Features Controlling the Coastal Environment Near the San Onofre Power Plant. Folsom, T.R. (Scripps Institution of Oceanography, Mt. Soledad Laboratory of Marine Radioactivity, La Jolla, CA, 92093). **Project number:** 6330. **Contract:** E(04-3)-34 Task 71. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

It now appears that the ultimate capacity for waste disposal of a coastal environment like that near the San Onofre Nuclear Power Plant depends strongly upon hydrodynamic and chemical parameters that have been little explored. Recent experimental studies of the behavior of plutonium on algal and other surfaces suggests that ultimate dispersal of many of the trace metals that come from coastal power plants may be influenced, and in some instances controlled, by their ratio of transfer to surfaces through aqueous boundary layers. There is evidence that surfaces of inorganic particulates as well as surfaces of microalgae must be included in any dynamic disposal model. Inevitably studies must be made of transfer properties of all hazardous nuclides that might escape at San Onofre.
Keywords: SAN ONOFRE-1 REACTOR; SAN ONOFRE-2 REACTOR; SAN ONOFRE-3 REACTOR; RADIOACTIVE EFFLUENTS; AQUATIC ECOSYSTEMS; ENVIRONMENTAL IMPACTS; MONITORING.

90073 Marine Geochemistry Research. Goldberg, E.D. (Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 6331. **Contract:** E(04-3)-34 Task 84. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects.

The objective is to understand the geochemical and geophysical behaviors of elements in sea water and the consequences of such activities to general earth science problems and to the management of industrial wastes. Emphasis has been placed upon the transfer processes of elements introduced into the oceans either from the continents, atmosphere or sea floor and to the time relationships of such reactions. The development of new geochronological techniques has formed an important part of our efforts. We have been concerned with the construction of new instruments and with the devising of new methods to further these goals. Over the past years we have been studying the mobilization of transuranics and heavy metals from fuel cycles into the coastal environment. We utilize the fluxes of transuranics and heavy metals to anoxic sediments, either estuarine or coastal marine, to obtain pollution histories. Time frames are introduced into the sediments usually with radiometric geochronological techniques and sometimes with natural varying. To ascertain the amounts of materials transported atmospherically from the continents to the oceans we have collected and measured pollutants in airborne dusts and in glaciers (which can have their strata dated by radiometric techniques). We have also developed coring techniques to recover relatively undisturbed samples from both coastal and deep sea sites.
Keywords: SEAS; ESTUARIES; WATER POLLUTION; TRANSURANIUM ELEMENTS; METALS; ENVIRONMENTAL TRANSPORT; MIGRATION; GEOCHEMISTRY; OCEANOGRAPHY; SEDIMENTS; INDUSTRIAL WASTES; GEOPHYSICS; SEDIMENTS; AGE ESTIMATION; DRILL CORES.

90074 Distribution and Fate of Biogenic and Petroleum-Derived Substances in Marine Environment. Kaplan, I.R. (Univ. of California at Los Angeles, Dept. of Geology, Los Angeles, CA, 90024). **Project number:** 6334. **Contract:** E(04-3)-34P.A134. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$125,000; DOI-$125,000.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This project will look for the causes to explain the distribution of organic substances in marine sediment, particularly the hydrocarbons. The depth distribution of hydrocarbons in relation to total carbon will be studied to determine whether enrichment or depletion at any one time interval is the result of climatic events related to erosion from land, or whether it reflects change of productivity in the water column. A number of trace metals will be studied to better ascertain the relationship between carbon compounds and the metals. Content of metals in sediments will be

studied with a view toward determining whether the enrichment process is the result of allocthonous or in situ processes. The following studies will be undertaken: (1) evaluation and differentiation of marine and terrestrial contributions of carbon compounds to ocean sediments; (2) fluxes of carbon, nitrogen, phosphorus and sulfur at the sediment-water interface; (3) evaluation of carbon and nitrogen fluxes into marine sediment as a function of climatic changes; (4) differentiation of marine biogenic and petrochemical hydrocarbons; (5) fate of hydrocarbons in the sediment column; (6) role of sediment organic matter in mobilization and removal of trace metals; and (7) distribution of trace metals in sediment as a function of climatic changes. The use of N-15/N-14 and S-34/S-32 stable isotope ratios in crude oils and petroleums has been proved to be an effective method to differentiate their origin and source. Gas chromatography and gas chromatography--mass spectrometry methods are able to establish compound recognition of petroleum products in marine sediments. Trace metal concentrations, such as uranium, fluctuate with climatic changes, as evidenced by the depth distribution of uranium in marine sediments. In order to differentiate hydrocarbons originating from naturally occurring sources, from those introduced into the ocean by anthropogenic processes, a very broad approach must be considered. First, one must be able to predict with confidence that certain classes of compounds are not normally synthesized by marine organisms. Second, it must be shown that the hydrocarbons are not induced from land by rivers or natural drainage systems. Third, it must be demonstrated that anthropogenic hydrocarbons in any specific location in the ocean can be differentiated from petroleum type substances either produced in natural seeps, or from oil shales cropping out on the ocean floor.
Keywords: PETROLEUM INDUSTRY; OIL SPILLS; WATER POLLUTION; METALS; ORGANIC COMPOUNDS; PETROLEUM; HYDROCARBONS; BIOCHEMICAL REACTION KINETICS; ENVIRONMENTAL EFFECTS; TOXICITY; SEDIMENTS; CARBON; NITROGEN; DISTRIBUTION; PHOSPHORUS; SULFUR; SYNERGISM; CLIMATES; DIFFUSION; TRACER TECHNIQUES; NITROGEN 15; NITROGEN 14; SULFUR 34; SULFUR 32; SEWAGE.

90075 Investigations of Physical Processes Affecting Leaf Temperature. Miller, P.C. (San Diego State University Foundation, San Diego, CA, 92182). **Project number:** 6400. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The underlying objective of the research is to develop the conceptual understanding of Arctic tundra dynamics through an interplay of field investigations, simulation modeling, and laboratory experimentation. The broad hypothesis to be tested is that the models developed to express the dynamics of the coastal, wet meadow tundra can predict the dynamics of inland tundra ecosystem types, given values for the parameters in the model which define the new ecosystems. The specific hypotheses are the values of parameters and relationships between variables currently being used. Some of the research needed to establish these will be carried forward in an on-going field study, sponsored by the NSF, of the grazer-vegetation interactions in inland tundra. More will be carried out as part of this proposal. Data collection at inland tundra locations has now accummulated enough information that comparison with wet tundra systems can begin.
Keywords: ARCTIC REGIONS; TUNDRA; TERRESTRIAL ECOSYSTEMS; SIMULATION.

90079 Processes of Energy Deposition by Heavy Particle Impact. Smith, F.T. (Stanford Research Institute, Stanford, CA). **Project number:** 006483. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$23,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

This project involves studies of a variety of energy-deposition processes, principally involving heavy ions incident on systems composed of light atoms (carbon, nitrogen, and oxygen). The goal is understanding of the mechanisms by which incident-ion energy is converted to excitational, vibrational, rotational and charge-state energy of the atoms or molecules of the target system. The molecules of concern are those comprising biological systems.
Keywords: HEAVY IONS; ENERGY ABSORPTION; CARBON; NITROGEN; OXYGEN; EXCITATION; VIBRATIONAL STATES; EXCITED STATES; ROTATIONAL STATES; IONIZATION; ION-MOLECULE COLLISIONS; ION-ATOM COLLISIONS; BIOLOGICAL MATERIALS; ION COLLISIONS.

90080 Mutation Rates and Mutational Loads in Humans. Cavalli, S.F. (Stanford University, Stanford, CA). **Project number:** 006496. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$35,000.
Related energy source: all(100). **R and D categories:** Health effects.

The objective of the project is the analysis of mutation drift and selection in human evolution. A theoretical study of continuous variation has shown that one can build recurrencies giving the generation by generation behavior and the equilibria for genetic, phenotypic means, varances and covariance. For a fully additive polygenic system these results can be written as a function of mutation, selection intensity and environmental variations. This study has many ramifications which are being followed both for straight Mendelian transmission and evolution as well as for complex transmission (including phenotypic, cytoplasmic, etc. and cultural transmission).
Keywords: MAN; BIOLOGICAL EVOLUTION; MUTATION FREQUENCY; HUMAN POPULATIONS; MUTATIONS; VARIATIONS; GENETICS; ENVIRONMENT; DATA ANALYSIS.

90082 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:** Health effects.

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.

90083 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: nuclear fission(100). **R and D categories:** Health effects.

During the coming year contract support will be employed to continue our selection and characterization of autosomal mutants. Autosomal 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 will then be applied to these new mutants that has been applied to the x-linked mutants. We will initiate a full-scale attempt to establish permanent cell cultures of the critical mutants. This support will permit us to maintain a full-scale tissue culture laboratory which will support almost all chemical analysis of DNA repair.
Keywords: GENETIC RADIATION EFFECTS; DROSOPHILA; BIOLOGICAL REPAIR; MUTAGENESIS; MUTAGEN SCREENING; NITROGEN MUSTARD; DNA; METHYL METHANESULFONATE; TOXICITY; BIOCHEMICAL REACTION KINETICS.

90088 Physical Mechanism of Action of the Photoreactivating Enzyme. Sutherland, J.C. (Brookhaven National Lab., Biology Dept., Upton, NY, 11973). **Project number:** 006934. **Contract:** AT(04-3)-34 PA No. 225. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE.
Related energy source: fossil fuels(75); solar(25). **R and D categories:** Health effects.

The objective is the determination of the mechanism of action of the photoreactivating enzyme. Ultraviolet light (wavelengths between 240 and 320 nm) causes death and mutations in procaryotic and eucaryotic organisms. In man, ultraviolet light can produce skin cancers. The primary molecular lesion responsible for these biological effects are thought to be photochemical modifications of the organisms' DNA. Cells of organisms throughout the phytogenetic tree have developed enzymatic mechanisms to repair damage produced in their DNA by ultraviolet light. We are studying the molecular mechanism of action of one of these enzymatic repair systems, the photoreactivating enzyme. The photoreactivating enzyme (PRE) uses visible or near ultraviolet light (300 less than lambda less than 600 nm) to monomerize pyrimidine dimers (cyclobutyl-dipyrimidines). Thus the PRE has two unique and valuable properties: (1) It uses a 3 eV photon to remove damage produced by

a 5 eV photon, and (2) it is specific for the major class of ultraviolet induced molecular lesions. Thus if an effect can be reversed by photoreactivation, then the effect is caused by pyrimidine dimers. The PRE uses visible and near ultraviolet light to repair DNA damaged by far ultraviolet light. We are studying the PRE using a variety of spectroscopic techniques using the same wavelengths (i.e., 240 to 600 nm). The spectroscopic techniques which have been used to study the PRE include) absorption and absorption difference spectroscopy, fluorescence, phophorescence, circular dichorism, magnetic circular dichroism and action spectroscopy.
Keywords: ULTRAVIOLET RADIATION; BIOLOGICAL EFFECTS; DNA; PHOTOCHEMICAL REACTIONS; BIOLOGICAL REPAIR; ENZYMES; MUTAGENESIS.

90093 Chronic Irradiation and Brain Development. Zamenhof, S. (UCLA School of Medicine, Department of Microbiology and Immunology, Los Angeles, CA, 90024). **Project number:** 008012. **Contract:** EY-76-S-03-0034. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$44,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objective of the project is to study the effect of low levels of chronic radiation (radioactive pollutants) on mammalian (rat) brain development over several generations, emphasizing the dose-effect relationships. In the first experiment: (1) the pregnant rats (F/sub 0/) and their fetuses will be exposed to chronic low level radiation that does not produce sterility; (2) some of the newborns (F/sub 1/) will be examined for first generation effects on brain development; and (3) the remaining F/sub 1/ females will be raised without further addition of radioisotopes, mated with non-irradiated males, and their offspring (F/sub 2/) examined for cerebral parameters. In the second experiment, the possibility of cumulative effect of radiation over generations will be investigated by continuous (chronic) exposure of pregnant mothers and of their progeny to low (non-sterilizing) levels of radiation (radioisotopes). Examination of the brains in consecutive generations (first through fifth) will be conducted as described above.
Keywords: TRITIUM; INTERNAL IRRADIATION; CHRONIC IRRADIATION; LOW DOSE IRRADIATION; RATS; PREGNANCY; CUMULATIVE RADIATION EFFECTS; FETUSES; BRAIN; ONTOGENESIS; PROGENY; BIOLOGICAL RADIATION EFFECTS.

90096 Atmospheric Effects 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:** 7042. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Integrated 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.

90097 Effect of Habitat Conditions on Spatial Parameters of Shorebird Population. Pitelka, F.A. (University of California, Dept. of Zoology, Berkeley, CA, 94720). **Project number:** 7223. **Contract:** 79-EV-70256.000. **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/biological processes and effects.

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.

90099 Pacific Regional Energy Management of Resource Development Planning Program. Kono, H. (State of Hawaii, P.O. Box 2359, Honolulu, HI, 96804). **Project number:** 7256. **Contract:** 043129$ **Supported by:** Department of Energy, Washington, DC (USA). Div of Regional Assessments. **Funding:** DOE-$50,000.
Related energy source: geothermal(20); solar(20); ocean thermal(20); biomass(20); wind(20). **R and D categories:** Integrated assessment.

Project provides energy environmental planning aid to Hawaii. Hawaii examines social, environmental costs, and benefits of such energy options as solar, geothermal, ocean thermal, biomass, and wind as alternatives to continued dependence on oil inputs and coal.
Keywords: ENERGY; ENVIRONMENT; PLANNING; HAWAII; SOCIAL IMPACT; ECONOMIC IMPACT; SOLAR ENERGY; GEOTHERMAL ENERGY; BIOMASS; WIND POWER; PETROLEUM; COAL; OCEAN THERMAL ENERGY CONVERSION; ENERGY POLICY.

90103 Development of Alternative Energy Facility Siting Policies for Urban Coastal Areas. Morell, D. (Princeton University, School of Engineering and Applied Sciences, Center for Environmental Studies, D332 Engineering Quadrangle, Princeton, NJ, 08540). **Project number:** 7565. **Contract:** EE-77-03-1520. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Policy Analysis. **Funding:** DOE-$37,000.
Related energy source: oil and gas(60); nuclear fuels(general)(40). **R and D categories:** Integrated assessment.

The research objective is to develop alternative energy facility siting policies applicable to urban coastal areas for potential use by the public and private sectors. The approach employs siting policy studies of urban coastal areas in northern New Jersey and the Gulf Coast of Texas and Louisiana; explicit inclusion of projected impacts of alternative siting policies; and dissemination and exchange of research information through national conferences and symposia. The project is expected to result in five reports for use by officials of local, state, and Federal government agencies, environmental interest groups and industry executives.
Keywords: COASTAL REGIONS; GOVERNMENT POLICIES; ENERGY FACILITIES; LAND USE; SITE SELECTION; PLANNING; URBAN AREAS; NEW JERSEY; TEXAS; LOUISIANA.

90105 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:** Integrated assessment; Health effects.

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.

90106 Influence of Late Radiation Effects on the Immunologic Parameters of Aging. Makinoda, T. (University of California, Los Angeles, CA). **Project number:** 007591. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$223,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.
Keywords: AGING; DELAYED RADIATION EFFECTS; BIOLOGICAL RADIATION EFFECTS; AGE DEPENDENCE HUMAN POPULATIONS; IONIZING RADIATIONS; DE COMMISSIONING; DECONTAMINATION; IMMUNOLOGY; RADIATION HAZARDS.

90113 Environmental Control Aspects of Coal Slurry Pipelines. Anderson, O.L. (University of California, Los Angeles, CA). **Project number:** 800241. **Supported by:** Department of Energy, Washington,

)C (USA). Office of Health and Environmental Research. **Funding:**)OE-$11,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives are to: (1) identify and determine the significance of all potential interactions between coal slurry and/or recovered slurry water and the environment; (2) assess water pollution control and water treatment strategies used for existing and proposed coal slurry pipeline systems; (3) assess current and developing technologies for control of suspended particles, trace elements and trace organics in waste waters; and (4) determine the feasibility of using saline water or partially treated sewage effluent as the carrier medium, and also determine the resulting interactions between the liquid and solid phases.
Keywords: COAL; SLURRY PIPELINES; WATER POLLUTION CONTROL; WATER TREATMENT; SALINITY; PH VALUE; ORGANIC COMPOUNDS; HYDROCARBONS; TRACE AMOUNTS; WASTE WATER; DATA COMPILATION; BIOLOGICAL EFFECTS; VIRUSES; BACTERIA; INFECTIVITY; HEALTH HAZARDS; METABOLISM.

90115 Environmental Control Technology Requirements for Future ac, High-Voltage Overhead Transmission Facilities. Walton, B.L. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA, 94025). **Project number:** 800189. **Contract:** EY-76-C-03-0115 p.a. No. 120. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$66,000.
Related energy source: conservation(100). **R and D categories:** Environmental control technology.

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.

90502 Cooling System Effects. Crawford, T.V.; Tilly, L.J. (Du Pont de Nemours (E.I.) and Co., Savannah River Plant, Aiken, SC, 29801). **Project number:** 669. **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(40); nuclear fission(40); hydroelectric(10); geothermal(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The operation of power plant cooling systems involves a series of events which influence the 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 hich crops, dominant species, and metabolic trophic transfer procses change as a function of temperature elevation and other aspects or 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 U.S.
Keywords: COOLING SYSTEMS; AQUATIC ECOSYSTEMS; BIOLOGICAL EFFECTS; SAVANNAH RIVER PLANT; THERMAL EFFLUENTS; TEMPERATURE EFFECTS; BIOLOGICAL STRESS; FOOD CHAINS; MICROORGANISMS; THERMOREGULATION; TOLERANCE.

90503 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:** 672. **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: fossil fuels(20); nuclear fuels(general)(80). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

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.

90505 Forest Management. Irwin, J.G. (Savannah River Plant, P.O. Box A, Aiken, SC, 29801). **Project number:** 979. **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: biomass(100). **R and D categories:** Ecological/biological processes and effects.

Compartment prescriptions for the total land management program will be updated annually on approximately 20,000 acres. Thirty to forty million board feet are prepared for twelve to eighteen timber sales, annually. Twelve to sixteen hundred acres are prepared for subsequent reforestation each year. Treatment for improvement of timber stands is accomplished on 500 to 600 acres annually. The prescribed burn program will range from 5000 to 10,000 acres per year. The Forest Management Program provides the Du Pont Fire Control Division with specialized training in wildfire suppression, back-up fire suppression crews, fire control expertise, and planning advice. The annual road maintenance program includes 100 miles of light maintenance, 25 miles of road reconstruction and 300 miles of mowing and clearing. Forty to sixty acres of borrow pits and other distressed soils are restored.
Keywords: FORESTRY; LAND USE; WOOD; FORESTS; PLANNING; HARVESTING; FIRE PREVENTION; MANAGEMENT.

90506 DuPont Forest Management Support. Irwin, J.G. (DuPont de Nemours (E.I.) and Co., P.O. Box A, Aiken, SC, 29801). **Project number:** RPIS No. 979. **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: biomass(100). **R and D categories:** Ecological/biological processes and effects.

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. Activities within the Forest Management Program include support to Cooperative Forest Research which will eventually result in the potential to produce useable biomass with a lower energy expenditure per unit produced. Also correction of eroded secondary roads, spoil piles and borrow pits is accomplished annually through Du Pont support to the Forest Management Program.

Keywords: FORESTS; MANAGEMENT; FIRES; CONTROL; HEALTH HAZARDS; COMPUTER CALCULATIONS; VEHICLES; EQUIPMENT; MAINTENANCE; OPERATION; BIOMASS; ENERGY CONSERVATION; NET ENERGY.

90508 Ocean Transport of Contaminants. Crawford, T.V.; Hayes, D.W. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 1301. **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: fossil fuels(35); nuclear fission(60); nuclear fusion(5). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

90509 Study of Atmospheric Releases. Crawford, T.V.; Pendergast, M.M. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 1337. **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: fossil fuels(10); nuclear fuels(general)(60); nuclear fission(20); nuclear fusion(10). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

90510 Radioecology of Actinide Elements. Smith, M.H. (University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 1338. **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 fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

90511 Cycling of Long-Lived Radionuclides. Crawford, T.V.; Corey, J.C. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 1339. **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 fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

90515 Management of Natural Resources. Smith, M.H. (Savannah River Ecology Lab, Drawer E, Aiken, SC, 29801). **Project number:** 1905. **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: nuclear fission(40); solar(20); biomass(20); conservation(20). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The research undertaken in this program is designed to help the Department of Energy to comply with both the letter and the spirit of congressional legislation requiring the development and institution of a site plan for the management of wild-life population and other natural resources on all lands under the control of the Secretary of Energy. Specifically, the Sikes Act (Public Law 93 45[illegible], Sec. 202) requires that...The Secretary of Interior shall develop with the prior written approval of the Atomic Energy Commission (now Department of Energy), a comprehensive plan for conservation and rehabilitation programs to be implemented on public land under the jurisdiction of the Chairman (now the Secretary of Energy)...As

ecently established in congressional testimony by Dr. J.L. Liverman, concerning this legislation, the Department of Energy considers that basic research oriented towards providing information for natural resource management and site-specific land-use decisions is an inextricable component of any program designed to fulfill agency responsibilities under this legislation and similar requirements imposed by the National Environmental Policy Act and Endangered Species Act. The research efforts undertaken in this program are designed to meet these objectives with respect to the SRP site. **Keywords:** WILD ANIMALS; POPULATIONS; RESOURCES; MANAGEMENT; FORESTS; ECOSYSTEMS.

90516 Cycling of Heavy Metals and Other Stable Elements. Smith, M.H. (Savannah River Ecology Lab., Aiken, SC, 29801). **Project number:** 1906. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$170,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90517 Cycling of Radioisotopes. Smith, M.H. (University of Georgia, Savannah River Ecology Lab, Drawer E, Aiken, SC, 29801). **Project number:** 1907. **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: fossil fuels(25); nuclear fuels(general)(75). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

Historically, our efforts in radioisotope research have emphasized work on 137-Cs. When released into aquatic environments most 137-Cs is immobilized in the sediments. Somewhat unique soil and sediment characteristics of the SRP and southeastern U.S. result in weaker fixation of 137-Cs to sediments and greater availability to plants, with higher than expected concentration ratios (up to 2 orders of magnitude higher than other locations). Since the transfer of contaminants from soils to plants begins the eventual pathway to man, it is of major importance in predicting potential effects on human health. Many of our efforts on 137-Cs plant-soil relationships are near completion and will be written up in the near future. Reduced levels of effort will go into studies of 137-Cs concentrations and dynamics in major animal species such as waterfowl, upland game birds and feral pigs consumed directly by man. Emphasis here will be on rates of uptake and predictability of concentrations. A low-level effort will continue on the long-term decline of 137-Cs in contaminated pond and stream systems for which the sites on the SRP are particularly suitable. Information on biological and physical half lives are available but estimates for the half life in an ecosystem are lacking. These data can only be collected by a low level effort over a long time period. The aim is to better understand the long-term processes of natural decontamination of aquatic systems. We have increased our emphasis on other radioisotopes using them as tracers of ecological processes and of the movement of other contaminants. We have studies involving isotopes of Zn, Cd, To and H3.
Keywords: RADIONUCLIDE MIGRATION; CESIUM 137; ANIMALS; BIRDS; SWINE; FOOD CHAINS; MAN; ZINC ISOTOPES; CADMIUM ISOTOPES; TRITIUM; TERRESTRIAL ECOSYSTEMS; CONTAMINATION; RADIOECOLOGICAL CONCENTRATION.

90518 Effects of Energy Production on the Structure of Aquatic Environments. Gibbons, J.W. (Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 1908. **Contract:** EY-76-C-09-0819. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$180,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The Savannah River Plant (SRP) provides an opportunity unsurpassed in the southeastern U.S. to assess the impact of reactor effluents on structural features of natural habitats. Reactor effluents can modify a variety of structural parameters of aquatic ecosystems. Such environmental stress can impose detectable effects of trophic relationships, species compostion and diversity, genetic diversity, population dynamics, spatial organization, movement patterns, biomass production, standing crop, and the distribution of energy and nutrients. Both basic and applied biological studies are contemplated.
Keywords: AQUATIC ECOSYSTEMS; BIOLOGICAL MODELS; SAVANNAH RIVER PLANT; BASELINE ECOLOGY; MATHEMATICAL MODELS; REACTORS; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS.

90519 Synergisms and Interactions in Aquatic Systems. Gibbons, J.W. (Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 1909. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

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 geology. 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 contined 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.

90520 Effects of Energy Production on the Function of Aquatic Environments. Gibbons, J.W. (University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Project number:** 1910. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

90521 Savannah River National Environmental Research Park (SRNERP). Cahoon, E.J. (Savannah River Operations Office, P.O. Box A, Aiken, SC, 29801). **Project number:** 2148. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.
Related energy source: fossil fuels(10); coal(20); oil and gas(2); oil shales and tar sands(1); nuclear fuels(general)(10); nuclear fission(10); *nuclear fusion(6); hydroelectric(3); geothermal(5); solar(5);* biomass(20); wind(3); conservation(5). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90534 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:** 6353. **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: fossil fuels(80); nuclear fission(20). **R and D categories:** Ecological/biological processes and effects.

The objectives are to: (1) develop further the application of radioactive tracer techniques for the analysis of trophic functions in soil-litter arthropod food chains; (2) develop and test experimental models which will estimate assimilation of nutrient elements by soil-litter arthropods; and (3) evaluate the ability of current techniques and models for estimating input fluxes from nutrient element contents. Fungal-arthropod interactions and how nutient elements are thereby released from litter and soil for availability as slant nutrients are determined. Radiotracer studies determine the excretion curves for nutrient elements in arthropods and these data can be used to develop models of accumulation, mobilization and transfer in the cycling process.
Keywords: SOILS; FOOD CHAINS; ARTHROPODS; TRACER TECHNIQUES; CHEMICAL ANALYSIS; NUTRIENTS; FUNGI; MINERAL CYCLING.

90540 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:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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 cruise 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.

90541 Trace Metal 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: fossil fuels(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90544 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:** 7076. **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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

90548 Biological Processes in the Water Column of the South Atlantic Bight. Paffenhofer, G. (Skidaway Inst. of Oceanography, Savannah, GA). **Project number:** 7153. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

Depending upon the latitude and season, either solar radiation or the availability of inorganic nutrients appear to control t*productivity of marine phytoplankton.* Nutrients are probably t limiting factor through much of the year along the southeast coa 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 au-

thors 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; (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.

90552 Research Aircraft Program. Crawford, T.V.; Schubert, J.F. (DuPont de Nemours (E.I.) and Co., Savannah River Laboratory, Aiken, SC, 29801). **Project number:** 976. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

90553 Cooperative Forest Management Research. (E.I. Du Pont de Nemours and Co., Aiken, SC, 29801). **Project number:** 2150. **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: biomass(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The production of naval stores (rosin and turpentine) is an important resource output from southern forests. Currently over one billion pounds annually go into such major end uses as rosin for paper size, synthetic rubber, adhesives, surface coatings, printing ink, synthetic pine oil, insecticides, pressure sensitive tapes, flavors and fragrances. It has been recently discovered that wounding and treatment of trees with the herbicide paraquat will induce increased oleoresin production. Increased production could lower prices and stabilize supply of rosin and turpentine and their derivatives to the point that they could compete with petroleum, natural gas, and coal tar derivatives as chemical intermediates in the production of many kinds of plastics. This substitution would allow more fossil fuels to be released to satisfy energy needs. Oleoresins themselves could also be converted to fuels.
Keywords: FORESTS; MANAGEMENT; TURPENTINE; BIOMASS; PRODUCTION; PINES.

90554 Environmental Studies, Fuel Plantation Research. Stubbs, J. (USDA Forest Service, Southeast Forest Experiment Station, P.O. Box A, Aiken, SC, 29801). **Project number:** 1636. **Contract:** EY-76-A-09-0908. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: biomass(100). **R and D categories:** Ecological/biological processes and effects.

The production of naval stores (rosin and turpentine) is an important resource output from southern forests. Currently over one billion pounds annually go into such major end uses as rosin for paper size, synthetic rubber, adhesives, surface coatings, printing ink, synthetic pine oil, insecticides, pressure sensitive tapes, flavors and fragrances. It has been recently discovered that wounding and treatment of trees with the herbicide paraquat will induce increased oleoresin production. Increased production could lower prices and stabilize supply of rosin and turpentine and their derivatives to the point that they could compete with petroleum, natural gas, and coal tar derivatives as chemical intermediates in the production of many kinds of plastics. This substitution would allow more fossil fuels to be released to satisfy energy needs. Oleoresins themselves could also be converted to fuels. Research is being accelerated and expanded to assess insect pest problems and the protection required, develop sounder insect control and preventive measures, and determine the importance of biological and environmental variables in the process.
Keywords: BIOMASS PLANTATIONS; ENVIRONMENTAL IMPACTS; RESINS; BIOSYNTHESIS; HERBICIDES; INSECTS; PEST CONTROL; FORESTS; CONIFERS; SYNERGISM.

90555 Coordination: Southeast Oceanographic Program. 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 fuels(general)(50). **R and D categories:** Ecological/biological processes and effects.

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.

90557 Air/Earth Cycling of Pollutants. Crawford, T.V.; Murphy, C.E. (DuPont de Nemours (E.I.) and Co., Savannah River Plant, Aiken, SC, 29801). **Project number:** 3185. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

90561 Aeromonas hydrophila as an Infection Agent in Alligators. Gorden, R.W. (Wake Forest University, Department of Biology, Winston-Salem, NC, 27109). **Project number:** 7372. **Contract:** EY-76-S-09-0965. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$4,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Ecological/biological processes and effects.

A study is conducted to determine if Aeromonas hydrophila is prime agent in causing disease and subsequent death of Par Pond alligators; to evaluate the effects of A. hydrophila infections on a seasonal basis; to develop techniques and procedures to minimize risk of mortality; and to devise long-term plan of management to ensure continued existence of Par Pond alligators.
Keywords: ALLIGATORS; BACTERIA; SENSITIVITY; MORTALITY; MANAGEMENT; INFECTIVITY; RESPIRATORY SYSTEM DISEASES.

91004 Epidemiological Studies of Specific Diseases, Developmental and Metabolic Processes and Other Physiological Effects. Allen, L. (Radiation Effects Research Foundation, Hiroshima, Japan). **Project number:** 000426. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$6,698,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.
Keywords: EPIDEMIOLOGY; DISEASES; METABOLISM; PHYSIOLOGY; BIOCHEMISTRY.

91007 Radioactivity on the Earth's Surface. Hardy, E.P. Jr. (Environmental Measurements Laboratory, New York, NY, 10014). **Project number:** 528. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91008 Radioactivity in Surface Air. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 529. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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 deposition 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.

91009 Radioactivity on Stratospheric Air. Hardy, E.P. Jr. (Department of Energy, Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 530. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this program are: to document the concentrations of radioactivity in the stratosphere as a function of latitude, altitude, and season; to computer 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 degress 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 anayzed 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. Chlorofluorocarbon (F-11) data was used to develop the stratospheric inventory for input to the ozone-CFM problem.
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.

91010 Evaluation and Development of Sampling Systems. Breslin, A. (DOE Environmental Measurements Lab., New York, NY). **Project number:** 002481. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$98,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

Methods are sought to improve air sampling sensitivity for particulates in very low concentrations, such as tropospheric background aerosols, stratospheric aerosols, and for trace constituents in urban and industrial areas. Substantially better sensitivity than presently available is required for measuring the concentrations of substances that may be hazardous even in low concentrations and for determining baseline concentrations of various atmospheric constituents.
Keywords: INDUSTRY; URBAN AREAS; TROPOSPHERE; STRATOSPHERE; SURFACE AIR; AIR POLLUTION; AEROSOLS; PARTICLES; TRACE AMOUNTS; MONITORING; AIR SAMPLERS; SENSITIVITY; OPTIMIZATION; PUBLIC HEALTH; HEALTH HAZARDS; HAZARDOUS MATERIALS.

91011 Radioactivity in the Biosphere. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 684. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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 vertebrae 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.

91012 Radiochemical Development Studies. Welford, G.A. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 685. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91013 Analysis of Samples of Ocean Water. Volchok, H.L. (Environmental Measurements Laboratory,376 Hudson Street, New York, NY, 10014). **Project number:** 686. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$5,000.
R and D categories: Physical and chemical processes and effects.

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.

91014 Radiation Transport. Molaug, J.E. (DOE Environmental Measurements Lab., New York, NY). **Project number:** 00730. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$154,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

Theoretical calculations, based largely on transport theory, are developed and employed to predict radiation fields, to guide experimental designs, and to aid in experimental interpretations and dose assessments. The developments involve idealized or generalized geometries, so they can be applied to various radiation shields, and to dosimetry and to activation determinations of interest to both HASL and other organizations.
Keywords: THEORETICAL DATA; EXPERIMENT PLANNING; FORECASTING; DOSIMETRY; SHIELDS; RADIATION PROTECTION; RADIATION TRANSPORT.

91016 Assessment and Control of Radioactive Air Contaminants. Breslin, A. (DOE Environmental Measurements Lab., New York, NY). **Project number:** 000732. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$69,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The exposure of man or woman and his or her environment to airborne radioactive substances is studied in terms of the successive steps from sources via environmental pathways to ultimate sites of deposition, including the respiratory tract. Particular attention is being given to public exposure to background radon and radon daughters. The long range objectives of these investigations are to improve capabilities to assess, monitor, and control contaminants in public and occupational environments.
Keywords: AIR POLLUTION; CONTROL; MAN; DEPOSITION; RESPIRATORY SYSTEM; RADON; DAUGHTER PRODUCTS; RADIATION MONITORING.

91017 Aerosol Technology. Breslin, A.J. (DOE Environmental Measurements Lab., New York, NY). **Project number:** 000733. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$455,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

Fundamental information is developed about the characteristics of airborne particles and techniques for particle generation and measurement which is needed for filtration studies, inhalation studies, and calibrating size classifying air samplers.
Keywords: AIR POLLUTION; PARTICLES; AEROSOLS; AEROSOL GENERATORS; AIR SAMPLERS; PARTICLE SIZE CLASSIFIERS; CALIBRATION; FILTRATION; INHALATION; RESEARCH PROGRAMS.

91018 Development Studies in Instrumentation. Graves, R.T. (DOE Environmental Measurements Lab., New York, NY). **Project number:** 000735. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$264,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

New measurement capability depends on the development of sensors, electronic techniques to process their signals, and control and data acquisition systems to record and reproduce the collected information. Investigations to determine the sensitivity, stability, and reliability of various sensors are being conducted in this project. Also, methods for utilizing optical, mechanical, and electronic transducers in practical applications are being developed. Since the integrated circuit and large-scale integrated electronics have demonstrated flexibility and economy, the translation of sensor analog signals into digital form is implemented in most new designs.
Keywords: AIR POLLUTION MONITORS; WATER POLLUTION MONITORS; AIR POLLUTION; WATER POLLUTION; DATA ACQUISITION SYSTEMS; CONTROL SYSTEMS; ELECTRONIC EQUIPMENT; DATA PROCESSING; SENSITIVITY; ACCURACY; TRANSDUCERS; OPTICAL EQUIPMENT; INTEGRATED CIRCUITS; DESIGN.

91020 Analytical Development Studies. Welford, G.A. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 1778. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$219,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91021 Trace Elements in the Biosphere. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 370 Hudson Street, New York, NY, 10014). **Project number:** 1779. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$783,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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; METABOLISM; HEALTH HAZARDS; CADMIUM; COPPER; MANGANESE; NICKEL; LEAD; FOSSIL-FUEL POWER

PLANTS; WATER POLLUTION; LAND POLLUTION; POLLUTION; FOOD; TISSUES.

91022 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:** 1780. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$83,000.
Related energy source: coal(40); nuclear fission(60). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91023 Non-Nuclear Pollutants in Surface Air. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 1781. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$237,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 (MAP/sup 3/S).
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.

91024 Assessment and Control of Non-Nuclear Air Contaminants. Bresli, A.J. (DOE Environmental Measurements Lab., New York, NY). **Project number:** 001785. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$120,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

Methods are developed for assessing and reducing exposures to man from hazardous air contaminants arising from energy production.
Keywords: ENERGY FACILITIES; CHEMICAL EFFLUENTS; AIR POLLUTION; HEALTH HAZARDS; HUMAN POPULATIONS; PUBLIC HEALTH; AIR POLLUTION CONTROL; MONITORING.

91032 Genetic and Physiological Aspects of Radiation Resistance and Fitness in Lepidopteran Insects for Use in Autocidal Control Programs. LaChance, L.E. (Metabolism and Radiation Research Lab., Fargo, ND, 58102). **Project number:** 6519. **Contract:** P7603214. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$36,000.
R and D categories: Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is to develop autocidal methods of control for several agriculturally important insects and thereby reduce the amount of agricultural chemicals applied to the environment. Pests studied include pink bollworm, Mediterranean flour moth, and the Heliothis complex (budworm, bollworm, and earworm that are serious pests of cotton, corn and other crops). Major emphasis is on radiation sterilization, hybrid sterility and genetics of field populations. All lepidopteran species have holokinetic chromosomes, unique mitotic divisions and require high doses of radiation to induce sterility. Our studies indicate it is feasible to use lower doses of radiation and minimize the debilitating effects of radiation on reproductive processes (eupyrene sperm transfer is required to stimulate females to start oviposition and to stop calling for mates) and rely on the inherited sterility in the progeny of parents given substerilizing doses for population suppression. We have made major contributions in the area of radiation-reproductive studies. Hybrid sterility is found in the male progeny of H. subflexa x H. virescens. This sterility will persist for over 40 generations of backcrosses (males sterile, females fertile). Studies emphasize transition from laboratory to field applications since we are a major center for Heliothis hybrid sterility research.
Keywords: INSECTS; CHROMOSOMES; RADIOSENSITIVITY; GENETIC VARIABILITY; MALES; STERILE MALE TECHNIQUE; STERILE INSECT RELEASE; AGRICULTURE; STERILITY; RADIOINDUCTION; CROPS; PRODUCTION; PEST CONTROL; RADIOSTERILIZATION; PEST ERADICATION.

91037 Flow of Energy and Cycling of Elements and Effects of Environmental Change in Estuarine and Neardrine Oceanic Ecosystems. Cross, F. (National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Beaufort, NC, 28516). **Project number:** 6536. **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: fossil fuels(50); nuclear fission(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to conduct a long term multidisciplinary study of cycling and effects of nuclide, metal, and other pollutants in estuarine environments. Various long range aspects of production in the estuary and control of production will be determined.
Keywords: AQUATIC ECOSYSTEMS; RADIONUCLIDE KINETICS; RADIONUCLIDE MIGRATION; COAL INDUSTRY; ENVIRONMENTAL IMPACTS; METALS; WATER POLLUTION; WATER POLLUTION ABATEMENT; FISHES; MINERAL CYCLING; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; METABOLISM.

91038 Behavioral Measure of Environmental Stress: Marine Fishes and Invertebrates. Olla, B.L. (National Maritime Fisheries Service/National Oceanographic and Atmospheric Administration, Sandy Hook Laboratory, Highlands, NJ, 07732). **Project number:** 6537. **Contract:** E(49-7)-3045. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$27,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects; Ecological/biological processes and effects.

A behavioral study of the effects of sub-lethal temperature and oil pollution stresses representative of the near shore environment of the Mid-Atlantic region will be conducted. Sensitivities of the blue crab, Callinectus sapidus, and the hake, Urophycis chuss, are being determined relative to naphthalene and Prudhoe Bay crude oil in regard to avoidance behavior. Influence of thermal plumes on movement and distribution of the bluefish, Pomatomus saltatrix, will also be determined. Thresholds of behavior will be determined for different levels of hydrocarbons on the organisms as related to temperature increase or decrease.
Keywords: AQUATIC ECOSYSTEMS; FISHES; BEHAVIOR; THERMAL POLLUTION; TEMPERATURE EFFECTS; BIOLOGICAL STRESS; WATER POLLUTION; INVERTEBRATES; THERMAL EFFLUENTS; AQUATIC ORGANISMS; BIOLOGICAL INDICATORS.

91040 Project Ashcan. Falkowski, S.J. (Air Force Geophysics Lab., L.G. Hanscom Field, Bedford, MA, 01750). **Project number:** 6542. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$367,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects.

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. Ex-

posed 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.

91041 Airlift Support of Project Ashcan. Director of Budget. (OCS Controller, Hq. Military Airlift Command, Scott Air Force Base, IL, 62225). **Project number:** 6544. **Contract:** EX-76-A-28-2935. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$72,000.

The purpose of this effort is for the Air Force to provide aerial recovery capability in support of Project Ashcan in Panama and Alaska.**Keywords:** EARTH ATMOSPHERE; RADIATION MONITORING; BALLOONS; SAMPLING; AERIAL MONITORING; AIRCRAFT.

91042 Atmospheric Transport and Dispersion of Pollutants and Related Meteorological Studies. Machta, L. (National Oceanic and Atmospheric Admin., Air Resources Laboratory, Silver Spring, MD, 20901). **Project number:** 6547. **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: fossil fuels(35); nuclear fuels(general)(65). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 MAPES 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.

91045 Advisory Center on Toxicology. Wands, R. (Department of the Navy, Washington, DC). **Project number:** 006557. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$29,000.
Related energy source: all(100). **R and D categories:** Health effects.
Keywords: TOXICITY; CHEMICAL EFFLUENTS; TOXIC MATERIALS; INFORMATION CENTERS.

91046 Study of Plutonium Oxide in a Natural Environment: Project Indola. Iranzo. (Goverment of Spain, Junta de Energia Nuclear, Madrid, Spain). **Project number:** 006558. **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:** Health effects.
Keywords: PLUTONIUM OXIDES; RADIONUCLIDE KINETICS; RADIONUCLIDE MIGRATION.

91053 Project Airstream. Calio, A.J. (NASA, Johnson Space Flight Center, Washington, DC, 20546). **Project number:** 6807. **Contract:** EX-76-A-28-3152. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$550,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects.

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.

91060 Health Effects: Krypton. Kirk, W.P. (U.S. Environmental Protection Agency, HERL (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:** Health effects.

Kr-85 is a radioactive noble gas produced in and released to the atmosphere in large quantities as a by-product of the nuclear fuel cycle. 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-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; HEALTH HAZARDS; FUEL CYCLE; GUINEA PIGS; RATS; CHRONIC EXPOSURE; ACUTE EXPOSURE; TOXICITY; LEUKEMIA; INHALATION.

91061 Development of a National Plan for the Safety and Health of Divers in Their Quest for Subsea Energy. Wallac, D.H. (Department of Commerce, Washington, DC). **Project number:** 007186. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE←$110,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.
Keywords: DIVING OPERATIONS; HEALTH HAZARDS; SAFETY; OCCUPATIONS; OCCUPATIONAL SAFETY; OFFSHORE OPERATIONS.

91064 Air Quality Policy Analysis. 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). Div. of Policy Analysis. **Funding:** DOE-$200,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The purpose of the contract is to provide DOE with air quality policy analysis on a task order basis of key air quality energy/environmental issues facing the Department. Efforts have included work performed in New Source Performance Standards, Regulatory Issue Analysis on Air Issues, Visibility Impairment, etc.
Keywords: AIR QUALITY; ENVIRONMENTAL POLICY; GOVERNMENT POLICIES; ENERGY POLICY.

91072 Assessment of the Potential Environmental Conflicts on Energy Conservation Activities: A Policy Issue Analysis. Gordon, R. (Donovan, Hamester and Rattien, Inc., 1055 Thomas Jefferson Street, NW, Washington, DC, 20007). **Project number:** 007599. **Contract:** EE-77-C-01-6127. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$41,000.
Related energy source: conservation(100). **R and D categories:** Integrated assessment.

The study is a review of all DOE energy conservation programs from the perspective of the benefit/cost ratio, i.e., energy saved/environmental damages incurred. Those conservation programs identified as having possible substantial environmental impacts are developed in some detail, using existing published data. Programs for which the issues are so developed are: (1) cogeneration; (2) building insulation; (3) reduction of air loss from buildings; (4) municipal waste systems and recycling; (5) electric automobiles; and (5) small automobiles.
Keywords: CO-GENERATION; BUILDINGS; THERMAL INSULATION; ENERGY CONSERVATION; MUNICIPAL WASTES; RECYCLING; AUTOMOBILES; ELECTRIC-POWERED VEHICLES; AIR INFILTRATION; RESEARCH PROGRAMS; COST BENEFIT ANALYSIS.

91076 Cooperative Effort for Development, Fabrication and Evaluation of Gas Analysis and Detection System for Multiple Trace Gas Characterization, Measurement, and Monitoring. Wood, G. (National Aeronautics and Space Administration, Langley Station, VA). **Project number:** 007610. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$341,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

The subject of this interagency agreement with NASA is the support of a cooperative effort for development, fabrication, and evaluation of a gas analysis system for multiple trace gas characterization, measurement, and monitoring. The objective is development of a low-cost small, portable mass spectrometer having direct air sample inlet features and incorporating a rugged, simplified, early serviceable quadrupole MS head unit, ion source, ion pump, and microprocessor.
Keywords: AIR POLLUTION MONITORS; AIR SAMPLERS; GAS ANALYSIS; TRACE AMOUNTS; MASS SPECTROMETERS; DESIGN; FABRICATION; PERFORMANCE TESTING; INDOOR AIR POLLUTION; GASES; MONITORING; ION SOURCES; SPUTTER-ION PUMPS; MICROPROCESSORS.

91125 Non-Nuclear Pollutants on the Earth's Surface. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 2477. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$241,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Deposition of a number of stable trace metals is being measured routinely at New York City; Chester, NJ; WHOI; Argonne National Laboratory; Seattle; Beaverton; and Lawrence Livermore Laboratory. In addition to the total deposit, a specially designed collector is being used to separate wet and dry fallout. A regional baseline station has been established at Chester, NJ. The site has an instrumented 300 ft. meteorological tower in addition to standard ground level weather observation instruments. Presently, total, wet, and dry fallout sampling is being carried out over monthly intervals. Global baseline stations at Mauna Loa, HI; Barrow, AK; American Samoa; and Antarctica are available to EML through NOAA for carrying out long-term measurements of non-nuclear pollutants. The objective is to learn about geographical differences and time trends of pollutants which are distributed globally as opposed to emissions from local or regional sources. Total as well as wet and dry fallout collected over monthly periods is being analyzed for lead, cadmium, nickel, mercury, vanadium, major anions and cations, and pH.
Keywords: EARTH ATMOSPHERE; AIR POLLUTION; MONITORING; DEPOSITION; BASELINE ECOLOGY; HAWAII; ALASKA; ANTARCTICA; PACIFIC OCEAN; CHEMICAL EFFLUENTS; ENVIRONMENTAL TRANSPORT; GLOBAL ASPECTS; LEAD; CADMIUM; NICKEL; MERCURY; VANADIUM; PH VALUE; ECOLOGICAL CONCENTRATION.

91145 Biogeochemistry of Petroleum Components at the Sediment Water Interface. Teal, J.M.; Farrington, J.W. (Woods Hole Oceanographic Inst., Woods Hole, MA, 02543). **Project number:** 7300. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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 which chemical compartments the hydrocarons 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.

91146 Ecological Baseline Investigations Along the Yukon River--Prudhoe Bay Haul Road, Alaska. Brown, J. (U.S. Corps of Engineers, Cold Regions Research and Engineering Lab., Hanover, NH, 03755). **Project number:** 7503. **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:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to evaluate the impact of the Yukon River--Prudhoe Bay haul road. Baseline conditions will be established for germination of weeds and weedy vegetation in the first year and the progress of the weed communities will be followed. Similar work was also established for cryptograms measurements and characterization of road dust. Its transport, deposition, and accumulation on vegetation are determined. Soil invertebrates are also studied as indicators of environmental change.
Keywords: ROADS; ALASKA; ENVIRONMENTAL IMPACTS; BASELINE ECOLOGY; PRUDHOE BAY; RIVERS; PLANTS; INVERTEBRATES; SEEDS.

91157 Non-Nuclear Pollutants in Stratospheric Air. Hardy, E.P. Jr. (Environmental Measurements Laboratory, 376 Hudson Street, New York, NY, 10014). **Project number:** 1783. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$226,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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.

91161 Development of a Technical Assistance Manual for Management of Transmission Line Rights of Way for Fish and Wildlife. Quinn, H.B. (Fish and Wildlife Service, Office of Biological Services, Washington, DC, 20240). **Project number:** 7403. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$12,000.
R and D categories: Ecological/biological processes and effects.

The objective of the project is to prepare a technical assistance manual which integrates specific management problems, proven fish and wildlife management techniques, and special problems in transmission line rights of way (ROW) management into comprehensive management strategies for land used as transmission line ROW by electric utilities. This manual could then be used by biologists to develop specific management plans for overhead transmission line ROW. This manual will treat separately the various biological provinces and communities of the United States and will address the management problems specific to each. The manual will provide the technical guidance necessary to implement a management plan in a particular biological community in any province.
Keywords: POWER TRANSMISSION LINES; ELECTRIC POWER; ENVIRONMENTAL EFFECTS; REGIONAL ANALYSIS; AQUATIC ECOSYSTEMS; TERRESTRIAL ECOSYSTEMS; FISHES; WILD ANIMALS; BIOLOGICAL EFFECTS; MANAGEMENT; POWER TRANSMISSION; USA; MAGNETIC FIELDS; ELECTRIC FIELDS.

91168 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:** 7496. **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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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.

91172 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 Health and Environmental Research. **Funding:** DOE-$87,000.
Related energy source: solar(50); biomass(50). **R and D categories:** Environmental control technology.

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 Environmental Control Technology Division of DOE 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 I will provide the state of the art of the technologies involved so that preliminary priorities can be established.
Keywords: POLLUTION CONTROL; TECHNOLOGY ASSESSMENT; BIOMASS; ENERGY CONVERSION; MANURES; BIOCONVERSION; METHANE; AGRICULTURAL WASTES; CROPS; TREES; CELLULOSE; AIR POLLUTION CONTROL; WATER POLLUTION CONTROL; LAND POLLUTION CONTROL; WASTE MANAGEMENT; PLANNING; ENVIRONMENTAL IMPACTS.

91173 Assessment of Environmental Control Industry: Waste Treatment Technology. Mercer, B.W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800247. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
Related energy source: fossil fuels(50); conservation(50). **R and D categories:** Environmental control technology.

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.

91180 Instrumentation for Nuclear Applications. Berger, M.J. (National Bureau of Standards, Radiation Physics Division, Center for Radiation Research, Washington, DC, 20234). **Project number:** 006560. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to obtain reliable data on the transfer of energy from radiation to biological matter via secondary electrons, in regard to the following aspects: electron energy degradation spectra and yield of primary activations; statistical fluctuations of energy depositions in small sites (e.g., genetic material in cell nuclei); and the development of an adequate electron cross-section data base to allow the above-mentioned calculations. The approach used involved the following: (1) the evaluation and systematic compilation of scattering and absorption cross sections; (2) the development of mathematical transport theory models, numerical as well as analytical; (3) execution of large-scale transport calculations with use of computers; and (4) analysis and interpretation of computer results, with emphasis on the statistics of energy deposition and on the yield of various types of primary activations (determined through use of energy degradation spectra).
Keywords: ELECTRONS; SECONDARY EMISSION; KNOCK-ON; TISSUES; ENERGY LOSSES; ENERGY SPECTRA; CHARGED-PARTICLE TRANSPORT; ENERGY ABSORPTION; FLUCTUATIONS; ELECTRON-ATOM COLLISIONS; CROSS SECTIONS; BIOLOGICAL MATERIALS.

91181 Support for Development and Calibration of a Transportable, Self-Contained hf Shore-Based Radar System. Barric, D.W. (National Oceanic and Atmospheric Administration, Sea States Studies Program, Boulder, CO). **Project number:** 007185. **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:** Characterization, measurement, and monitoring.

A concept for radar remote-sensing of near-surface ocean currents in coastal regions is described. The system employs pairs of low-power (50 W), transportable, hf (30 MHz) radars whose signals from the shore are scattered from ocean waves that serve as tracers, i.e., underlying currents imparting a slight change in velocity to the ocean waves, which is detected by the radar received. Signals from each of the two geographically separated radar units of the pair, scattered from the same point on the sea, are used to construct a complete current vector for that point. In an operational system a radar pair will take simultaneous measurements over an ocean area with a grid having a 3-km spacing. Vectors will be constructed for each 3-km-square section, and a map of the near-surface current field will be output in real-time by a mini-computer on-site. System performance and simulation studies show that a radar pair can provide current data to a range from the coast of about 70 km. The optimum spacing between paired radars is nominally 40 km. Error analyses show that probable azimuthal position errors are less than 3 degrees for signal-to-noise ratios exceeding 10 db. Simulations using random sea-echo and noise signals indicate that probable rms current-velocity errors are not more than 5 cm/s.
Keywords: RADAR; MOBILITY; SITE SELECTION; REMOTE SENSING; OCEANOGRAPHY; NATURAL GAS INDUSTRY; PETROLEUM INDUSTRY; WATER WAVES; WAVE FORCES.

91183 Medium-Scale LNG Spill Tests. Lind, C.D. (U.S. Naval Weapons Center, China Lake, CA, 93555). **Project number:** 800220 (RPIS). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$135,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

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.

91184 Analysis of the Environmental Control Technology for Oil Shale and Tar Sand Development. de Nevers, N.H. (University of Utah, Department of Chemical Engineering, Salt Lake City, UT, 84112). **Project number:** 800150. **Contract:** FY-76-S-02-4043 Mod 003. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$56,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

A program is proposed that is designed to evaluate the environmental control technology for oil shale development and tar sand development and to determine whether the available technology is adequate to meet current and forseen environmental requirements. Areas for further R and D are suggested. The program also includes review and analysis of existing literature, performance of cost analyses, and evaluation of proposed technologies. Summary reports are to be made accessible to technical readers, describing the technology and evaluating it.
Keywords: OIL SHALES; OIL SANDS; EXPLOITATION; POLLUTION CONTROL EQUIPMENT; TECHNOLOGY ASSESSMENT; COST; ENVIRONMENTAL EFFECTS; OIL SAND INDUSTRY; OIL SHALE INDUSTRY; POLLUTION CONTROL.

91185 Performance Testing of Three Offshore Skimming Devices. Farlow, J.S. (Environmental Protection Agency. Washington. DC). **Project number:** 800223. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A program is reported to assess and evaluate the state-of-the-art of existing harbor offshore-oil spill cleanup capabilities in the

event of an oil spill during drilling operation for oil in the outer shelf. Three offshore oil skimming devices (a MARCO Class V, a cyclonet 100, and an Offshore Devices, Inc.) will be tested and evaluated in a test tank. The tank is 667 feet long, 65 feet wide and the tank holds 8 feet of water. Waves as much as 2.5 feet high can be generated, simulating harbor conditions. The data will be analyzed for each item, a report written plus color slides and a 20-minute movie film will be prepared.
Keywords: OIL SPILLS; DEMONSTRATION PROGRAMS; TEST FACILITIES; SKIMMERS; PERFORMANCE TESTING; EVALUATION; CONTINENTAL SHELF.

91186 Field Tests of Oil Spill Cleanup Equipment. Harlow, J.S. (Environmental Protection Agency, Washington, DC). **Project number:** 800199. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

The objective is to test and evaluate oil spill control and/or cleanup equipment in the EPA Oil and Hazardous Material Simulated Environmental Test Tank (OHMSETT) facility located at Leonardo, New Jersey. The test simulates actual operational conditions by generating waves up to 2.5 feet high and other complex wave motion found in harbors. The equipment to be tested has been developed by private enterprise and is offered for sale to the general public. Equipment to be tested is placed in a tank (667 feet long by 65 feet wide and a depth of 8 feet), wave motion is generated, and then the control equipment is moved over the surface at simulated operation speeds. Various skimmers are tested to collect oil from the water surface, then grab samples of water are collected and analyzed to evaluate the effectiveness of the equipment.
Keywords: OIL SPILLS; CLEANING; WATER POLLUTION CONTROL; POLLUTION CONTROL EQUIPMENT; PERFORMANCE TESTING; PETROLEUM; REMOVAL.

91187 Assessment of Hazards and Control of LNG Spills on Water. Parnarouskis, M.C. (United States Coast Guard, Office of Research and Development, Washington, DC, 20590). **Project number:** 800140. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$65,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A program is reported to determine the extent of hazard of 5.7 m-3 LNG released on water. Predictive mathematical models are used to determine extent of hazard. Appropriate field experiments were conducted to compare analyzed results with models. A final report is to be published as a US Coast Guard R and D report.
Keywords: LIQUEFIED NATURAL GAS; GAS SPILLS; HAZARDS; DEMONSTRATION PROGRAMS; WATER POLLUTION; POLLUTION CONTROL.

91190 Waste Heat Management in the Electric Power Industry. Harleman, D.R.F. (Massachusetts Institute of Technology, Energy Laboratory, Room 48-311, Cambridge, MA, 02139). **Project number:** 800136. **Contract:** EY-76-S-02-4114.A001. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$125,000.
Related energy source: fossil fuels(35); nuclear fuels(general)(35); conservation(30). **R and D categories:** Environmental control technology.

The cost, conversion efficiencies, and environmental impacts associated with power plant cooling systems are discussed and two complementary subtasks are defined. In the first, various cooling systems (river diffusers, cooling ponds, wet, wet/dry and dry towers) are designed and compared for a hypothetical site. Two specific areas which have been addressed are: (1) the effect that the cost of replacement energy has on the optimal size of cooling systems (especially dry towers); and (2) the development of a quasi-steady representation of the transient response of systems with large thermal inertia (e.g., cooling ponds). The results of this single-site comparison are being used to compare costs, on a national level, of various cooling technologies. In the second half of the study the design and operation of supplementary (mixed-mode) cooling systems is being examined in the context of a case study involving Browns Ferry Nuclear Plant. The plant has been designed to operate in either open, helper or closed modes. The most important findings of the study to date are that: (1) using the best mode of operation, the mixed-mode cooling system results in only 10% of the capacity losses experienced by a totally closed system; (2) the cooling tower-related capacity loss is extremely sensitive to the specified limit on induced temperature increases (a decrease from 5 to 3 degrees F in the allowable temperature rise produces a 300% increase in lost capacity); and (3) about one-third of the capacity losses incurred using a mixed-mode system is the result of natural temperature variations which are interpreted as plant-induced effects by the monitoring system; this unnecessay loss may be cut in half by the use of a predictive model for natural temperature fluctuations developed in this study.
Keywords: ELECTRIC POWER INDUSTRY; WASTE HEAT; COOLING TOWERS; COOLING SYSTEMS; THERMAL POWER PLANTS; DESIGN; OPERATION; BWR TYPE REACTORS; EFFICIENCY; ENVIRONMENTAL IMPACTS; COST.

91191 Assessment of Practicality of Oil Spill Treatment. Wilson, M.P. (University of Rhode Island, Mechanical Engineering Department, Kingston, RI, 02881). **Project number:** 800139. **Contract:** EY-76-S-02-4047. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$495,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A program is being conducted to determine practicability and feasibility of treating oil spills with dispersants. The program comprises conducting mathematical, laboratory--scale, neso-scale and in situ experiments to compare treated and untreated oil spills. A literature search and background study was completed. Complete meso--scale tests are planned.
Keywords: OIL SPILLS; EMULSIFICATION; BENCH-SCALE EXPERIMENTS; MATHEMATICAL MODELS; FEASIBILITY STUDIES; EVALUATION.

91193 Partial Support--Ocean Services Board. Vetter, R.C. (National Research Council, Ocean Science Board, 2101 Constitution Avenue, Washington, DC, 20418). **Project number:** 6540. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000; OGA-$170,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

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.

91194 Partial Support of the University National Oceanographic Laboratory System (UNOLS) Office. Johrde, M.K. (National Science Foundation, Office for Oceanographic Facilities, Washington, DC, 20550). **Project number:** 7136. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$19,000; NSF.

The UNOLS Office objectives are: (1) 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 (2) to improve the level and stability of federal support for academic oceanography, thereby continuing and enhancing the excellence of this nation's oceanographic programs.**Keywords:** OCEANOGRAPHY; RESEARCH PROGRAMS; PLANNING; COST; FINANCING; GOVERNMENT POLICIES.

91196 Effects of Sulfur Dioxide and Nitrogen Dioxide on Vegetation. Weinsteih, L.H. (Boyce Thompson Inst. for Plant Research, Inc., 1086 N. Broadway, Yonkers, NY, 10701). **Project number:** 7235. **Contract:** EE-77-8-02-4368. **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:** Ecological/biological processes and effects.

The objectives of this research are to provide data on the direct and indirect effect of SO/sub 2/ in important crop and forest species of plants and how they are affected by NO/sub 2/. This kind of information can be used to assess the impacts on agriculture and forestry of coal-fired power plants and other large users of coal or

other fossil fuels, including: (1) the mode of action and metabolic transformations of SO/sub 2/ in plants; (2) the effect of SO/sub 2/ on the plant as it affects its suitability as a host for plant pathogens; (3) the effects of SO/sub 2/ on the suitability of plants to colonization by the Mexican bean beetle and on the production of volatile terpenoids and their relation to susceptibility of conifers to invasion by spruce budworm; (4) the effect of NO/sub 2/ on the phytotoxicity of SO/sub 2/ with respect to foliar lesions, yield, and quality; and (5) the effects of SO/sub 2/ alone and in combination with NO/sub 2/ on root physiology and development. The great majority of experiments will be carried out with wheat, corn, and soybeans. Economically, they represent the most important grain crops grown in North America. Biochemically, they represent the two major photosynthetic pahtways, C-3 and C-4. Experiments will be conducted with potted plants under controlled environment conditions to determine that certain phenomena can occur. Whether they are of importance will be determined in subsequent tests in the field under ambient conditions of temperature, light, rainfall, etc.
Keywords: SULFUR DIOXIDE; NITROGEN DIOXIDE; PLANTS; METABOLISM; AIR POLLUTION; BIOLOGICAL EFFECTS.

91197 Inner Shelf Sediment Transport Experiment (INSTEP). Swift, D.J.P. (National Oceanic and Atmospheric Administration, Atlantic Oceanographic and Meteorological Laboratories, Miami, FL, 33149). **Project number:** 7237. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$150,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects.

The objectives are to determine coastwise and coast-normal components of suspended sediment flux; and to determine patterns of sea floor erosion and sedimentation. Instrument arrays combining current meters, nephelometers, acoustic transducers, cameras and wave gages will be procured, analyzed and tested. These instruments will be used to measure movement of suspended sediments and bed loads and to characterize bottom erosion and deposition.
Keywords: OCEANOGRAPHY; COASTAL WATERS; NEW YORK; SEDIMENTS; ENVIRONMENTAL TRANSPORT; WATER CURRENTS; CHEMICAL COMPOSITION; REMOTE SENSING; SEA BED.

91198 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:** 7343. **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 shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The object of this work is to collate, analyze and interpret the C-a, C-b, V-a, and V-b oil shale tract bascline 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.

91199 Sources of Ozone and Sulfates in the Northeastern U.S. Husain, L. (New York State Department of Health, Albany, NY, 12202). **Project number:** 7344. **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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91201 Investigation into the Usefulness of Multivariate Diffusion Processes in the Study of Home Range. Dunn, J.E. (University of Arkansas, Fayetteville, AR, 72701). **Project number:** 7171. **Contract:** EY-76-S-05-5147. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$15,000.
R and D categories: Ecological/biological processes and effects.

An attraction of the present multivariate Ornstein--Uhlenbeck model for home range studies is that it readily allows one to compare various sampling strategies before proceeding to the field, given sufficient a priori information. It is proposed that donated data sets be acquired and used to establish a central data bank which will contain uniformly estimated home range parameters for a wide range of cataloged species and conditions. A secondary advantage which will accrue is that this bank will constitute a permanent shared record of home range information for the sake of both contemporary and temporal comparisons. Since many available data sets are likely to be collected with a haphazard sampling interval, a general program to obtain estimates of home range parameters from unequally spaced data will be completed. Particular emphasis will be placed on deriving new Ornstein--Uhlenbeck models which account for physical boundary conditions, e.g. the air—water interface for fish, and to their related inference problems. Special attention will also be directed to characterizations and inference problems which relate to the study of territorial interaction between organisms.
Keywords: MATHEMATICAL MODELS; HABITAT; BASELINE ECOLOGY; SAMPLING; BIOLOGICAL MODELS; TERRESTRIAL ECOSYSTEMS; FISHES.

91202 Effects of H/sub 2/S on Vegetation. Thompson, C.R. (University of California, Statewide Air Pollution Research Center, Riverside, C714-787-5131;C714-796-1342, 92521). **Project number:** 7506. **Contract:** EY-76-S-03-0034. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: geothermal(100). **R and D categories:** Ecological/biological processes and effects.

The present proposal would study the effects of actual levels of H/sub 2/S 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 H/sub 2/S levels would do to agricultural and native species. A third objective would be to compare the long-term toxic effects of H/sub 2/S and SO/sub 2/ on selected plant species so that the amount of injury to vegetation could be predicted downwind from a source of H/sub 2/S as it oxidized to SO/sub 2/.
Keywords: HYDROGEN SULFIDES; PLANTS; CONTAMINATION; CROPS; GEYSERS GEOTHERMAL FIELD; ENVIRONMENTAL EFFECTS; SULFUR DIOXIDE.

91203 Fatty Acid Ecology of Plankton Communities. Jeffries, H.P. (University of Rhode Island, Graduate School of Oceanography, Kingston, RI, 02881). **Project number:** 7520. **Contract:** U-7702073. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$39,000.
Related energy source: fossil fuels(100). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

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 disributions 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.

91204 Effects of Acid Precipitation on Cation Transport in New Hampshire Forest Soils. Cronan, C.S.; Reiners, W.A.; Reynolds, R.C. Jr. (Dartmouth College, Department of Biological Sciences, Hanover, NH, 03755). **Project number:** 7619. **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: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

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.

91205 Distribution of Marine Birds on Georges Bank and Adjacent Waters. Powers, K.D. (Manomet Bird Observatory, Manomet, MA, 02345). **Project number:** 7740. **Contract:** 78-S-02-4706. **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:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

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; RISK ASSESSMENT; POPULATION DYNAMICS; TERRESTRIAL ECOSYSTEMS; WATER QUALITY.

91206 Measurement of Surface Fluxes of Pollutants. Stedman, D.H. (University of Michigan, Ann Arbor, MI, 48105). **Project number:** 7961. **Contract:** EP-78-S-02-4958. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$47,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objectives of this work are to, in cooperation with ANL, develop and test fast response sensors for O3, NOx and SOx. The fast response sensors, < 1 sec response time, will be used in conjunction with ANL eddy correlation techniques to determine surfluxes of pollutants to various surfaces. This will provide a measure of pollutant deposition velocity.
Keywords: OZONE; NITROGEN OXIDES; SULFUR OXIDES; AIR POLLUTION MONITORS; DEPOSITION; VELOCITY; TESTING; TIME DEPENDENCE; AEROSOLS; ENVIRONMENTAL TRANSPORT.

91207 Radon Transport Processes in Near Surface and Underground Environments. Wilkening, M.H. (New Mexico Institute of Mining and Technology, Socorro, NM, 87801). **Project number:** 7962. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$56,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91208 Impact of Gaseous Sulfur and Aerosols Produced by Power Plants on the LCN Budget. Saxena, V.K. (University of Utah, Department of Meteorology, Salt Lake City, UT, 84112). **Project number:** 7963. **Contract:** EP-78-S-02-465. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this study is to characterize the cloud condensation nuclei component of urban and power plant plumes using the state-of-the-art CCN spectrometer developed. The measurement program will be conducted in cooperation with the PNL MAP3S plume studies.
Keywords: SULFUR; ENVIRONMENTAL TRANSPORT; CLOUDS; CONDENSATION NUCLEI; URBAN AREAS; PLUMES; FOSSIL-FUEL POWER PLANTS; MATHEMATICAL MODELS; ENVIRONMENTAL IMPACTS; METEOROLOGY; PARTICLES.

91209 Characterization of Organic Species Emitted from Oil Shale Conversion Processes. Natusch, D.F. (Colorado State University, Department of Chemistry, Ft. Collins, CO, 80523). **Project number:** 7342. **Contract:** EP-78-S-02-4960. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$116,000.
Related energy source: oil and gas(30); oil shales and tar sands(70). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This project will identify a suitable surrogate for a full scale oil shale retorting operation, probably an isolated western refinery, and to study the organic emissions, their stability and/or transformations during atmospheric transport. Comparisons will be made with available oil shale processing data to develop an understanding of the potential impact of large scale shale oil processing on the atmospheric environment.
Keywords: OIL SHALE PROCESSING PLANTS; CHEMICAL EFFLUENTS; AIR POLLUTION; ENVIRONMENTAL EFFECTS; RETORTING.

91210 Held for Water Resources Council. Project number: 6931. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$848,000.
R and D categories: Integrated assessment.

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.

91211 California Institute of Technology Development of General Research Program, Part II. (California Institute of Technology, Pasadena, CA, 94301). **Project number:** 7329. **Contract:** 6503767. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$45,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The program aims at providing policy studies based on interdisciplinary application of modern analytical methods to alternatives for energy production, energy use and environmental control. It deals with such topics as taxing, regulation, leasing, water resources in the Colorado basin, management of waste heat from thermal power plants, and air pollution modeling for photochemical smog in the Los Angeles basin as well as implications of chemical composition of fuels on air pollution.
Keywords: SOCIO-ECONOMIC FACTORS; ENERGY POLICY; ENVIRONMENTAL POLICY; ENERGY; ELECTRIC POWER; POWER GENERATION; ENERGY CONSUMPTION; WASTE MANAGEMENT; AIR POLLUTION; MATHEMATICAL MODELS; WATER RESOURCES; WASTE HEAT; THERMAL POWER PLANTS; SMOG; CHEMICAL COMPOSITION; TAXES; CALIFORNIA.

91212 Support for Research on Northern Great Plains Coal. Krutilla, J.V. (Resources for the Future, 1755 Massachusetts Avenue NW, Washington, DC, 20036). **Project number:** 7706. **Contract:** EP-78-C-01-6205. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$37,000. **Related energy source:** coal(100). **R and D categories:** Integrated assessment.

The objective is to provide a validated hydrologic simulation model for use in quantitative analysis of available flow, given existing and prospective water claims for competing uses, as well as the effects of legal and institutional factors on flow availability for coal extraction and conversion in the Upper Yellowstone Basin of the Fork Union coal formation. The project will provide a detailed predictive and analytical capability for assessing alternative stream flow allocations and their tradeoffs in a major fossil fuel development area where water could be a major constraint. The project should contribute substantially to an understanding of the impacts of coal development in the Fort Union formation area including the impact of coal development on water quality and particularly on the availability of water to other uses such as agriculture, recreation, industry, and community and commercial developments.
Keywords: GROUND WATER; SURFACE WATERS; HYDROLOGY; MATHEMATICAL MODELS; WATER RESOURCES; COAL MINING; WATER QUALITY; WATER REQUIREMENTS; GREAT PLAINS; COAL; ENERGY SOURCE DEVELOPMENT.

91213 Report Preparation--Evolving Environmental Problems as a Result of the Proposed National Energy Plan (NEP). Jacknow, J. (Joel Jacknow, 8110 Timber Valley Court, Dunn Loring, VA, 22027). **Project number:** 7711. **Contract:** GK-01-01-03-3. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$10,000.

The contractor shall identify and examine evolving problems that are candidates for environmental assessments as a result of the National Energy Plan. The problems that may be identified should relate to the various technical solutions that may be implemented as part of various conservation and energy efficiency policies and the development of new nonfossil fuel based technologies such as solar and wind power. Examples of evolving problems are: (1) the increased use of plastics by the automobile industry, (2) the increased production of insulation materials, and (3) the manufacture and disposal of photovoltaic cells having cadmium as a major component. The contractor shall identify issues of this type and analyze the key questions and major subsidiary problems of each issue. The contractor shall prepare a series of reports each dealing with one of these issues. It is expected that 10 such reports will be prepared. Each report shall identify data requirements for eliminating problems and resolving questions identified in the study. In addition, the contractor shall identify resources and information in prior studies which are useful in assessing solution alternatives. Additional assessment efforts which may be needed will also be identified.**Keywords:** NATIONAL ENERGY PLAN; ENERGY CONSERVATION; IMPLEMENTATION; GOVERNMENT POLICIES; PLASTICS; AUTOMOBILES; THERMAL INSULATION; THERMAL EFFICIENCY; PLANNING.

91214 Grant for Energy and Financial Planning with the Crow Coal Authority. Yellowtail, J. (Crow Coal Authority, Box 220, Crow Agency, MT, 59022). **Project number:** 7713. **Contract:** EP-78-G-01-6214. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$180,000.
Related energy source: coal(100). **R and D categories:** Integrated assessment.

The basic objectives of this contract are: (1) to develop a model Comprehensive Energy Management Plan for a reservation's specific planning problems of a tribe facing rapid social, economic, and environmental changes due to the impact of coal development so that the Crow Coal Authority will have the manpower and information to deal effectively with the energy developers; and (2) to develop a model Financial Plan for a reservation impacted by energy research and development. This plan will allow the Crow Tribe to base development on their actual needs.
Keywords: AMERICAN INDIANS; PLANNING; SOCIO-ECONOMIC FACTORS; COAL; ENERGY SOURCE DEVELOPMENT; INDIAN RESERVATIONS; SOCIAL IMPACT; ECONOMIC IMPACT; ENERGY MANAGEMENT.

91215 Program Development/Support. Iura, T. (Aerospace Corporation, 20030 Century Blvd., Germantown, MD, 20767). **Project number:** 7895. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Regional Assessments. **Funding:** DOE-$115,000. **Related energy source:** all(100). **R and D categories:** Integrated assessment.

The objectives are to: (1) prepare draft requirements documentation and assist in coordination of program objectives, plans, requirements, and outputs; (2) assist in preparation for, conduct of, and documentation of interlaboratory/contractor project reviews and prepare summaries and recommendations; (3) assist with budget planning activities and prepare drafts of budget-oriented documentation; (4) review and analyze draft regional reports for consistency of methodology and results, depth of analysis, reasonableness of contents, and extent of regional coverage; and (5) assist with overall interface activities with the Water Resource Council and other water authorities and compile baseline water resource and quality data for energy technologies in support of the interfacing activity.
Keywords: INFORMATION SYSTEMS; MANAGEMENT; WATER RESOURCES; BASELINE ECOLOGY; WATER QUALITY; ENERGY; PLANNING.

91216 Fluid Dynamic Study of Open-Topped Chambers. Thompson, C.R. (University of California, Statewide Air Pollution Center, Riverside, CA, 92502). **Project number:** 7964. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

91217 In Vitro Enzymatic Studies on the Nature and Repair of X-Ray-Induced Lesions in DNA. Wallace, S.S. (New York Medical College, Department of Microbiology, Valhalla, NY, 10595). **Project number:** 7968. **Contract:** EP-78-S-02-4966.A000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$48,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objectives are to (1) determine enzymatic specificity of nucleases which recognize DNA damages induced by ionizing radiation; (2) react defined substrates with purified enzymes from E. coli yeast and a variety of sources; and (3) elucidate molecular mechanisms of DNA repair of ionizing radiation damage.
Keywords: X RADIATION; IRRADIATION; IN VITRO; DNA; BIOLOGICAL RADIATION EFFECTS; STRAND BREAKS; RADIOINDUCTION; BIOLOGICAL REPAIR; NUCLEASES; ENZYME ACTIVITY; SPECIFICITY.

91218 Partial Support of the Man and Biosphere Program. King, D.R. (United States National Committee for Man and the Biosphere, Washington, DC, 20520). **Project number:** 7399. **Contract:** EX-76-A-28-3227. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$30,000.
R and D categories: Ecological/biological processes and effects.

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.

91219 Feasibility Study: Environmental Research Park. Blanco, F.J. (Conservation Trust of Puerto Rico, P.O. Box 4747, San Juan, PR, 00905). **Project number:** 7786. **Contract:** EV-78-G-05-5853. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
R and D categories: Ecological/biological processes and effects.

The work wil 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 as 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 park.
Keywords: PUERTO RICO; NATURE RESERVES; RESOURCE CONSERVATION; ECOSYSTEMS; MAPS; PLANTS; SOILS; HYDROLOGY; BASELINE ECOLOGY; PLANNING.

91220 Partial Support of the Twelfth International Symposium on Remote Sensing of the Environment. Cook, J.J. (Environmental Research Institute of Michigan, Center for Remote Sensing, P.O. Box 618, Ann Arbor, MI, 48107). **Project number:** 7805. **Contract:** EV-83-91(HQ). **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$10,000.
R and D categories: Physical and chemical processes and effects.

The prime objective of this conference, to be held in Manila, Philippines, April 20--26, 1978, is to encourage reports of work in progress and to stimulate an exchange of information throughout the international remote sensing community. The symposium should: (1) provide an assessment of the state-of-the-art of remote sensing technology, as well as its application in various disciplinary areas; (2) provide the broadest practical forum for the presentation and publication of reports on work planned, in progress, or completed in all aspects of this interdisciplinary field; and (3) provide a convenient and effective vehicle for both formal and informal contact among individuals, groups, agencies and organizations engaged in all aspects of research development and application of this technology.
Keywords: MEETINGS; REMOTE SENSING; TECHNOLOGY ASSESSMENT; RESEARCH PROGRAMS.

91221 DNA Synthesis Inhibition Test for Screening of Mutagenic Carcinogens. 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: fossil fuels(45); nuclear fuels(general)(55). **R and D categories:** Health effects.

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.

91222 Partial Support for the Global 2000 Study. Barney, G.O. (Council on Environmental Quality, 722 Jackson Place, NW, Washington, DC, 20006). **Project number:** 7710. **Contract:** EE-78-A-28-3260. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000; OTHER-$450,000.
R and D categories: Integrated assessment.

The study is to serve as the foundation of the Government's longer-term planning for environmental quality assurance. The study will draw upon existing models and projection tools, giving first priority to capabilities within the Government. While most projection and modeling capabilities now available are restricted to relatively narrow disciplines or subjects, the study will draw these single-purpose projections together as consistently as possible into an integrated whole. The results of this process will be compared with those of large-scale systems--models such as that developed by Professor Mihajlo Mesarovic at Case Western Reserve University. A number of these large systems--models will be analyzed as possible approaches to the kind of integrated analyses required for longer-range planning. The study will identify scarcities and problems which may become serious by 2000 and the years following the turn of the century, to the extent that these can be identified in this brief analysis. The study will also suggest ways in which the effectiveness and efficiency of longer-range planning can be increased and will identify research priorities in science, technology and other areas.
Keywords: GOVERNMENT POLICIES; ENVIRONMENTAL POLICY; GLOBAL ASPECTS; ENVIRONMENT; QUALITY ASSURANCE; COMPARATIVE EVALUATIONS; PLANNING; ENERGY SHORTAGES; ENVIRONMENTAL IMPACTS; FORECASTING.

91223 Damagng 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:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

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.

91224 LPG Safety Research. 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). Div. of Environmental Control Technology. **Funding:** DOE-$10,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

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.

91225 Environmental Assessment for Gasifiers in Industry. Cowser, K.E. (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). Div. of Environmental Control Technology. **Funding:** DOE-$250,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

91227 Evaluate Feasibility of Methods and Systems for Reducing LNG Tanker Fires. 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). Div. of Environmental Control Technology; Maritime Administration, Washington, DC (USA). **Funding:** DOE-$50,000; DOC-$63,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

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.

91228 Development of Coatings for Protection of Coal During Transport and Storage. Kromrey, R.V. (Atlantic Research Corporation, 5390 Cherokee Avenue, Alexandria, VA, 22314). **Project number:** 800293. **Contract:** EP-78-C-02-4632. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$100,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

Coal in stockpiles or in rail cars is subject to adverse effects from exposure to wind and rain. Dust emission and leachate formation are the most serious environmental problems caused by this exposure. The purpose of this program is to evaluate the technical feasibility and economics of coating coal stores to prevent moisture penetration and air circulation. Formulations of coating mixes are prepared and promising compositions are tested for rheological properties, tensile and compressive strength, thermal coefficient of expansion, water permeability, and grindability. Test panels are constructed for evaluation of the coatings on a coal surface. An application device capable of applying one gallon per minute of coating material is to be constructed. This unit will be used to coat large panels for outdoor weathering tests and longer term observation. An economic analysis will determine the cost of applying coatings to rail cars and coal stockpiles of various sizes. A cost/benefit study will establish the relative merits of various coating alternatives to provide the desired degree of protection at the lowest cost. Efforts proposed for FY79 include further evaluation of coatings on test panels and small stockpiles. An application system capable of applying 10 gallons per minute of coating mix will be constructed. A field test on a stockpile of up to 50,000 tons will be conducted. A detailed economic analysis based upon data from the larger scale operations will be performed.
Keywords: COAL; TRANSPORT; STORAGE; STOCKPILES; WEATHERING; LEACHING; DUSTS; COATINGS; FEASIBILITY STUDIES; ECONOMICS; PHYSICAL PROPERTIES; MECHANICAL PROPERTIES; EVALUATION; RUNOFF; PARTICLES; RAIL TRANSPORT; CONTROL.

91229 State-of-the-Art Review of State/Federal Environmental Regulations 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). Div. of Environmental Control Technology. **Funding:** DOE-$10,000.
Related energy source: fossil fuels(30); nuclear fuels(general)(30); hydroelectric(20); geothermal(10); conservation(10). **R and D categories:** Environmental control technology.

Environmental regulations concerning electrical effects of all the state and federal agencies are reviewed. The various regulatory agencies were contacted to obtain up-to-date data on environmental regulations of electrical effects consisting of: (1) interference to communication facilities, (2) public safety and comfort, (3) noise pollution, and (4) air-quality. Results of the study include: (1) Communication Interference: evaluation of the impact to communications by transmission lines is required by FCC, REA and 23 states (no quantitative values are given); (2) Public Safety and Comfort: 26 states, REA and Office of Nuclear Reactor Regulations require evaluation of public safety and comfort and undue hazard to the property in proximity of transmission lines (Only state of Oregon has developed quantitative values of permissible 9.0 kV/m electric field level. NESC requires 5 mA short-circuit criteria. Various regulatory agencies require different levels, e.g., Minnesota--8 kV/m ac and 12 kV/m dc, New York--6.9 kV/m over public roads and 10.6 kV/m over private roads, 1 kV/m at the edge of right-of-way, and North Dakota--8 kV/m ac and 33 kV/m dc; (3) Noise Pollution: of 24 states and EPA requiring evaluation of impact of noise from transmission lines, 9 states and EPA have established noise guidelines (the permissible noise limits at the property line varies from 40 db(A) to 70 db(A)); and (4) Air Quality: air quality guidelines adopted by EPA and most of the states for photochemical are ozone--0.08 ppM (by volume) not to be exceeded once per year and oxides of nitrogen--0.05 ppM maximum annual arithmatic mean.
Keywords: POWER SYSTEMS; POWER TRANSMISSION LINES; ENVIRONMENTAL EFFECTS; REVIEWS; REGULATIONS; OVERHEAD POWER TRANSMISSION; AIR QUALITY; NOISE POLLUTION; SAFETY.

91230 Study of Gelled LNG: An Alternate Method for Handling LNG with Increassed Environmental Safety in Transportation and Storage. 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). Div. of Environmental Control Technology. **Funding:** DOE-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

Details are given concerning a program to assess the technical and economic feasibility of decreasing the hazard of transporting, storing, and handling LNG ty 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.

91231 Control of Emissions from Gasifiers Using Coal with a Chemically Bound Sulfur Scavenger. 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). Div. of Environmental Control Technology. **Funding:** DOE-$78,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

91232 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). Div. of Environmental Control Technology. **Funding:** DOE-$35,000.
Related energy source: coal(20); other advanced(80). **R and D categories:** Environmental control technology.

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.

91233 LPG (Liquefied Petroleum Gas) Safety and Environmental Control Research Assessment. Patrick, M. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 800350. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$40,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

Efforts are reported to prepare assessment of needed research in the area of LPG safety and environmental control.
Keywords: LIQUEFIED PETROLEUM GASES; SAFETY ENGINEERING; POLLUTION CONTROL; RESEARCH PROGRAMS; TECHNOLOGY ASSESSMENT; ENVIRONMENTAL EFFECTS.

91234 Oil Spill Burning. Dawson. (Pattelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 800351. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

A program is described to determine feasibility of burning oil spills. Included is a literature review and lab-scale and field-scale experiments.
Keywords: OIL SPILLS; FEASIBILITY STUDIES; COMBUSTION; TESTING; BENCH-SCALE EXPERIMENTS; EVALUATION.

91235 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:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE-$70,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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.

91236 Assessment and Control of Radioactive Emissions from Coal Mining Processing and Combustion. 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). Div. of Environmental Control Technology. **Funding:** DOE-$35,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The purpose of this work is 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. There are three basic parts to the research required in order to achieve the stated technical objectives: (1) resolution of the distribution(s) of radionuclides in the various sectors of the coal utilization cycle, (2) analysis of the nature and magnitude of radionuclide releases associated with coal use, and (3) identification of control technologies to counter environmental problem areas that are uncovered, if any.
Keywords: COAL MINING; COAL; PROCESSING; COMBUSTION; ASHES; WASTE DISPOSAL; RADIOACTIVE EFFLUENTS; RADIOISOTOPES; ENVIRONMENTAL EFFECTS; HEALTH HAZARDS; STORAGE; GROUND WATER; SURFACE WATERS; EVALUATION; COAL GASIFICATION; COAL LIQUEFACTION.

91237 Modeling Climatic Effects of Carbon Dioxide Increases. Knox, J.B. (Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA, 94550). **Project number:** 3028. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$55,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

This project will use several models including the Livermore 2-dimensional Zonal Atmospheric Model (ZAM-2) and a simplified 1-dimensional climate/carbon reservoir model, to study the response of the global climate to increased atmospheric CO2 concentrations. An objective of this work is to narrow the range of uncertainty in assessing temperature changes by considering the effects of hydrologic balance, the vertical thermodynamic, kinetic and chemical structure of the atmosphere, and meridional transport. Other Livermore models, particularly the Stratospheric Chemistry/CO2 model will be used in conjunction with the ZAM-2 and simplified 1-D model to study the effect of changes in long and short wave radiation on atmospheric composition and the thermal effects due to increased CO2 on stratospheric ozone.
Keywords: CLIMATES; CARBON DIOXIDE; ECOLOGICAL CONCENTRATION; MATHEMATICAL MODELS; EARTH ATMOSPHERE; OZONE; STRATOSPHERE.

91238 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:** 3032. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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.

91239 Investigation of the Atmospheric and Surface Ocean CO2 Partial Pressure in the Indian Ocean. Takahashi, T. (Columbia University, Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** 7663. **Contract:** EE-77-S-02-4581. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$16,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to conduct a comprehensive survey of the Indian Ocean surface water CO2 partial pressure and the atmospheric CO2 concentrations during the GEOSECS Indian Ocean Expedition conducted November 1977 through April 1978. These data will supplement similar data taken with similar equipment in previous GEOSECS cruises in the Atlantic and Pacific and together with these would provide an estimate of CO2 partial pressure distribution in the world's oceans. These data will be of value in delineating the regions of CO2 exchange and its magnitude and direction between the air and the ocean.
Keywords: EARTH ATMOSPHERE; CLIMATES; CARBON DIOXIDE; SEAS; INDIAN OCEAN; SURFACE WATERS; ECOLOGICAL CONCENTRATION; METEOROLOGY; MATHEMATICAL MODELS; ENVIRONMENTAL TRANSPORT.

91240 Partial Support for the First GARP Global Experiment. Epstein, E.S. (National Oceanic and Atmospheric Administration, Rockville, MD, 20852). **Project number:** 7709. **Contract:** EE-78-A-28-3259. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$125,000.
R and D categories: Physical and chemical processes and effects.

This support is to help equip ships with wind finding equipment that will be used in the first GARP Global Experiment (FGGE). FGGE will take place in 1977--1979 with a general buildup phase beginning in September 1977. The program will go into full operation in September 1978. There will be two 60-day intensive observation periods: the first beginning in January 1979 and the second in May 1979. In the observational program, a gap had been identified in the collection of essential wind information in the vertical over the ocean. It has been proposed that 20 ships be equipped with automatic upper air wind sounding equipment. The DOE is helping to partially finance the cost of this addition.

Keywords: AIR POLLUTION; OCEANOGRAPHY; METEOROLOGY; GLOBAL ASPECTS; WIND.

91241 Study of the Abundance of Carbon Dioxide in the Atmosphere and in Exchange with the Oceans. Keeling, C.D. (University of California at San Diego, Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** 7769. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$375,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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 oceans. As a world meteorological organization 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 interpretation of the field data.
Keywords: CARBON DIOXIDE; ECOLOGICAL CONCENTRATION; CARBON CYCLE; ENVIRONMENTAL TRANSPORT; SEAS; BOUNDARY LAYERS; CLIMATES; MATHEMATICAL MODELS; EARTH ATMOSPHERE.

91242 Partial Support of the Newly Formed Climate Research Board. White, R.M. (National Research Council, Climate Research Board, 2101 Constitution Avenue, Washington, DC, 20418). **Project number:** 7799. **Contract:** EE-78-A-28-3265. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$15,000.
R and D categories: Physical and chemical processes and effects.

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.

91243 Models of Carbon Flow in Tropical Ecosystems with Emphasis on Their Role in the Global Carbon Cycle. Lugo, A.E. (University of Florida, Center for Wetlands, Gainesville, FL, 32611). **Project number:** 7981. **Contract:** EV-83-91(OR). **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$177,000.
Related energy source: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

The objectives 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 life zones; (4) to simulate 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. Four documents are expected as a result of these efforts.
Keywords: CARBON CYCLE; GLOBAL ASPECTS; TROPICAL REGIONS; ECOSYSTEMS; MATHEMATICAL MODELS; DATA COMPILATION; ENVIRONMENTAL TRANSPORT; CARBON DIOXIDE; EARTH ATMOSPHERE; CLIMATES.

91244 Workshop to Formulate an Oceanographic Subprogram for DOE Carbon Dioxide Effects Program. Ostlund, H.G. (University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, 4600 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** 7982. **Contract:** EV-78-G-05-6049. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$19,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The purpose of this project is to assemble a workshop and formulate an oceanographic subprogram for the DOE CO2 Effects Program. The focus of the workshop will be to develop a research program for investigating the CO2 source/sink controversy. Topics for the workshop include: (1) laboratory studies of the carbonate system kinetics; (2) coordinated and standardized ship program to study ocean transfer processes; (3) use of manmade tracers to gain insight on CO2 transfer; and (4) air/sea exchanges as a function of 222-Rn deficiency. The workshop will convene a group of ocean scientists and seagoing technical people to outline requirements for the oceanographic subproject. Ship requirements, parameters to be measured, equipment, crew, logistics, organization and data processing will be determined. About 20 to 25 workshop participants will be convened in June. A document will be produced for use by a ship operations group (such as GEOSECS), which, in turn, will judge technical feasibility of the proposed subprogram, incuding costs and capital requirements. The document plus the review by a ship operations group will provide a firm plan for DOE decisions about an oceanographic subprogram.
Keywords: OCEANOGRAPHY; CARBON DIOXIDE; ENVIRONMENTAL EFFECTS; RADON 222; TRANSLOCATION; METEOROLOGY; FEASIBILITY STUDIES; CLIMATES; TRACER TECHNIQUES; REACTION KINETICS; ENVIRONMENTAL TRANSPORT; SEAS.

91245 Research on the Dynamics of Climate. Gates, W.L. (Oregon State University, Climatic Research Institute, Corvallis, OR, 97331). **Project number:** 7987. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$293,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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 models' performance in comparison with observed data, and to the study of selected climatic processes in the ocean-atmosphere system.
Keywords: CLIMATES; EARTH ATMOSPHERE; MATHEMATICAL MODELS; CARBON DIOXIDE; ECOLOGICAL CONCENTRATION; DIFFUSION; EARTH ATMOSPHERE; ENVIRONMENTAL TRANSPORT; DATA ACQUISITION; DATA ANALYSIS.

91246 Dendrochronology of the Bristlecone Pine. Ferguson, C.W. (University of Arizona, Laboratory of Tree Ring Research, Tucson, AZ, 85721). **Project number:** 7989. **Contract:** EE-78-A-28-3274. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$75,000.
R and D categories: Physical and chemical processes and effects.

The objectives are to document bristlecone pine chronology using dated specimens from the White Mountains of Southwestern USA and to use dendrometric data and samples to calibrate isotopic ratio methodology related to biosphere contribution of CO2 to the global atmospheric pool. A master bristlecone pine chronology will be developd 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. Under NSF auspices, a 7104-year chronology has been developed. The chronology is being extended to 10,000 years, and recent chronologies will be refined.
Keywords: PINES; EARTH ATMOSPHERE; CARBON DIOXIDE; ECOLOGICAL CONCENTRATION; CHEMICAL COMPOSITION.

91247 Expansion of Global Atmospheric Monitoring of Carbon Dioxide. Hanson, K.J. (National Oceanic and Atmospheric Administration, Environmental Research Laboratories, Boulder, CO, 80302). **Project number:** 7990. **Supported by:** Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment. **Funding:** DOE-$52,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to expand the existing capability of the Geophysical Monitoring for Climatic Change (GMCC) program network for monitoring atmospheric CO2 concentrations to document fully the future rise in atmospheric CO2. This project will use the existing CO2 flask sampling and analysis capability of GMCC to

initiate flask sampling of CO2 concentration at 14 additional locations around the earth. The purpose is to investigate the suitability of these locations for long-term monitoring of baselne CO2 concentrations.
Keywords: CARBON DIOXIDE; ECOLOGICAL CONCENTRATION; AEROSOL MONITORING; CLIMATES; GLOBAL ASPECTS; ENVIRONMENTAL IMPACTS; EARTH ATMOSPHERE; MATHEMATICAL MODELS.

91248 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

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 the alpha emissions from plutonium, emphasis is being placed on local dose and particle distribution for insoluble particles. The diversity of aerosol forms and correlations of inhalation and the necessity of using laboratory animal experiments to evaluate human health protection problems dictate the use of a factorial experimental approach with particle size, activity and chemical form, exposure level and animal species as parameters. In inhalation studies of 238-PuO2 in Beagle dogs, a large fraction of the plutonium present at two years after exposure is in liver and bone. Studies of the local distribution of plutonium in liver will better define the risk to this organ. Studies of the local distribution of inhaled PuO2 in the lung indicate that the fraction of the lung at risk from alpha irradiation decreases more rapidly than indicated by whole lung clearance parameters because of preferential clearance of some regions in the lung.
Keywords: PLUTONIUM; INHALATION; LUNGS; DOSIMETRY; RADIATION DOSES; RADIONUCLIDE KINETICS.

91249 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Present radiation exposure guidelines for internally-deposited actinide elements such as Am or Cm have been generally extrapolated from the behavior of Pu. This project is being conducted to assess the in vivo solubility and subsequent translocation of Am or Cm following inhalation of these transplutonium elements relative to Pu. Laboratory animals are exposed once by inhalation to a laboratory-produced aerosol and are serially sacrificed at different intervals after exposure to obtain organ distribution data. The initial deposition and subsequent retention of inhaled transplutonium element aerosols are studied using well-characterized aerosols having known size, shape and chemical form. The roles of mechanical clearance and particle solubility on retention and redistribution as influenced by particle size and chemical form are thus assessed. Using serial sacrifice of experimental animals, the time course of radiation dose to specific tissue and organs is determined. Kinetic models based on these data will permit extrapolation to other situations beyond those studied directly. Results to date indicate that the existing Pu data are a poor basis for predicting the dose patterns associated with inhaled Am or Cm. The data being obtained in this project will provide a substantially improved data base.
Keywords: INHALATION; RADIATION DOSES; AMERICIUM; PLUTONIUM; CURIUM; RADIOACTIVE AEROSOLS; RADIONUCLIDE KINETICS; DOSIMETRY; DATA ACQUISITION.

91250 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

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. A broad range of mixtures is being studied on a generic basis to provide data applicable to a number of different situations. Specifically, factors that affect the dissolution and absorption of radionuclides from the lung and their subsequent translocation to other organs are being studied. 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 characterizations such as 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. Data that have been obtained to date have indicated that some differences do occur when radionuclides are inhaled as mixtures. Current studies are directed to determining the relative importance of specific activity, chemical form and aerosol matrix.
Keywords: ACTINIDES; INHALATION; TOXICITY; RADIONUCLIDE KINETICS; METABOLISM; DOSIMETRY; URANIUM.

91251 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Thorium fuel will likely be developed for long-term production of electric power, especially in the United States and Canada. A unique component of recycled uranium produced from irradiated thorium fuel will be 232-U. Uranium-232 decays in a series of short-lived daughter products which emit alpha and beta radiations and end ultimately in stable 208-Pb. Radioactive daughter products in this decay chain may emanate from particles of fuel material deposited in the lung and translocate throughout the body. This emanation results from recoil of daughter product atoms and from diffusion of ions, especially thoron, 220-Rn. The emanation of daughter products from particles in the lung will vary with particle size, particle shape, particle composition and temperature treatment history. Physical, chemical and biological studies of factors influencing the emanation of daughter products are being conducted to construct predictive models applicable to different thorium fuel cycles. This model will be developed primarily for insoluble uranium and thorium oxide particles containing 232-U. Procedures and equipment for the production of needed aerosols are now being developed and refined to conduct the needed studies.
Keywords: THORIUM; URANIUM 232; INHALATION; LEAD 208; RADON 220; RADIONUCLIDE KINETICS; RADIOACTIVE AEROSOLS; TOXICITY.

91252 Inhaled Ruthenium: Radiation Dose Patterns. Snipes, M.B. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 002664. **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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Ruthenium radionuclides (103-Ru and 106-Ru) are present in nuclear fuels in large quantities after a period of sustained operation of a power reactor and represent potential inhalation hazards for man in the event of an accidental release. Since the chemical form of radioruthenium influences its biological consequences, it is important to study forms which man would encounter in an accident or incident situation. Previous studies with 106Ru-Rh dioxide in dogs and Syrian hamsters have suggested lung, kidney and bone as critical organs. Laboratory animals are being exposed by inhalation to Ru to determine the resultant dose patterns. Current studies with dogs and rats exposed to 106Ru-RhO4 suggest nasal turbinates may be a critical organ for this vapor form of 106Ru-Rh. The 106Ru-RhO4 deposited in this way appears to be relatively soluble. Translocation of the absorbed 106Ru-Rh appears similar to that for 106Ru-Rh solubilized and absorbed from particles of 106Ru-RhO2 deposited in lung. Results from these studies are improving our understanding of the deposition, retention, metabolic and dose patterns associated with the forms of radioruthenium that may be encountered by people working in the nuclear industry.
Keywords: RUTHENIUM 103; RADIATION DOSES; INHALATION; RUTHENIUM 106; RADIONUCLIDE KINETICS; LUNGS; TOXICITY.

91253 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

The objective of this study is to use laboratory animals to obtain a better understanding between absorbed dose (local or average) and the possible long-term biological consequences in man of inhaling plutonium radionuclides released from different segments of nuclear fuel cycles. Studies are being conducted in Beagle dogs and rodents to define the 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 different sized aerosols of either 239-PuO2 or 238-PuO2 to achieve graded initial lung burdens. For a given initial lung burden, average radiation dose to the lung was constant but local dose rate around inhaled particles differed for different combinations of radionuclide and particle size. 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 238-PuO2. Rodents are being utilized to supplement studies in dogs. Hamsters were exposed to polydisperse aerosols of 239-PuO2, 239-Pu(NO3)4, and 238-PuO2. Pulmonary neoplasia was not observed in these animals. Additional studies are now in progress using Fischer-344 rats.
Keywords: PLUTONIUM 239; DOSE-RESPONSE RELATIONSHIPS; RADIONUCLIDE KINETICS; BEAGLES; RODENTS; RADIATION DOSES; INHALATION; HAMSTERS; RATS; PLUTONIUM 238; LUNGS; PARTICLE SIZE.

91254 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

This project is investigating the toxicity of alpha-emiting radionuclides other than plutonium that are produced in several nuclear fuel cycles. The studies are being performed using well-characterized aerosols, relying on Fischer-344 rats as the principal laboratory animal. Emphasis is being placed on determining the effect certain characteristics such as particle size, chemical form, elemental characteristics, and specific activity of particles on the dose-response relationships. In addition, the characteristics of the host will also be evaluated by using different ages at exposure and exposing animals with pre-existing pulmonary disease to alpha irradiation. Syrian hamsters exposed to aerosols of 241-AmO2 died with radiation pneumonitis at high alpha radiation dose levels. At lower levels, animals died of non-pulmonary diseases apparently not related to radiation and neoplasia was not observed. In view of these results, studies now being initiated are being done in Institute-raised, Fischer-344 rats. Because of anticipated high solubility of some alpha-emitting radionuclides such as curium, even as the oxide, non-pulmonary radiation-induced disease is expected as a high proportion of the experimental animals.
Keywords: ACTINIDES; DOSE-RESPONSE RELATIONSHIPS; TOXICITY; RATS; HAMSTERS; AMERICIUM 241; CURIUM; RADIONUCLIDE KINETICS.

91255 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Chromosome aberrations are some of the most sensitive indicators of interaction of radiation with cells. The rate of chromosome aberration production and elimination as a function of radiation dose rate, quality and distribution provides valuable information on the effects of internally-deposited radionuclides. Recognizing the potential for man's inhaling accidentally released radionuclides, assays are being developed to evaluate chromosome damage in lung cells after inhalation of insoluble radioactive particulates. Because the rate of cell division in a normal lung is low, the use of these cells in cytogenetic assays is difficult. To overcome this problem, exposure to NO2 is being used to stimulate lung cell division. Cells from minced lung tissue and alveolar macrophages are used as sources of dividing cells. Lifespan studies will be initiated in which animals are exposed to insoluble radioactive particulates by inhalation and chromosome damage in lung cells will be determined at various intervals after exposure using NO2 inhalation to stimulate cell division. Since the lung-associated lymph nodes tend to accumulate inhaled particulates, lymphocytes from these tissues will also be evaluated for chromosome aberrations. Subsequent studies using cytokinetic techniques will be designed to determine lung cell damage around insoluble particles.
Keywords: CHROMOSOMAL ABERRATIONS; BIOLOGICAL INDICATORS; BIOLOGICAL RADIATION EFFECTS; RADIATION DOSES; PLUTONIUM; NITROGEN DIOXIDE; RADIONUCLIDE KINETICS; TOXICITY; BIOASSAY.

91256 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:** Health effects.

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.

91257 Low Btu Gasifier: Early Damage Indicators. 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.

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.

91258 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:** Health effects.

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.

91259 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 fuels(general)(50); nuclear fission(50). **R and D categories:** Health effects.

Insoluble radioactive particulates, which could be inhaled after accidental releases in the use of nuclear energy, tend to accumulate in lung-associated lymphoid tissues of experimental animals. These lymphoid tissues are the first site at which immune responses would be produced against antigens released from primary lung tumors. A loss of their function could allow tumor growth in the lung without recognition by immunosurveillance mechanisms. To determine if an accumulation of inhaled radioactive particles in these tissues disrupts immunologic function, the lungs of animals exposed by inhalation of 239-PuO2 and control animals are immunized to particulate antigens and immunologic responses evaluated. Results from control animals indicate that this method of immunization produces a response only in lung-associated lymphoid tissue. This allows the direct determination of the effects of inhaled radioactive particulates on regional immunity. A model to quantitate antibody-forming cells in individual airways of the dog lung after immunization has been developed. It will be used to evaluate the effects of instilled insoluble 239-PuO2 on the production of antibody-forming cells in exposed and control airways in individual dogs. These data will help determine effects of inhaled radioactive particulates on local and regional lung immunity.
Keywords: IMMUNOLOGY; INHALATION; RADIONUCLIDE KINETICS; PLUTONIUM 239.

91260 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:** Health effects.

Energy conservation is an important part of our national energy policy. Implementing this policy will require increased use of insulating materials. Current knowledge of the fibrogenic and carcinogenic properties of these materials when inhaled is inadequate considering their increasingly widespread utilization. Phenolformaldehyde resin binder, urea formaldehyde binder, and glass fibers are being evaluated with in vitro cytotoxicity tests. Intratracheal instillation studies of milled commercial insulation fibers (resin coated), nominally sized bare glass fiber and Chrysotile asbestos are being conducted to assess relative toxicity and to aid in choosing fibers suitable for long-term inhalation studies. Changes in connective tissue metabolism and morphologic changes will be used to assess relative toxicity. Inhalation studies with coated and bare glass fibers in varying aerodynamic diameters and asbestos fibers will be conducted in rats. These will be used to establish deposition and retention patterns and relative fibrogenic and/or carcinogenic potential of these materials. The results will be used to define the potential health risks that might result from expanded use of insulation materials.
Keywords: BUILDINGS; THERMAL INSULATION; ENERGY CONSERVATION; TOXICITY; BIOLOGICAL EFFECTS; TOXIC MATERIALS; ASBESTOS; FIBERGLASS; FORMALDEHYDE; HEALTH HAZARDS; INHALATION; CARCINOGENS.

91261 Assessments of Developments and Issues in EPA Regulation of Energy Related Discharges of Toxic Water Pollutants. Wright, S. (Fred C. Hart Assoc., 527 Madison Avenue, New York, NY, 10022). **Project number:** 007524. **Contract:** EP-78-C-02-4747. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Policy Analysis. **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The purpose of this contract is to supply analytical and auxiliarry support to Division of Policy Analysis/Office of Environment for the assessment of developments and issues in the regulation of energy-related discharges of water pollutants. Assessment focuses on evaluating consequent issues which are pertinent to energy use and development in order to assist in policy formulation in this area.
Keywords: ENERGY FACILITIES; CHEMICAL EFFLUENTS; WATER POLLUTION; POLLUTION REGULATIONS; US EPA; TOXIC MATERIALS; US DOE; ENVIRONMENTAL POLICY.

91262 Examination of Toxic Substances Control Act Data System Requirements and Its Impact upon DOE. Seidel, L. (American Management Systems, 1501 Wilson Blvd., Arlington, VA, 22209). **Project number:** 007739. **Contract:** EV-78-X-01-3563. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Policy Analysis. **Funding:** DOE-$10,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

Provisions of the Toxic Substances Control Act (TSCA) require the development of test data to demonstrate that the manu facture, processing, distribution, use, and disposal of chemical substances and mixtures do not present an unreasonable risk to health or the environment. Chemical substances and mixtures are used extensively in the production of energy and the development of new energy and conservation technologies. If DOE and the energy industry do not respond adequately to this new requirement, the production of some conventional energy sources may be restricted and the commercialization of new energy and conservation technologies may be delayed. It is necessary for DOE to anticipate the requirements imposed by TSCA, identify activities which respond to those requirements, and implement those activities in the context of a comprehensive DOE strategy for toxic substances.
Keywords: TOXIC MATERIALS; LEGISLATION; US DOE; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL POLICY.

91263 Analysis of Developing Trends in the Siting of Conventional Coal-Fired Power Plants (Legal Component). Schroeder, C.H. (Armour, Schroeder, St. John and Wilcox, 440 Pacific Avenue, San Francisco, CA, 94133). **Project number:** 7788. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Policy Analysis. **Funding:** DOE-$74,000.
Related energy source: coal(100). **R and D categories:** Integrated 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.

91265 Policy Implications for DOE of OSHA and Mining Safety and Health Act (MSHA) Regulations. Strayhorn, L.L. (ABT Associates, Inc., 55 Wheeler Street, Cambridge, MA, 02138). **Project number:** 007995. **Contract:** EP-78-X-01-5386. **Supported by:** Department of Energy, Washington, DC (USA). Office of Technology Impacts. **Funding:** DOE-$10,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The impacts of OSHA and MSHA on DOE programs, facilities, and policies are analyzed. Contacts with Department of Labor (DOL) and study of DOL documents, as well as the fundamental legislation, will provide the basis for the work and for the report, due on or about October 15, 1978.
Keywords: US DOE; US OSHA; MINING; SAFETY STANDARDS; LEGISLATION; GOVERNMENT POLICIES.

91266 Inducible Error-Prone Repair in B. subtilis. Yasbin, R.E. (Pennsylvania State University, S231 Frear, University Park, PA, 16802). **Project number:** 007972. **Contract:** EP-78-S-02-4964. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$46,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Health effects; Ecological/biological processes and effects.

The objectives are to study the mechanism of activation and the mode of action of inducible error-prone repair and other SOS functions in B. subtilis, and to correlate activation of SOS functions in bacteria with the action of carcinogens. The isolation of mutants in B. subtilis deficient in various aspects of the SOS system as well as the characterization of bacterial mutants lacking proper control over SOS activation are the approaches to be taken. Enzymes involved in error-prone repair mechanisms will be determined. The relationship between the development of competence in B. subtilis and the activation of SOS functions will be determined.
Keywords: BACILLUS SUBTILIS; BIOLOGICAL REPAIR; ERRORS; INDUCTION; GENETICS.

91267 Biochemical Genetics of Yeast. Sherman, F. (University of Rochester, School of Medicine and Dentistry, Department of

Radiation Biology and Biophysics, 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-$111,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Health effects.

The objectives are to: (1) isolate and characterize of structural and regulatory mutants for ISO-1 and ISO-2-cytochrome c; (2) identify amino acids inserted by various nonense 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: YEASTS; GENETICS; MUTANTS; AMINO ACIDS; BIOCHEMISTRY; MUTAGENESIS; BIOLOGICAL MODELS; ENZYMES.

91268 Coal Liquids Carcinogenicity Screening Test. Calkins, W.H. (E.I. du Pont de Nemours, Inc., Central Research Department, Wilmington, DE, 19898). **Project number:** 7582. **Contract:** EP-78-C-02-4758.A000. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$207,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective of this project is to define in a preliminary fashion the carcinogenicity problem to be expected in the production, handling and utilization of synthetic crude oils. The study involves conducting a rapid screening series of mutagenicity and tumor initiation promotion tests on common distillation fractions of a crude petroleum control and seven synthetic crude oils derived from coal and oil shale by several processes under development. Selected analytical tests will be run on the fractions to provide some identification of the nature of the samples. The biological tests involved are still developmental in nature, but are well documented and designed to provide on a short term basis an indication of which materials are potentially hazardous and should be investigated more thoroughly by longer term testing procedures.
Keywords: COAL LIQUIDS; CARCINOGENESIS; SCREENING; COAL LIQUEFACTION; MUTAGENESIS; CHEMICAL EFFLUENTS.

91269 *Microirradiation and Renucleation of Mouse Eggs.* Lin, T.P. (Univ. of California at San Francisco, Department of Anatomy, San Francisco, CA, 94143). **Project number:** 007973. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$37,000.
R and D categories: Health effects.

The project will be started September 1, 1978.
Keywords: MICE; MUTAGENESIS; TERATOGENESIS; BIOLOGICAL RADIATION EFFECTS; OVA; BIOLOGICAL MODELS.

91270 Transport of Toxic Solar Energy Working Fluids Released to the Atmosphere: Information Requirements. Barr, S. (Los Alamos Scientific Laboratory, MS 588, Los Alamos, NM, 87545). **Project number:** 002683. **Contract:** GK-01-02-03-1. **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:** Physical and chemical processes and effects; Integrated assessment.

The purpose of this study is to determine the magnitude and nature of hazards resulting from the accidental release of solar heating and cooling working fluids. A review of installations, materials, properties and toxicities, and possible release events will be conducted.
Keywords: HEAT TRANSFER FLUIDS; TOXICITY; TOXIC MATERIALS; HEALTH HAZARDS; SOLAR HEATING SYSTEMS; SOLAR COOLING SYSTEMS; ENVIRONMENTAL TRANSPORT; EARTH ATMOSPHERE.

91271 *Genetics and Biochemistry of DNA Repair in Eukaryotes.* Mishra, N.C. (University of South Carolina, Department of Biology, Columbia, SC, 29208). **Project number:** 007967. **Contract:** EP-78-S-09-1071. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$42,000.
R and D categories: Health effects; Ecological/biological processes and effects.

Most organisms possess enzymes that can repair DNA damaged by various radiation and radiometric chemicals. There are at least three key enzymes involved in this process. These are DNA polymerase, deoxyribonuclease, and ligase. The specific role of these key enzymes in DNA repair in eukaryotes has not yet been elucidated due to the lack of a biochemical genetic approach. The aim of the present study is to characterize and compare DNA polymerases and deoxyribonucleases from the wild type and mutant strains of eukaryotic organisms such as Neurospora crassa. Mutants of Neurospora (as well as that of Chinese hamster ovary (CHO) cell line), presumably defective for deoxyribonuclease and DNA polymerase, have been recently isolated in the laboratory. These mutants will be biochemically characterized and compared with the wild type enzyme to establish which enzymes control a particular function in DNA repair and other aspects of DNA biosynthesis. After biochemical characterization, these mutants will also be examined for their ability to repair damage caused by exposure to radiation, radiomimetic drugs, and carcinogens. Also, a number of Neurospora mutants which are known to be sensitive to uv radiation or defective in recombination will be characterized for DNA polymerases and nucleases to elucidate the biochemical basis of these defects. These studies will provide a detailed knowledge of the different aspects of DNA repair and the role of the key enzymes there in. The results of present studies involving lower and higher eukaryotes can be meaningfully generalized for similar studies in humans. Efficient DNA repair in man is necessary for the maintenance of normal growth and for exposure to the sunlight and to various radiometric chemicals present in our environment. Due to the introduction of various chemicals in our environment, there is increased risk of damage to our own genetic material (including that of our crops and cattle) and the outcome of the proposed study may provide a meaningful insight into these problems.
Keywords: IONIZING RADIATIONS; ULTRAVIOLET RADIATION; IRRADIATION; NEUROSPORA; MUTANTS; BIOLOGICAL RADIATION EFFECTS; DNA; BIOLOGICAL REPAIR; DNA-ASE; POLYMERASES; LIGASES; ENZYME ACTIVITY; RADIOMIMETIC DRUGS; CARCINOGENS; BIOCHEMISTRY; GENETICS; BIOLOGICAL EFFECTS; DNA REPLICATION; GENE RECOMBINATION.

91272 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: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Health effects.

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.

91273 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.
R and D categories: Health effects; Ecological/biological processes and effects.

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: CARCINOGENESIS; MUTAGENESIS; BACTERIA; BACTERIOPHAGES; BIOCHEMICAL REACTION KINETICS.

91274 Biochemical Genetics of Aromatic Metabolism in Cultured Somatic Cells of Nicotiana sylvestris. 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 Health and Environmental Research. **Funding:** DOE-$71,000.
R and D categories: Health effects; Ecological/biological processes and effects.

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.

91275 Development of New Fluorescent Markers for Chromosome Study. Tsou, K.C. (Univ. of Pennsylvania Hospital, 1515 Ravdin Inst., 3400 Spruce St., 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.
R and D categories: Health effects.

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; GENETIC EFFECTS; GENES; MUTAGENESIS; BIOASSAY; DYES; ACRIDINES; OPTICAL PROPERTIES.

91276 Impact of Energy-Related Pollutants on Chromatin 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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

Th 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.

91277 Effects of Mutagenic Agents on the Initiation of DNA Replication in Mammalian Cells. Taylor, J.H. (Florida State University, Institute of Molecular Biophysics, 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-$39,000.
Related energy source: all(100). **R and D categories:** Health effects.

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 xrays (250 Kvp) were all shown to inhibit initiation under prescribed conditions.
Keywords: X RADIATION; ULTRAVIOLET RADIATION; IRRADIATION; SYNCHRONOUS CULTURES; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; DNA REPLICATION; INHIBITION; ALKYLATING AGENTS; MUTAGENS; ACTINOMYCIN; BUDR; BIOLOGICAL EFFECTS.

91278 H-Test for Mutations. 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: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objective is to assay germ-line mutagenicity of effluents and emissions in energy production, e.g., as in coal combustion. The H-test which screens more than 30 histocompatibility loci in mouse spermatogonia (sperm, oocytes) is employed. First, the test system with TEM (triethylenemelamine) will be calibrated to normalize eventual comparisons among different energy effluents and with other test systems. The second step will be to test effluents and their derivatives, suggested by lower tier tests. The contract was initiated two weeks ago. Past work (supported by NIH) demonstrated that the test does detect mutations, and that with x-rays its results differ significantly from those of the 7-locus test owing to differences in selection and repair. Applied to the energy problem, it will increase the range of perspective in judging mutagenicity, an essential factor in comparisons for policy decisions.
Keywords: MUTAGENESIS; BIOLOGICAL MODELS; CHEMICAL EFFLUENTS; MICE; SPERMATOZOA; MUTAGEN SCREENING; COMBUSTION PRODUCTS.

91279 Neutron Interactions with Biological Tissue. Caswell, R.S. (National Bureau of Standards, Department of Commerce, Washington, DC, 20234). **Project number:** 006770. **Contract:** 5321470. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$67,000.
Related energy source: nuclear fuels(general)(20); nuclear fission(50); nuclear fusion(30). **R and D categories:** Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The objective is to obtain information about neutron interactions with tissue through secondary charged particles using theoretical calculations whose input includes neutron cross section data, range, stopping power, straggling information, and geometrical properties. This information is basic to radiological physics, radiation biology, neutron radiation protection, neutron therapy, and neutron dosimetry standards. This program is aimed at understanding the basic picture of the physical stage in the interaction of neutrons with tissue and biological materials. Quantitative description of the processes and spectra involved in the transfer of energy from neutron radiation to the biological material provides a useful input to the attempt to understand biological effects of neutron radiation. This is carried out through use of a number of computer calculations using nuclear data and stopping power data as input.
Keywords: NEUTRON BEAMS; TISSUES; NEUTRON DOSIMETRY; BIOLOGICAL EFFECTS.

91280 Surface Analyses and Reactions of Particulate Pollutants. Powell, C.J. (National Bureau of Standards, Chem. B-248, Washington, DC, 20234). **Project number:** 007108. **Contract:** EA-77-A-01-6010. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$99,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this project is to apply modern electron-spectroscopic methods of surface analysis to determine the surface composition of particulate pollutants in the atmosphere and to determine the nature and rate of pollutant reactions and transformations that occur on particle surfaces. We use either a scanning Auger-electron system to determine the elements present on the surfaces of selected, individual particles or an x-ray photoelectron spectrometer to determine the elements and possible compounds present on the surfaces of groups of particles. A gas analyzer will enable us to identify gaseous reaction products when gases interact with the particles. We expect (1) to determine the elements present on particle surfaces and to correlate with particle size; (2) to determine relative concentrations of elements as a function of depth from the surface; and (3) to determine the solid or gaseous reaction on transformation products when pollutant gases interact with environmental and artificial particle surfaces.
Keywords: AUGER ELECTRON SPECTROSCOPY; PARTICLES; AIR POLLUTION; PARTICLE SIZE; GASES; SURFACES; CHEMICAL COMPOSITION; CHEMICAL REACTIONS; AEROSOLS.

91281 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: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

91282 Enzymatic Studies of Radiation Damage. Laskowski, M. (Roswell Park Memorial Institute, Laboratory of Enzymology, 666 Elm Street, Buffalo, NY, 14263). **Contract:** EY-76-S-02-3225. **Supported by:** New York State Dept. of Health, Albany (USA). **Funding:** NYDH-$69,000.
R and D categories: Health effects; Ecological/biological processes and effects.

The discovery that venom phosphodiesterase 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 on 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; DNA; BIOLOGICAL REPAIR; RADIATION INJURIES; VENOMS; BIOCHEMICAL REACTION KINETICS; ENZYMES.

91283 Effect of SO2 on Light Modulation of Plant Metabolism. Anderson, L.E. (University of Illinois at Chicago Circle, Biology Department, Box 4348, Chicago, IL, 60680). **Project number:** 007970. **Contract:** EP-78-S-02-4961. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$52,000.
Related energy source: fossil fuels(100). **R and D categories:** Ecological/biological processes and effects.

Sulfur dioxide is a noxious industrial, and occasionally natural, pollutant. Recent experiments indicate that SO2 inactivates the system for light modulation of enzyme activity in the chloroplast, thereby potentially causing metabolic chaos and even the death of the plant. The planned experiments are outlined: to examine a wide number of plants with respect to the effect of sulfur dioxide on the light modulation system, with particular emphasis being placed on economically important species; to identify the component of the light modulation system which is affected by sulfur dioxde; to demonstrate that this component is irreversibly denatured by sulfur dioxide; and to determine whether the light modulation system is involved in stomatal opening. If light modulation of photosynthetic carbon metabolism is the biochemical process affected by SO2 in green plants, then once light modulation and the basis for sulfur dioxide sensitivity is understood it should be possible to determine tolerable levels of SO2 for economically important species and to establish scientifically based guidelines for controlling emission of SO2. The results of the experiments outlined will be of importance, then, to operations producing SO2, and to foresters, farmers, urban planners, and others concerned with the effects of SO2 on the environment.
Keywords: SULFUR DIOXIDE; BIOLOGICAL EFFECTS; PLANTS; BIOLOGICAL STRESS; ENZYMES; CATALYSIS; METABOLISM; CHLOROPLASTS; PHOTOSYNTHESIS; ENVIRONMENTAL EFFECTS; AGRICULTURE; BIOCHEMISTRY.

91289 Femopotetic 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:** Health effects.

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 function 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.

91304 Toxicological Coal Assessment. Wallace. (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:** Health effects.

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 carcino-

genesis 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.

91321 Potential Effects of Solar Systems Working Fluids as Ecosystem Contaminants. Wilson, D. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** 002684. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: solar(100). **R and D categories:** Ecological/biological processes and effects.

Solar heating and cooling of homes and commercial buildings is expected to be a rapidly growing energy industry which utilizes a wide range of chemical materials as working fluids for heat transfer and storage. This project in experimentation and evaluation addresses the understanding of the implications of accidental releases and disposal patterns which place these materials in the ecosystem. An emphasis is placed upon screening for those substances which may damage vegetation, disturb soil microflora, and affect plant litter reduction or release toxic substances to ground water. Experimental work involves development and application of test systems using hydrophonic and soil plant growth and reproduction tests, soil microflora respiration, and microcosms and field plots for evaluating effects of working fluids on the chemical composition of ground water. The application of these results will be made in developing guidelines for handling and disposal of environmentally acceptable solar system working fluids, including a capability to assess any significant pathways for toxic substances to man.
Keywords: WORKING FLUIDS; TOXICITY; SOLAR HEATING SYSTEMS; SOLAR COOLING SYSTEMS; HEAT STORAGE; HEAT TRANSFER FLUIDS; EVALUATION; ECOSYSTEMS; GROUND WATER; CHEMICAL COMPOSITION; ENVIRONMENTAL IMPACTS.

91323 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:** Characterization, measurement, and monitoring.

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.

91332 Support of NEPA Coordination Activities. Gustafson. (Argonne National Lab., Argonne, IL). **Project number:** 002756. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

Assistance will be provided to DOE/ASEV Office of NEPA Coordination for the preparation of environmental assessments, preparation of guidelines and other documentation related to DOE environmental impact statement activities, review of preliminary draft environmental statements, and other assistance as required by the Office of NEPA Coordination.
Keywords: ENVIRONMENTAL IMPACT STATEMENTS; INFORMATION NEEDS; RECOMMENDATIONS; GOVERNMENT POLICIES; ENVIRONMENTAL POLICY; BASELINE ECOLOGY; TERRESTRIAL ECOSYSTEMS; ENVIRONMENT; POLLUTION ABATEMENT.

91333 Cellular Fine Structure as a Sensitive Indicator of Altered Cell Function in Chronic Toxicity Studies. Seed, T.M. (Argonne National Lab., Argonne, IL). **Project number:** 002759. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$114,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective of these studies is to develop sensitive, ultrastructural indicators of early pathologic processes in the beagle dog subjected to low doses of ionizing radiation or other selected nonnuclear toxicant. The change in structure and function of hematopoietic and reproductive stem cells resulting from irradiation of adult and fetal dogs and their relationship(s) to late pathology form the basis of these investigations. It is prticularly important to look at the interactions of the cells and their respective stimulatory factors. The area of investigation is the cell surface where the primary relationship is established through cell surface receptor interactions. It is our intent to define standard macromolecular patterns of cellular differentiation in control animals and to relate any deviations from the ogan pathology. Minimal toxic effects should be more apparent, and detected at earlier times when analyzed in terms of subcellular disturbances. Our specific aims include: (1) establishing minimal toxic dose rates in terms of derangement of macromolecular pattern of cell differentiation within these sensitive organ systems; and (2) to establish interrelationship between such subcellular deviations and ensuing disease.
Keywords: BEAGLES; GAMMA RADIATION; BIOLOGICAL RADIATION EFFECTS; LOW DOSE IRRADIATION; ULTRASTRUCTURAL CHANGES; STEM CELLS; BLOOD FORMATION; CELL DIFFERENTIATION; DOSE RATES; ANIMAL CELLS; TOXIC MATERIALS; BIOLOGICAL EFFECTS.

91334 Instrumentation Technology--Radiation Detector Systems for Trace Plutonium Measurements. Stkaus, M.G. (Argonne National Lab., Argonne, IL). **Project number:** 002772. **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:** Characterization, measurement, and monitoring.

A joint ANL-LBL program to improve instrumentation and techniques for measuring traces of plutonium in the environment and in vivo by x- and gamma-ray detection is outlined. Large-area silicon and germanium detector systems will be developed for elemental and isotopic analyses. Crystals with thin windows on both surfaces will be edge mounted to provide large detection areas and in turn high sensitivity. Initially, a 3 x 3 Si detector array will be constructed having a detection area of 50 to 100 cm2 and an energy resolution of 300 to 400 eV at 17 keV. Measurement sensitivity of 1 PCI of Pu in 1 g of soil in 100 min is predicted. This minimum detectable level is determined by direct interference from the natural activity in soil. By virtue of the high resolution, this Si detector system is expected to be 10 to 100 times more sensitive than a NaI detector system.
Keywords: SI SEMICONDUCTOR DETECTORS; GE SEMICONDUCTOR DETECTORS; PERFORMANCE; SPECIFICATIONS; SENSITIVITY; ENVIRONMENT; PLUTONIUM; RADIATION MONITORING.

91336 Coke Oven Toxicity. 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(100). **R and D categories:** Health effects.

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.
Keywords: COKE OVENS; CHEMICAL EFFLUENTS; TOXICITY; LUNGS; POLYCYCLIC AROMATIC HYDROCARBONS; AEROSOLS; PARTICLE SIZE; CARCINOGENS; CHEMICAL COMPOSITION; PHYSICAL PROPERTIES; BIOLOGICAL EFFECTS; INHALATION; INGESTION; SKIN ABSORPTION; SYNERGISM; RODENTS.

91337 Beta Dose Measurement for Fuel Reprocessing, Fission and Activation Product. Jones, D.E. (Idaho National Engineering Lab., Idaho Falls, ID). **Project number:** 002811. **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:** Characterization, measurement, and monitoring.

The Idaho Chemical Processing Plant (ICPP), which has done pioneering work in fuels reprocessing, has perhaps the most severe requirements for good beta dosimetry of any nuclear facility. The recent reduction of standard limits for beta (nonpenetrating) dose has resulted in such exposures often being work limiting in this facility. In most other facilities and previously at ICPP the beta exposures were well below guideline limits so conservative estimates that were often high were of little concern. Thus, personnel dosi-

meter devices and procedures were never designed to optimize beta response as well as the photon response. The primary emphasis of this research proposal will be to improve and optimize the personnel beta dose measurement capability. An additional goal is to work with equipment suppliers to complete prototype development of an instrument based upon the DOE-HASL design to allow proper measurement of both beta and gamma components of mixed radiation fields. Both the personnel monitor and instrument will be designed for response to match recently revised standards for penetrating-nonpenetrating dose measurements.
Keywords: IDAHO CHEMICAL PROCESSING PLANT; BETA DOSIMETRY; PERSONNEL; RADIATION HAZARDS.

91338 Physics and Chemistry of Pollutant Interactions in the Environment. Sele, B.E. (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:** Characterization, measurement, and monitoring.

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.

91339 Radiation Protection Studies. McLaug, J.E. (DOE 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:** Characterization, measurement, and monitoring.

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.

91340 Environmental Evaluation Methods. McLaug, J.E. (DOE 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:** Characterization, measurement, and monitoring.

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.

91341 Behavioral Effects of Electric Fields. Laties. (University of Rochester, Rochester, NY). **Project number:** 002858. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$145,000.
Related energy source: conservation(100). **R and D categories:** Health effects.

Our aim is to generate reliable dose-effect functions using behavioral baselines. A variety of behavioral baselines are being used with species ranging from rodents to birds to primates. Specific projects involve: (1) tests of vision; (2) tests to discriminate between different amounts of vibration impressed upon a finger; (3) studies of counting ability; and (4) studies of schedule-controlled behavior.
Keywords: ELECTRIC FIELDS; BIOLOGICAL EFFECTS; CHRONIC EXPOSURE; DOSE-RESPONSE RELATIONSHIPS; RODENTS; BIRDS; PRIMATES; BEHAVIOR; PATHOLOGICAL CHANGES.

91342 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(100). **R and D categories:** Health effects.

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.

91365 Radiation Biochemistry. Altman. (University of Rochester, Rochester, NY). **Project number:** 002897. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$44,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

It is well known that a variety of environmental conditions such as external or internal radiations can lead to pathologic changes in the connective tissue of many organs within the mammalian body. Paramount among these pathologic changes is the laying down in connective tissue space of collagen fibrils leading to fibrosis which, in turn, can bring about pathologic changes in organ function. Impaired organ function may have more far-reaching consequences which could extend functional impairment to organ systems not themselves exhibiting fibrotic changes. In the latter instance, one should mention pathologic changes in the histohematic barrier a result of which may be changes in the transport of nutrients across the histohematic barrier in the capillaries. The excessive deposition of collagenuous fibrils in connective tissue space, a process which involves primarily the protein collagen uniquely localized in connective tissue, is accompanied, as has been shown in this laboratory, by changes in the chemical composition of the ground substance in connective tissue. The chemical components in question here are the group of polymeric carbohydrates, the glycosaminoglycans (GAG) which represent an important nonprotein entity in connective tissue.
Keywords: RADIOCHEMISTRY; RADIOBIOLOGY; PATHOLOGICAL CHANGES; CONNECTIVE TISSUE; RADIOSENSITIVITY; BIOLOGICAL EFFECTS.

91366 Aquatic Ecology. Berg. (University of Rochester, Rochester, NY). **Project number:** 002898. **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:** Health effects.

This is a continuing study of the mechanism of environmental toxicity of two heavy metals, ruthenium and mercury, which are released in significant amounts with the waste products of power production. Radioactive ruthenium (106-Ru) is released into the environment during reprocessing of spent nuclear fuels. Mercury, released during combustion of coal and oil, contributes up to 30% of the industrial discharges of mercury to the environment. After release, each element enters into a variety of compounds, some of which are ecologically inert while others are rapidly absorbed and accumulated by living organisms and are a toxic hazard to biotic communities and to people. A precise assessment of such hazards is especially useful where choices are to be made between technological options for the future.
Keywords: RUTHENIUM 106; MERCURY; TOXICITY; POWER GENERATION; WASTES; NUCLEAR FUELS; REPROCESSING; COAL; PETROLEUM; COMBUSTION; INDUSTRIAL WASTES; BIOLOGICAL ACCUMULATION; HEALTH HAZARDS; WATER POLLUTION.

91367 Delayed Effects of Radiation. Casarett. (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:** Health effects.

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; MAMMALS; RADIATION INJURIES; ANIMAL CELLS; TISSUES; ORGANS; PATHOGENESIS; NEOPLASMS; DISEASES; RADIOINDUCTION; LIFE SPAN; DOSE-RESPONSE RELATIONSHIPS.

91368 Lung Deposition and Transport Modelling. Ferin. (University of Rochester, Rochester, NY). **Project number:** 002901. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$92,000.
Related energy source: coal(100). **R and D categories:** Health effects.

The increased prevalence of chronic, nonspecific pulmonary disease has expanded interest regarding pathogenic mechanisms and biologic characteristics of the lung. Realizing the vast number of potentially-damaging agents, researchers have begun to focus attention on the defense mechanisms of the respiratory tract. The organism's defense against environmental factors involves efficient pulmonary clearance mechanisms whereby the deep parts of the lungs are kept clear and sterile. Since the cells are the alveolar membrane and the internal environment of the alveolar are directly exposed to the external environment by inhalation, the protection of these structures and the maintenance of alveolar integrity are of great concern. Different lung pathologies, including lung cancer, have been related, mostly in a hypothetical way, to inefficient clearance function.
Keywords: RESPIRATORY SYSTEM DISEASES; LUNGS; PATHOLOGICAL CHANGES; LUNG CLEARANCE; IMMUNE REACTIONS; NEOPLASMS; EFFICIENCY; POLLUTION; BIOLOGICAL EFFECTS.

91370 Radiation Damage of DNA. Lange. (University of Rochester, Rochester, NY). **Project number:** 002903. **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:** Health effects.

The radiation lethality of an organism can now be understood in terms of the dose-survival response of the animal's vital tissue precursor (stem) cells. The aim of this project is to explain the mechanism(s) of: (1) organismal recovery from radiation injury in terms of stem cell repopulation and differentiation, which can be studied in the animal; (2) cellular recovery and repair of sublethal damage, which are best studied in culture; and (3) at the molecular level, the packaging of mammalian DNA in the chromosome and of the cell's ability to repair damaged DNA.
Keywords: DNA; RADIATION INJURIES; LETHAL RADIATION DOSE; DOSE-RESPONSE RELATIONSHIPS; SURVIVAL TIME; STEM CELLS; CHROMOSOMES; BIOLOGICAL REPAIR.

91371 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:** Health effects.

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. This is true whether consideration is given to exposed humans or to animals irradiated under experimental conditions. 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: RADIOISOTOPES; DOSIMETRY; PHANTOMS; RADIOTHERAPY; LYMPHOCYTES; CELL CULTURES; MAN; ANIMALS; BIOLOGICAL RADIATION EFFECTS.

91372 Baseline Studies to Support Metabolism (EPA-174). Mercer. (University of Rochester, Rochester, NY). **Project number:** 002906. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$169,000.
Related energy source: all(100). **R and D categories:** Health effects.

The ultimate goal of this program is to explain quantitatively the part played by the physical and chemical properties of airborne particles in the chain of events between exposure to a toxic aerosol and the production of biological damage. Its scope includes: (1) routine measurement of particulate properties for all aerosols needed for animal exposures; (2) development of methods for generating aerosols designed to meet specific requirements for studies of clearance mechanisms; (3) investigation of fundamental mechanisms of sampling processes to provide a basis for the development of improved instrumentation and more accurate methods of data interpretation; (4) investigation of mehanisms related to the stability of aerosols and to aerosol-vapor (-gas) interactions; (5) solubility rate interpretation of data now available in the literature; and (6) investigation of the effect of particulate properties on the physiological clearance on intact particles from nonciliated regions of the lung.
Keywords: AEROSOLS; TOXIC MATERIALS; INHALATION; PHYSICAL PROPERTIES; LUNG CLEARANCE; CHEMICAL PROPERTIES; AEROSOL GENERATORS; SAMPLING; DATA ANALYSIS; CHEMICAL REACTIONS; ANIMALS; SOLUBILITY.

91373 Physiological Effects of Electric Fields in Animals. Michaelson. (University of Rochester, Rochester, NY). **Project number:** 002907. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research.. **Funding:** DOE-$190,000.
Related energy source: conservation(100). **R and D categories:** Health effects.

Studies are being performed in the rat and dog to relate the sequential changes in hypothalamic and pituitary function to alterations in body metabolism or homokinetic perturbations as a result of exposure to various regimens of x-rays, microwaves, or combinations of these two electromagnetic energies, during the perinatal as well as adult periods of life. Radioimmunoassay (RIA) techniques and competitive protein-binding analysis are utilized to measure fluctuations in pituitary, thyroid, and adrenal hormones to study homeostasis, impairment of physiologic capacity, and functional integrity of the neuroendocrine system to assess pathophysiological sequelae from exposure to electromagnetic radiant energies.
Keywords: X RADIATION; PERINATAL IRRADIATION; RATS; DOGS; BIOLOGICAL RADIATION EFFECTS; HYPOTHALAMUS; PITUITARY GLAND; HOMEOSTASIS; AUTONOMIC NERVOUS SYSTEM; ADRENAL HORMONES; PITUITARY HORMONES; THYROID HORMONES; RADIOIMMUNOASSAY; CPB; MICROWAVE RADIATION; BIOLOGICAL EFFECTS; RADIOSENSITIVITY EFFECTS; PATHOLOGICAL CHANGES.

91374 Cellular Effects of Electric Fields. Miller, M. (University of Rochester, Rochester, NY). **Project number:** 002908. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$61,000.
Related energy source: conservation(100). **R and D categories:** Health effects.

Humans, animals, and plants are exposed daily to a large number and variety of natural and man-made radiations. In addition, humans are exposed to various radiations in occupational and medical settings. The effects of ionizing radiations on biological systems are reasonably well understood and standards now exist for safe levels of human exposure and for release of radioactive materials into the environment in general. This project concerns two types of nonionizing radiation which are also a part of our environment but are less well understood--biomedical ultrasound and extremely low frequency electromagnetic radiation. Ultrasound is widely used in diagnostic and therapeutic clinical practices. Presently the exposures

of humans to ultrasound are deemed safe and it is generally believed that biological effects are produced only by heating which is the desired result in therapeutic applications and is negligible in diagnostic applications. We have now, however, identified several nonthermal biological effects induced in plant and animal test systems by biomedical ultrasound at therapeutic intensities. The purpose of the current research is to elucidate the nature of these nonthermal effects and to determine the mechanisms responsible so that a reasonable prediction can be made as to the likelihood of effects from diagnostic intensities.
Keywords: ULTRASONIC WAVES; ELECTROMAGNETIC FIELDS; HZ RANGE; BIOLOGICAL EFFECTS; ANIMALS; PLANTS; MAN; ULTRASONOGRAPHY; SIDE EFFECTS; HEALTH HAZARDS; ANIMAL CELLS; PLANT CELLS; PATHOLOGICAL CHANGES.

91375 Alpha Radiobiology. Morken. (University of Rochester, Rochester, NY). **Project number:** 002909. **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:** Health effects.

This research program provides information on the biological effects, and their mechanisms, of internal alpha irradiation. Its immediate purpose has been to inquire into the nature of the radiological effects of radon and its decay products, uncomplicated and uncompromised by the presence of other possible tumorigenic agents, to demonstrate whether alpha radioactivity alone could be the stimulus to produce lesions which would develop into lung cancer and to provide information on the biological mechanisms which may be involved in these various responses.
Keywords: ALPHA PARTICLES; BIOLOGICAL RADIATION EFFECTS; RADON; DECAY; DAUGHTER PRODUCTS; CARCINOGENS; LUNGS; NEOPLASMS.

91376 Deposition, Transportation and Fate of Associated Components. Morrow. (University of Rochester, Rochester, NY). **Project number:** 002910. **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:** Health effects.

The principal objective of this research project is the procurement of basic information on the deposition, clearance, and fate of inhaled materials. Of special relevance are specific materials which are major toxicologic concerns in various energy-related technologies and those substances which, by virtue of their special physiochemical properties, serve as investigative probes or prototypes for the pursuit of mechanistic information generally applicable to inhalation toxicology. The success of this dual approach depends considerably upon the preparation of well-controlled and fully-characterized aerosols, their administration to laboratory animals or human subjects by the respiratory route under circumstances which allow quantification, and the subsequent evaluation of the retention, translocation, and elimination processes. The last-mentioned effort is concerned with every level of biological organization which is amenable to investigation, i.e., the organism, organ, cellular, and subcellular, and it seeks to elucidate functional, cytologic, biochemical, and pathogenic mechanisms and interactions. These kinds of information contribute directly to the quantification and understanding of dose-effect relationships. They are fundamental to the development of toxicologic and radiologic protection standards and the establishment of practices for both occupational and public health protection.
Keywords: POLLUTION; INHALATION; TOXICITY; AEROSOLS; RESPIRATORY SYSTEM; PATHOGENESIS; DOSE-RESPONSE RELATIONSHIPS; RADIATION PROTECTION; STANDARDS; PUBLIC HEALTH; LUNG CLEARANCE; DEPOSITION.

91377 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:** Health effects.

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.

91378 Organic Fluoride Toxicology. Smith. (University of Rochester, Rochester, NY). **Project number:** 002912. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$58,000.
Related energy source: conservation(100). **R and D categories:** Health effects.

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. These relate chiefly to compounds of interest in anesthesiology or as pesticides. In some instances, e.g., methoxyflurane, fluoride may be released in amounts sufficient to constitute a biological hazard. Other fluoro compounds have real or potentail 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 could be helpful in assessing risks associated with their use.
Keywords: ORGANIC FLUORINE COMPOUNDS; CHEMICAL BONDS; STABILITY; TOXICITY; HEALTH HAZARDS; ANESTHETICS; PESTICIDES; RISK ASSESSMENT; PATIENTS; HUMAN POPULATIONS; DIELECTRIC MATERIALS; HEAT TRANSFER FLUIDS.

91379 Baseline Studies to Support Metabolism (EPA-102). Terepke. (University of Rochester, Rochester, NY). **Project number:** 002913. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$99,000.
Related energy source: all(100). **R and D categories:** Health effects.

The overall aim of the project is directed toward exploring the precise morphological and biochemical events that take place during transcellular transport of calcium (and possibly other divalent cations), a process which we consider to be distinctly different from transport associated with intracellular calcium ion regulation. The long-term goal is to achieve a better understanding of the intracellular processes involved in the transfer of absorbed materials, physiological or toxic, through the cytosol and into the recipient organism.
Keywords: CELL CULTURES; ANIMAL CELLS; CALCIUM; METABOLISM; MEMBRANE TRANSPORT; MEMBRANES; MORPHOLOGY; BIOCHEMISTRY.

91380 Assessment of Health Effects of Energy Systems. Goldman, M. (University of California at Davis, Davis, CA). **Project number:** 002923. **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:** Health effects.

Assessment of risks to health from energy-related pollutants are required to meaningfully estimate the environmental cost/risk/benefit tradeoffs involved in development of energy resources and production technologies. The risk assessment program at the Radiobiology Laboratory utilizes three levels of effort: (1) acquisition and storage of relevant data, (2) gathering of mathematical and statistical methods useful in assessing risks, and (3) analysis of data using existing methods or by new techniques. Emphasis will be placed on determining the validity of models relative to pollutant exposure modalities (e.g., single, acute exposures vs. chronic exposures). Emphasis will also be placed on assessing decremental effects on health other than mortality and tumorigenesis. Our literature review of health effects of pollutants from fossil-fuel power generation (published as an annotated bibliography) made clear that the available animal data, needed to scale effects to humans, are not always in the best form. Such data will require extensive effort before they can be properly utilized to assess risks. We have chosen the coking industry as a surrogate for future planned coal conversion plants. The similarities between fugitive emissions, characterization and monitoring are significant and germane to new conversion methods. This research will build on the experimental data base and models evolved to relate to information obtained on coke oven workers and their health status following high level exposures to develop models for lower level exposure assessment to possible impacted members of the general population.
Keywords: ENERGY SOURCES; COST BENEFIT ANALYSIS; POLLUTION; HEALTH HAZARDS; DATA ACQUISITION; BIOLOGICAL EFFECTS; COKING; FOSSIL-FUEL POWER PLANTS.

91384 Chemical and Physical Characterization of FBC Effluents. Cunningham. (Argonne National Laboratory, Argonne, IL). **Project number:** 002942. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$113,000.

Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

This study is designed to obtain the required chemical and physical characterization of the effluents from fluidized bed combustion of coal. The primary purpose for such characteriation is to provide necessary information for a meaningful biological (toxicological, carcinogenic, and mutagenic) evaluation of the FBC process to be conducted in the Division of Biological and Medical Research at Argonne National Laboratory. The characterization of the reacting, aging effluent will provide information of value to understanding both the atmospheric chemistry of pollutants and dose-response relationships in biological systems.

Keywords: FLUIDIZED-BED COMBUSTION; COMBUSTION PRODUCTS; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; TOXICITY; CARCINOGENS; MUTAGENS; CHEMICAL EFFLUENTS; HEALTH HAZARDS.

91386 **Personnel Exposures at Nevada Test Site.** (DOE, Nevada Operations Office, Las Vegas, NV). **Project number:** 002945. **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:** Health effects.
Keywords: NEVADA TEST SITE; PERSONNEL DOSIMETRY; NUCLEAR EXPLOSIONS; RADIATION DOSES; HEALTH HAZARDS; RISK ASSESSMENT; EPIDEMIOLOGY; DATA ANALYSIS; FISSION PRODUCTS; IONIZING RADIATIONS.

91387 **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:** Characterization, measurement, and monitoring.

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.

91389 **Policy Studies: Air Quality.** Leppert, G. (Argonne National Lab., Argonne, IL). **Project number:** 002962. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$210,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: AIR QUALITY; ENVIRONMENTAL POLICY; ENERGY SOURCE DEVELOPMENT; ENERGY POLICY; POLLUTION; DECISION MAKING; TECHNOLOGY ASSESSMENT.

91390 **Policy Studies: Conservation and Health.** Hamilton, L. (Brookhaven National Laboratory, Upton, NY). **Project number:** 002964. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$250,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: ENVIRONMENTAL POLICY; ENERGY CONSERVATION; HEALTH HAZARDS; FUEL CYCLE; ENERGY SOURCE DEVELOPMENT; TECHNOLOGY ASSESSMENT; ENVIRONMENTAL IMPACTS; DECISION MAKING.

91391 **Regional Assessment Activities.** Palmed, P.F. (Brookhaven National Laboratory, Upton, NY). **Project number:** 002967. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$411,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: REGIONAL ANALYSIS; ENVIRONMENTAL IMPACTS; ENERGY SOURCE DEVELOPMENT; ENERGY MODELS; ENVIRONMENTAL POLICY.

91392 **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 Health and Environmental Research. **Funding:** DOE-$105,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: AIR POLLUTION; LAND POLLUTION; ENVIRONMENTAL IMPACTS; TECHNOLOGY ASSESSMENT; ENERGY POLICY; ENVIRONMENTAL POLICY; DECISION MAKING.

91393 **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 Health and Environmental Research. **Funding:** DOE-$155,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: WASTE MANAGEMENT; WASTE DISPOSAL; ENVIRONMENTAL POLICY; ENVIRONMENTAL IMPACTS; ENERGY POLICY; TECHNOLOGY ASSESSMENT.

91395 **Regional Assessment Activities.** Burnham. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002978. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$274,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: REGIONAL ANALYSIS; ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; LAND USE; WESTERN REGION; ENVIRONMENT.

91396 **Policy Studies: Toxics.** Snyder, A.W. (Sandia Labs., Albuquerque, NM). **Project number:** 002980. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$100,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: TOXIC MATERIALS; GOVERNMENT POLICIES; AIR POLLUTION; WATER POLLUTION; ENVIRONMENTAL IMPACTS; ENVIRONMENTAL POLICY; ENERGY POLICY; HEALTH HAZARDS.

91397 **Cleanup of Animal Facilities.** (United Nuclear Industries, Inc., Richland, WA). **Project number:** 002981. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$92,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.
Keywords: NUCLEAR ENERGY; FISSION PRODUCTS; ENVIRONMENTAL IMPACTS; CARCINOGENESIS; BIOLOGICAL RADIATION EFFECTS; RADIOACTIVE WASTE DISPOSAL; DECONTAMINATION; ANIMALS; ANIMAL SHELTERS; RADIATION PROTECTION.

91398 **Geothermal Planning for Snake River Plain.** (Idaho National Engineering Laboratory, Idaho Falls, ID). **Project number:** 002982. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$75,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects.
Keywords: GEOTHERMAL ENERGY; PLANNING; ENVIRONMENTAL IMPACTS; IDAHO; WYOMING; WASHINGTON; SULFUR OXIDES.

91399 **Desulfurization of Petroleum Fractions and Organo-Sulfur Compounds by Microorganisms.** Rigau, J. (Center for Energy and Environmental Research, Caparra Heights, PR). **Project number:** 002983. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$22,000.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.
Keywords: PETROLEUM FRACTIONS; ORGANIC SULFUR COMPOUNDS; DESULFURIZATION; MICROORGANISMS BIOCONVERSION.

91400 **Geothermal Noise Effects.** Leitner, P. (Lawrence Livermore Laboratory, Livermore, CA). **Project number:** 002984. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$17,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects.

Keywords: GEOTHERMAL ENERGY; GEOTHERMAL INDUSTRY; NOISE POLLUTION.

91402 Subcontract Funds for Geothermal. (Lawrence Livermore Laboratory, Livermore, CA). **Project number:** 002986. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.
Related energy source: geothermal(100). **R and D categories:** Physical and chemical processes and effects.
Keywords: GEOTHERMAL ENERGY; ENVIRONMENTAL IMPACTS; TECHNOLOGY ASSESSMENT; ENERGY SOURCE DEVELOPMENT.

91403 Effects of Petroleum Hydrocarbons on Behavior of Marine Organisms. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002987. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$56,000.
Related energy source: oil and gas(100). **R and D categories:** Ecological/biological processes and effects.
Keywords: HYDROCARBONS; AQUATIC ORGANISMS; BEHAVIOR; PETROLEUM INDUSTRY; BIOLOGICAL EFFECTS; METABOLISM; ENVIRONMENTAL IMPACTS.

91406 Technical Evaluation: Analysis. (Argonne National Laboratory, Argonne, IL). **Project number:** 002992. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$142,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; INFORMATION SYSTEMS; DATA ANALYSIS.

91408 Surveillance of Facilities and Sites Dose Reassessment from the Bravo Incident. Naidu, J.R. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** 003010. **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:** Health effects.
Keywords: IONIZING RADIATIONS; NUCLEAR ENERGY; WASTE MANAGEMENT; DECONTAMINATION; DECOMMISSIONING; HEALTH HAZARDS; RISK ASSESSMENT; HUMAN POPULATIONS; RADIATION DOSES; RADIATION HAZARDS; BIOLOGICAL RADIATION EFFECTS; RADIOACTIVE WASTE DISPOSAL.

91409 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: all(100). **R and D categories:** Physical and chemical processes and effects.
Keywords: ENVIRONMENTAL IMPACTS; ENERGY PARKS; TERRESTRIAL ECOSYSTEMS; SITE SELECTION; ENERGY SOURCE DEVELOPMENT.

91416 Solid Waste to Methane Study, Pompard 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:** Characterization, measurement, and monitoring.

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.

91417 US Uranium Registry. Breite, B.D. (Hanford Environmental Health Foundation, Richland, WA). **Project number:** 003182. **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:** Health effects.

The U.S. Uranium Registry will provide centralized collection and analysis of data on the exposure and estimated deposition of uranium and radon daughters among exposed workers and investigate the effects of these nuclides on the health and mortality of workers in the uranium mining, milling, enrichment, and fuel fabrication industries. Insufficient attention has been devoted to the study of the health of workers exposed to uranium in the nuclear industry. The mining and further processing of uranium will increase as a result of the current emphasis on nonproliferation nuclear cycles. This expansion of the uranium industry, estimated in 1976 as a 25-fold increase in uranium mining and milling and a 15-fold increase in fuel fabrication facilities, increases the urgency of defining as thoroughly as possible the potential health effects that might be anticipated in various segments of the industry. The results of the activities included in the Uranium Registry could be a major contribution to setting standards for exposure of workers to uranium. It can also assist in the identification of work assignments or process steps that are major sources of uranium exposures of workers and, therefore, should be given high priority for the development of control procedures.
Keywords: URANIUM MINES; FEED MATERIALS PLANTS; ISOTOPE SEPARATION PLANTS; FUEL FABRICATION PLANTS; RADIATION HAZARDS; PERSONNEL; RADIATION DOSES; DATA COMPILATION.

91419 Decentralized Energy Systems. Leppert, G. (Argonne National Laboratory, Argonne, IL). **Project number:** 003210. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$95,000.
Related energy source: all(100).
Keywords: ENERGY SUPPLIES; ENVIRONMENTAL IMPACTS.

91420 Alternative Urban Strategies. Berman. (Lawrence Berkeley Laboratory, Berkeley, CA). **Project number:** 003211. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: URBAN AREAS; LAND USE; POLLUTION ABATEMENT; ENERGY SUPPLIES; ENVIRONMENTAL POLICY.

91422 Small Scale Combustion Testing of Synthetic Fuels. Sharke, 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:** Characterization, measurement, and monitoring.

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.

91424 Field Research: SRC Pilot Plant. States, J.B. (Battelle Pacific Northwest Lab., Richland, WA). **Project number:** 003237. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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 liquification 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 of their biological effects to an explanation of their causative mechanisms.
Keywords: SRC PROCESS; PILOT PLANTS; CHEMICAL EFFLUENTS; WASTES; CHEMICAL COMPOSITION; ENVIRONMENTAL TRANSPORT; AIR POLLUTION; GASEOUS WASTES; LIQUID WASTES; SOLID WASTES; PARTICLES; BIOLOGICAL EFFECTS; WASHINGTON; ENVIRONMENTAL IMPACTS.

91425 Biomedical and Environmental Effects of Electrical Storage Systems. Sharma. (Argonne National Laboratory, Argonne, IL). **Project number:** 003246. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$117,000.
Related energy source: conservation(100). **R and D categories:** Health effects.
Keywords: ENVIRONMENTAL IMPACTS; BIOLOGICAL EFFECTS; HEALTH HAZARDS; ELECTRIC POWER; ELECTRIC BATTERIES.

91426 Non-Nuclear Health Protection. (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:** Characterization, measurement, and monitoring.

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.

91427 Environmental Assessment of Solar Energy Technology. Hoover, J. (Lawrence Berkeley Laboratory, Berkeley, CA). **Project number:** 003249. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$240,000.
Related energy source: solar(100). **R and D categories:** Integrated assessment.
Keywords: SOLAR ENERGY; TECHNOLOGY ASSESSMENT; ENVIRONMENTAL IMPACTS; ENERGY SOURCE DEVELOPMENT.

91430 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: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91431 Staff Level of the Field Patent Operation. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** 003254. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$11,000.
Related energy source: all(100). **R and D categories:** Health effects.
Keywords: ENERGY SOURCE DEVELOPMENT; FUEL CYCLE; ENVIRONMENTAL IMPACTS; ENERGY.

91432 Statistical Health Effects Studies. (Hanford Environmental Health Foundation, Richland, WA). **Project number:** 003255 **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:** Health effects.
Keywords: NUCLEAR ENERGY; HEALTH HAZARDS; FISSION PRODUCTS; STATISTICS; IONIZING RADIATIONS; HUMAN POPULATIONS; RADIATION DOSES; RADIATION HAZARDS.

91434 Environmental Health Analysis. Jobin, W. (Center for Energy and Environment, Caparra Heights, PR). **Project number:** 003258. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$70,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.
Keywords: ENVIRONMENT; HEALTH HAZARDS; POLLUTION; ENERGY; HUMAN POPULATIONS.

91435 Assessment of Health Effects Related to Surface Oil Shale Retorting. (Laramie Energy Technology Center, Laramie, WY). **Project number:** 003260. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$270,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.
Keywords: OIL SHALES; RETORTING; HEALTH HAZARDS; HYDROCARBONS; PARTICLES; PHOTOCHEMICAL OXIDANTS; AIR POLLUTION; LAND POLLUTION.

91436 Fractionation of Organic Samples from Hygas Pilot Plant. Cunningh, 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:** Characterization, measurement, and monitoring.

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.

91443 Develop On-Line Aerosol Sizing Mass Monitoring Instrument. Guthals. (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:** Characterization, measurement, and monitoring.

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 instrumen' has been constructed, tested in the laboratory, and successfull operated on a few trial runs aboard manned balloons, aircraft, an 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.

91445 Development of Recommendations for Protection Against Radiation Emitted by Internally Deposited Radionuclides. Ney, W.R. (National Council on Radiation, Washington, DC). **Project number:** 006523. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$171,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

Council will formulate and study new and innovative means of approaching radiation problems of public and agency concern, develop ways for early identification of problems, and develop analytical procedures to assist NCRP Board in assigning priorities to proposed new NCRP efforts. Work will continue on a priority basis for addressing problems of radioactivity in drinking water. The council will provide recommendations dealing with: (1) radiation hazards resulting from the release of radionuclides into the environment; (2) radionuclides and labeled organic compounds incorporated in genetic material; (3) physical and biological properties of radionuclides; (4) selected occupational exposure problems arising from internal emitters; (5) administered radioactivity; (6) radiation dose calculations; (7) maximum permissible concentrations for occupational and non-occupational exposures; (8) management of radionuclides produced in nuclear power generation; (9) experimental verification of internal dosimetry calculations; (10) radiation exposure from consumer products; (11) radiation associated with medical examinations; (12) radiation received by radiation employees; and (13) radioactivity in water.
Keywords: RECOMMENDATIONS; RADIATION PROTECTION; RADIOISOTOPES; DRINKING WATER; RADIOACTIVITY; RADIATION HAZARDS; DOSIMETRY; MAXIMUM PERMISSIBLE CONCENTRATION; NUCLEAR POWER PLANTS; CONSUMER PRODUCTS; INTERNAL IRRADIATION.

91447 Cooperative Program Between WRC and DOE to Initiate Achievement of the Objectives of Section 13. Fairch, W.D. (Water Resources Council, U.S., Washington, DC). **Project number:** 007141. **Supported by:** Department of. Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$182,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: ENVIRONMENTAL POLICY; IMPLEMENTATION; GOVERNMENT POLICIES; WATER RESOURCES; TECHNOLOGY ASSESSMENT; ENERGY POLICY; POLLUTION REGULATIONS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; WATER POLLUTION ABATEMENT.

91449 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(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91450 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(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91451 Characterization of Organic Species Emitted from Oil Shale Conversion Processes. Natush. (Colorado State University, Fort Collins, CO). **Project number:** 007342. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$116,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

In order to assess the potential environmental impact of atmospheric emissions from future oil shale conversion operations it is necessary to know both their chemical composition and the ways in which this composition changes in the emitted plume. Present indications are that significant amounts of organic material may be emitted to the atmosphere from a fullscale oil shale conversion plant; however, essentially nothing is known about the identities of the species involved and information about probable plume transformations is largely speculative. Research is, therefore, proposed to identify organic material present at two points in the process stream of the Paraho pilot plant. The two points chosen represent emissions which will and will not be subjected to terminal incineration thereby representing two possible future operational configurations. In order to study the corresponding plumes, it is proposed to collect samples both from the Paraho plant plume and from a surrogate plume which can be shown to have similar composition to that anticipated for a full-scale oil shale conversion plant. A petroleum refinery plume is suggested for this purpose. Plume samples will be collected at various distances from the source and analyzed to determine the identities and amounts of organic species and of inorganic gases and particles likely to be involved in the transformation of organic species. Limited laboratory simulation will be undertaken to obtain information about rates of conversion and conversion products. A plume dispersion model will then be developed to describe the primary physical and chemical processes which determine spatial and temporal changes in plume composition.
Keywords: PARAHO PROCESS; OIL SHALE PROCESSING PLANTS; CHEMICAL EFFLUENTS; AIR POLLUTION; PLUMES; SAMPLING; PETROLEUM REFINERIES; CHEMICAL COMPOSITION; ATMOSPHERIC CHEMISTRY.

91454 Proposal for Partial Support of the Subcommittee on the Geochemical Environment in Relation to Health. 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:** Characterization, measurement, and monitoring.
Keywords: HEALTH HAZARDS; CHEMICAL EFFLUENTS; OCCUPATIONAL DISEASES; COAL INDUSTRY; AIR POLLUTION; GEOCHEMISTRY; GOVERNMENT POLICIES; ENVIRONMENTAL POLICY; LAND POLLUTION.

91459 Lipid Changes in Plankton Communities Due to Pollution. Jeffries, H.P. (University of Rhode Island, Kingston, RI). **Project number:** 091459. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$39,000.
Related energy source: all(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The research proposed here deals with the chemical state of plankton communities. I hypothesize that the fatty acid patterns of entire communities should be less variable and more predictable in offshore waters than in progressively more variable, physically controlled estuarine habitats. For ecological purposes, I have been able to express the complexity contained in a matrix of fatty acid concentrations as a simple trajectory in time. The pattern that results has features corresponding to ecological phenomena, e.g., seasonal re-

placement and response to perturbation. Our understanding of this special kind of community behavior would be greatly extended by the comparative study advanced here. It could conceivably lead to supplemental ways for assessing impacted situations and those requiring further study by more traditional methods.
Keywords: SEAS; ESTUARIES; AQUATIC ECOSYSTEMS; PLANKTON; CARBOXYLIC ACIDS; VARIATIONS; WATER POLLUTION; BIOLOGICAL EFFECTS; BIOCHEMISTRY; COMPARATIVE EVALUATIONS.

91461 Development of Alternative Energy Facility Siting Policies for Urban Coastal Areas. Morell, D. (Princeton University, Princeton, NJ). **Project number:** 007565. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$37,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: URBAN AREAS; COASTAL REGIONS; LAND USE; SITE SELECTION; ENERGY FACILITIES.

91464 Environmental Assessments and Impacts Analyses Through SEAS. Pikul, R. (Mitre Corp., McLean, VA). **Project number:** 007602. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$819,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: ENVIRONMENTAL IMPACTS; DATA COMPILATION; DATA ANALYSIS; INFORMATION SYSTEMS; ENERGY; ENVIRONMENT.

91467 Leading Trends in Environmental Regulation. (Flow Resources, Inc., San Rafael, CA). **Project number:** 007698. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$135,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: POLLUTION REGULATIONS; ENVIRONMENTAL POLICY; ENERGY; ENVIRONMENT; RECOMMENDATIONS.

91473 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 shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91474 Distribution of Marine Birds on the Mid-Atlantic U.S. Outer Continental Shelf. Powers, K.D. (Manomet Bird Observatory, Manomet, MA). **Project number:** 007740. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

91486 Federal Non-Nuclear Energy Research and Development Program to Evaluate the Adequacy of Attention to Environmental Matters. Sawler, L.E. (Environmental Protection Agency, Washington, DC). **Project number:** 007918. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$359,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.
Keywords: ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; NATIONAL GOVERNMENT; ENVIRONMENTAL POLICY; RESEARCH PROGRAMS.

91787 Heterogeneous Chemistry of Atmospheric Species: Reactions of Gases on Aerosols. Golden, D. (SRI International, Menlo Park, CA). **Project number:** 007951. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$65,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The gas-solid chemical reactions which occur on the surfaces of particulates in the atmospheric transformation of fossil-fuel combustion pollutants are of critical importance in determining the ultimate fate of both gaseous and particulate pollutants. The role of these reactions is not well understood. The SRI group studies rates and products of reactions of the principal gaseous species with well-defined surfaces representing the expected particle surfaces, to establish and quantify the role of the more important reactions.
Keywords: AEROSOLS; FLUE GAS; CHEMICAL REACTIONS; COMBUSTION PRODUCTS; CHEMICAL REACTION KINETICS; PARTICLES; FLY ASH; SURFACE PROPERTIES; AIR POLLUTION.

91788 Trace Metal Characterization and Speciation in Geothermal Effluent. Kowals, 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:** Characterization, measurement, and monitoring.

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.

91789 Myocardial Perfusion Scintigraphy Using a New Technique, the Mesh Chamber. Osborn, L.S. (Massachusetts Institute of Technology, Cambridge, MA). **Project number:** 007953. **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:** Characterization, measurement, and monitoring.

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.

91790 Development of Laser-Excited Molecular Luminescence Spectrometric Methods for Polynuclear Aromatic Hydrocarbons. Winefo, J.D. (University of Florida, Gainesville, FL). **Project number:** 007954. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$69,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91791 In Vivo Detection, Localization and Measurement of Radionuclides in Man. Laurer, G.R. (New York University Medical Center, New York, NY). **Project number:** 007955. **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:** Characterization, measurement, and monitoring.

The purpose of this effort is to design, construct and test a photon detection system which will give both location and intensity of radioisotopes deposited in the human body through inhalation or ingestion. A knowledge of the distribution of radionuclides in the body is important for the quantitative assessment of body burdens or organ burdens in whole-body in-vivo detection of transuranium elements. It is important to know as accurately as possible where the site of deposition is and how it may become translocated in the subsequent treatment of the exposed individuals. Active collimation is the operating principle to be developed for use with this system. The active collimation technique uses pulse-shape discrimination to give spatial resolution (XYZ axes) without the need for separate physical collimation devices. Because of this, the detector will have a much larger aperture and, hence, a greater counting efficiency than that obtainable with other currently used systems.
Keywords: RADIOISOTOPES; DETECTION; BIOLOGICAL LOCALIZATION; MAN; PHOTONS; RADIATION DETECTORS; INHALATION; INGESTION; TISSUE DISTRIBUTION; BODY BURDEN; TRANSURANIUM ELEMENTS; COLLIMATORS; SPATIAL RESOLUTION; EFFICIENCY; DOSIMETRY.

91793 Study of Feasibility of Detecting Effects of Low-Dose Radiation in Shipyard Workers. Matano, G.M. (Johns Hopkins University, Baltimore, MD). **Project number:** 007960. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$21,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective is to initiate a study to determine the feasibility of establishing an appropriate population of nuclear and non-nuclear shipyard workers for a study of the long-term effects of low-level radiation.
Keywords: LOW DOSE IRRADIATION; PERSONNEL; SHIPS; NUCLEAR SHIPS; DELAYED RADIATION EFFECTS.

91794 Measurement of Surface Fluxes of Air Pollutants. Stedma, D.H. (University of Michigan, Ann Arbor, MI). **Project number:** 007961. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

This proposal is for a collaborative study with the ongoing meteorological research by DOE Argonne under Bruce Hicks. Our part of the experiment is to devise, test, and provide, together with personnel for their use, appropriate detectors of air pollutants. The pollutants studied would include ozone, nitrogen oxides, and sulfur species. Mr. Hicks' ongoing program would provide the experimental sites, the meteorological data, and the flux data handling facility. The DOE group is the leader in the micrometeorological technique of flux measurements by eddy correlation. We will provide chemical instrumentation to meet their somewhat stringent demands, particularly response speed greater than one hundred milliseconds. We have already demonstrated the success of this collaboration in two short feasibility study field trips in which ozone fluxes were measured.
Keywords: AIR POLLUTION; OZONE; NITROGEN OXIDES; SULFUR DIOXIDE; ATMOSPHERIC CHEMISTRY; COAL; COMBUSTION; BOILER FUEL.

91796 Impact of Gaseous Sulfur and Aerosols Produced by Power Plants on the CCN Budget. Saxena, V.K. (University of Utah, Salt Lake City, UT). **Project number:** 7963. **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:** Physical and chemical processes and effects.

A comprehensive program to study the regional transport and dispersion of sulfur and chlorine particles is proposed. The study is aimed at determining the variability of CCN upwind and downwind of the power plants, investigating the growth and formation of CCN in the plane plume, and determining whether the gaseous sulfur-to-sulfate conversion processes give rise to a secondary maximum in the CCN concentration downwind of the plume. Our newly developed CCN spectrometer will be used. It is capable of producing real time measurement and display of the entire CCN spectrum within as short a time interval as 15 seconds. Airborne measurements abroad a DC3 aircraft will be made. One of the most fascinating aspects of the proposed study is the utilization of the CCN activity spectrum as a natural tracer of the air mass history. The proposed study will help MAP3S in four respects. First, the submicron cycle and therefore a study of their transport is needed. Second, they represent the fingerprints of a pollution plume in terms of their activity spectrum and are the best tracers of air originating from urban-industrial areas. Third, they have been shown to be derived from the gaseous sulfur-to-sulfate conversion processes and are involved in the acid rain. Fourth, larger sulfate particles directly emitted from power plants may form haze at ambient relative humidities thereby degrading the visibility.
Keywords: FLY ASH; ENVIRONMENTAL EFFECTS; SULFUR; CHLORINE; AEROSOLS; AIR POLLUTION; VISIBILITY; POWER PLANTS; CONDENSATION NUCLEI; CHEMICAL REACTION KINETICS; PARTICLES; CLOUDS; SULFUR; CHLORINE; ATMOSPHERIC CHEMISTRY; ENVIRONMENTAL IMPACTS; ACID RAIN.

91798 Determining the Mutagenic Potential of Environmental Agents of Importance of Man. Legato, M.S. (University of Texas, Austin, TX). **Project number:** 007965. **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:** Health effects.

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. Legator has identified 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 as compounds he would like to evaluate.
Keywords: MUTAGENESIS; CHEMICAL EFFLUENTS; BY-PRODUCTS; MAN; BIOASSAY; MOLECULES; ALKYLATING AGENTS; POLYCYCLIC AROMATIC HYDROCARBONS; MICE; DROSOPHILA; IN VITRO; ORGANIC COMPOUNDS; BENZENE; COKE OVENS; COMBUSTION PRODUCTS; FLUE GAS; AIR POLLUTION; HEALTH HAZARDS; BIOCHEMICAL REACTION KINETICS; TOXICITY.

91799 Proposal for Non-Random Mutagenesis. Goldsb, R.A. (University of Maryland, College Park, MD). **Project number:** 007966. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$52,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

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; RISK ASSESSMENT; MINING; ANIMAL CELLS; TEMPERATURE EFFECTS; SULFUR OXIDES; ECOLOGICAL CONCENTRATION; BIOLOGICAL EFFECTS.

91800 Genetics and Biochemistry of DNA Repair in the Eukaryotic Microorganism Neurospora Crassa. Mishra, N.C. (University of South Carolina, Columbia, SC). **Project number:** 007967. **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:** Health effects.

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: GENETICS; BIOCHEMICAL REACTION KINETICS; DNA; BIOLOGICAL REPAIR; NEUROSPORA; PHYSIOLOGY; MUTANTS; MUTAGENESIS; CARCINOGENESIS.

91802 Interaction of Polynuclear Aromatic Carcinogens with DNA. Geacinto, N. (University of New York, New York, NY). **Project number:** 007969. **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:** Health effects.

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 pres-

ent 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: POLYCYCLIC AROMATIC HYDROCARBONS; TOXICITY; COAL; AIR POLLUTION; SOOT; COMBUSTION PRODUCTS; DNA; AQUEOUS SOLUTIONS; BIOCHEMICAL REACTION KINETICS; COAL INDUSTRY; HEALTH HAZARDS.

91808 Evaluations of Nuclear Fuel Cycles Being Considered Under INFCE. (Science Applications, Inc., Palo Alto, CA). **Project number:** 007975. **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:** Integrated assessment.
Keywords: FUEL CYCLE; ENVIRONMENTAL EFFECTS; INFORMATION SYSTEMS; GOVERNMENT POLICIES; NUCLEAR ENERGY; BIOLOGICAL RADIATION EFFECTS; ENERGY POLICY; ENVIRONMENTAL POLICY.

91810 Models of Carbon Flow in Tropical Ecosystems with Emphasis on their Role in the Global Carbon Cycle. Lugo, A.E. (University of Florida, Gainesville, FL). **Project number:** 007981. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$177,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.
Keywords: MATHEMATICAL MODELS; CARBON; TROPICAL REGIONS; TERRESTRIAL ECOSYSTEMS; MINERAL CYCLING; ENVIRONMENTAL TRANSPORT; GLOBAL ASPECTS.

91812 Studies of Participants in Nuclear Tests. Jablon, S. (National Academy of Sciences, Washington, DC). **Project number:** 007985. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$114,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

NAS will conduct studies to determine whether former Smoky participants leukemias are occurring excessively. The study is intended to verify the findings on Smoky participants and to determine whether these findings relate specifically to the population present at Smoky or to all tests.
Keywords: NUCLEAR EXPLOSIONS; HUMAN POPULATIONS; LEUKEMIA; HEALTH HAZARDS; RADIATION HAZARDS; FISSION PRODUCTS; DATA ACQUISITION; DATA ANALYSIS; EPIDEMIOLOGY; RADIOINDUCTION; DELAYED RADIATION EFFECTS.

91813 Decontamination of the Hawaii Development Irradiation Facility. Kitogawa, Y. (Hawaii State Government, Honolulu, HI). **Project number:** 007986. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.
Keywords: FISSION PRODUCTS; DECOMMISSIONING; HEALTH HAZARDS; RADIATION PROTECTION; IRRADIATION PLANTS.

91818 Characteristics and Environmental Investigations of DOE's Anaerobic Digestion Facility. Sengupta, S. (University of Miami, Miami, FL). **Project number:** 007991. **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:** Characterization, measurement, and monitoring.

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.

91819 Nature of Nitrogenous Pollutants of In Situ Oil Shale Processes. Yen, T.F. (University of Southern California, Los Angeles, CA). **Project number:** 007993. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$17,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91820 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).

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.

91821 National Coal Policy. Abshire, D. (Georgetown University, Washington, DC). **Project number:** 008035. **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:** Integrated assessment.
Keywords: COAL; GOVERNMENT POLICIES.

91830 Separation Processes for Water Effluents from Coal Conversion Plants. Luecke, R.H. (University of Missouri, Rolla, MO). **Project number:** 800135. **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:** Environmental control technology.

The objective of this research is to evaluate the feasibility of solvent extraction for the removal of contaminants from wastewater in coal gasification processes. The distribution between aqueous and solvent phases of various phenols, naphthols, and pyridines, which constitute the principal contaminants in coal gasification wastewaters, are being investigated. Judicious choice of solvents will facilitate selection of future solvents based on chemical structure. Simultaneous studies are being conducted on the capability, efficiency, and cost of solvent extraction processes for removing these compounds from coal gasification wastewater.

Keywords: COAL GASIFICATION PLANTS; WASTE WATER; SOLVENT EXTRACTION; WATER TREATMENT; PHENOLS; NAPHTHOLS; PYRIDINES; PARTITION.

91838 Dry/Wet Cooling Towers. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 800232. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology.

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.

91839 Removal of NOx and SO2 from Flue Gas Through Electron Beam Irradiation. Bush, J.R. (Research Cottrell, Bound Brook, NJ). **Project number:** 800239. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$20,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology.

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.

91840 Environmental Control Implications of Large Scale Lignite Utilization. (Texas A and M University, College Station, TX). **Project number:** 800242. **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:** Environmental control technology.

The objective of this program is to assess the environmental control implications of lignite utilization. The major areas of concern are in air quality standards and the ability of current higher rank coal combustion technologies to handle lignite combustion which is expected to produce ash and particulate matter that is different from coal ash and particulate. Further, the study will address water quality issues, solids disposal, legal constraints, strip mining issues and waste heat disposal associated with lignite utilization.
Keywords: LIGNITE; COMBUSTION; ENVIRONMENTAL IMPACTS; AIR POLLUTION; WASTE DISPOSAL; WATER QUALITY.

91841 Diesel Emissions: Environmental Fate, Health Effects, and Control Technology. Kebely, V. (Aerospace Corporation, Germantown, MD). **Project number:** 800256. **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:** Environmental control technology.

The objective of this project is to summarize the state of knowledge on the nature and quantity of diesel emissions, their transport and fate, the health effects, and the status of relevant control technology to determine the potential effects of an increased fraction of diesels in the light duty vehicle fleet in the future. The survey was conducted during May and June 1978 and was based on reviews of published data, computer searches of research project inventories, discussions with both federal and private sector organizations, and information obtained through attendance at the joint DOT/DOE/EPA workshop in Washington, DC, 27--28 April 1978, and the EPA symposium in Ann Arbor, MI, 17--19 May 1978. The survey was completed and documented in June 1978.
Keywords: VEHICLES; DIESEL ENGINES; EXHAUST GASES; AIR POLLUTION; ENVIRONMENTAL TRANSPORT; CHEMICAL REACTIONS; BIOLOGICAL EFFECTS; AIR POLLUTION ABATEMENT; MOBILE POLLUTANT SOURCES; POLLUTION CONTROL EQUIPMENT.

91858 Study of Decommissioning Accelerators and Fusion Devices. Gustafson, P.F. (Argonne National Lab., Argonne, IL). **Project number:** 800313. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$85,000.
Related energy source: nuclear fusion(100). **R and D categories:** Environmental control technology.

The objective of this study is to prepare a document describing the general technical and environmental effects of the decommissioning of particle accelerators. A second document describing the general technique and environmental effects of decommissioning a fusion device will be prepared.
Keywords: NUCLEAR FACILITIES; DECOMMISSIONING; ACCELERATORS; THERMONUCLEAR REACTORS; DECONTAMINATION; REACTORS.

91859 Preliminary Assessment of Control Technology Rio Blanco Site: Subsidence/Grouting. Moody, M. (Lawrence Livermore Laboratory, Livermore, CA). **Project number:** 800316. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$40,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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.

91865 Control Technology for In-Situ Oil Shale Retorts. Fox, J.P. (Lawrence Berkeley Laboratory, Berkeley, CA). **Project number:** 800353. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$25,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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: OIL SHALES; IN-SITU RETORTING; GROUND WATER; WATER POLLUTION CONTROL; SHALE GAS; MIGRATION; PLUGGING; HYDRAULICS; HYDROLOGY; WASTE PRODUCT UTILIZATION; ACID MINE DRAINAGE; SPENT SHALES.

91866 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 Health and Environmental Research. **Funding:** DOE-$50,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology.

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 from 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: OIL SHALES; RETORTING; WASTE WATER; WATER TREATMENT; SPENT SHALES; PACKED BED; ACTIVATED SLUDGE PROCESS.

91881 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: all(100). **R and D categories:** Characterization, measurement, and monitoring.

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.

91884 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:** Health effects.

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.

91886 ITU Coal Gasification Pollutant and Effluent Characterization. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 002319. **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:** Characterization, measurement, and monitoring.

The production of low Btu gas (150 Btu/scf) by in situ burning of coal has been demonstrated with considerable success by the Laramie Energy Research Center and Lawrence Livermore Laboratory. Morgantown Energy Research Center will soon test in situ coal gasification in West Virginia. The objective to the proposed research program is to initiate a study of the gas stream from the in situ experiment which will identify any unforeseen emission problems. The program will involve characterization of the spectrum of inorganic and organic materials in the product gas, the entrained water vapor, the coal-tar by-product, and the gaseous effluents from combustion of the product gas. The study will provide information about potential pollutants and emission problems to avoid delay of the development of this promising technology.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; CHEMICAL EFFLUENTS; CHEMICAL COMPOSITION; WASTE WATER; COAL TAR; GASEOUS WASTES; LOW BTU GAS; COMBUSTION PRODUCTS.

93101 Trends in Desulfurization Capabilities, Processing Technologies, and the Availability of Crude Oils. Peer, E.L.; Marsik, F.V. (Department of Energy, Division of Oil, Natural Gas and Shale Resources, Federal Bldg., 12th and Pennsylvania Ave., NW, Washington, DC, 20461). **Project number:** DOE/RA-0005. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Oil, Gas, Shale and In Situ Technology. **Funding:** DOE.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

This report was prepared as a result of concerns expressed by a number of persons within the Federal government and industry over the great dependence of U.S. refineries on predominantly sweet domestic crude oils. Since this production is declining, growing dependence must be placed on imported crude oils which are overwhelmingly sour in both production and reserves. The report addresses the subject of trends in conversion of domestic refineries to sour crude processing capability, technologes involved, the investments, operating costs and profitability of such capacity as well as problems confronting refiners installing capacity to handle sour crudes.
Keywords: SOUR CRUDES; DESULFURIZATION; PETROLEUM; AVAILABILITY; PETROLEUM REFINERIES; MODIFICATIONS; ECONOMICS; TECHNOLOGY ASSESSMENT.

93102 Slagging Fixed-Bed Gasification. Ellman, R.C. (Grand Forks Energy Technology Center, Box 8213, University Station, Grand Forks, ND, 58202). **Project number:** FE-7042-GFETC. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$2,410,000; EPA-$750,000.
Related energy source: *coal(100).* ***R and D categories:*** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objectives of this program are to characterize and establish mass production rate of solid, gaseous, and liquid effluents produced in fixed-bed gasification of coal; to identify major, minor, and trace components, both organic and inorganic, of effluents; to establish material balances as functions of coal source and gasifier operating parameters; to establish or determine such processing or treatments to recover byproducts in effluents; to maximize reuse of water; and to assure environmentally acceptable disposal of wastes. A pilot plant gasifier of 1 ton/hour capacity is used to produce effluents for analysis and study from a variety of test coals. Scaleable representative samples will be collected during operation by which mass balances and fate of components can be determined. Analytical techniques appropriate and specific to effluent characteristics will be developed and used to establish treatment and processing requirements. A data base relating to the production and characteristics of effluents generated in fixed-bed gasification of a variety of coals and at a variety of operating conditions will be established.
Keywords: COAL GASIFICATION; PACKED BED; PILOT PLANTS; AIR POLLUTION; WATER POLLUTION; SOLID WASTES; WASTE DISPOSAL; LIQUID WASTES; GASEOUS WASTES; ELEMENTS; TRACE AMOUNTS; HYDROCARBONS; BY-PRODUCTS; RECOVERY; WATER; RECYCLING; CHEMICAL ANALYSIS; CARCINOGENS; SURFACE WATERS; WASTE MANAGEMENT.

94065 Fire Criteria for Solar Heating Fluids. Benjamin, I. (National Bureau of Standards, Washington, DC, 20234). **Supported by:** Department of Energy, Washington, DC (USA). Office of Solar and Geothermal Programs. **Funding:** DOE-$120,000.
Related energy source: solar(100). **R and D categories:** Operationa safety; Characterization, measurement, and monitoring.

The objective is to provide a rational basis for specifying flammability standards for the heat transfer liquids used in solar energy collection systems. The approach will be to: determine size of ignition source necessary to obtain sustained ignition of liquids

preheated to various operating temperatures; use 1/4-scale compartment to obtain rate of burning and rate of heat release for pools of liquids preheated to various temperatures; verify selected cases in full scale room burn tests; and determine compartment temperatures generated by selected insulation materials saturated by heat transfer fluids and by ignition of flowing leaks.
Keywords: SOLAR COLLECTORS; SOLAR HEATING SYSTEMS; HEAT TRANSFER FLUIDS; SOLAR COOLING SYSTEMS; FIRE HAZARDS; FIRE RESISTANCE; SAFETY ENGINEERING; FLAMMABILITY; STANDARDS.

94071 OTEC Program Management Support: Physical and Climatic Environmental Impacts. Ditmars, J.D. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** 49553. **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$80,000.
Related energy source: ocean thermal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

Argonne will provide program management support to DOE regarding Ocean Thermal Energy Conversion (OTEC) physical and climatic environmental impacts. Technical management activities will include review of proposed studies, work products, and environmental documents; monitoring of OTEC contractors; program planning consistent with the OTEC Environmental Development Plan; and communication and interaction with DOE and related OTEC contractors in the environment and resource area. Specific studies undertaken in support of the management activities include: the feasibility of limited-area ocean modeling, climatic impact assessment feasibility, summary of descriptive physical oceanography of sites for model application, application of models, and planning for OTEC-1 physical experiments.
Keywords: OCEAN THERMAL ENERGY CONVERSION; ENVIRONMENTAL IMPACTS; MANAGEMENT; OCEANOGRAPHY; FEASIBILITY STUDIES; EXPERIMENT PLANNING; RESEARCH PROGRAMS; CLIMATES; MATHEMATICAL MODELS.

94073 Reactor Safety Studies. Kazimi, M.S. (Massachusetts Institute of Technology, Cambridge, MA, 02139). **Contract:** EG-77-S-02-2431. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fusion Energy. **Funding:** DOE-$60,000.
Related energy source: nuclear fusion(100). **R and D categories:** Operational safety.

The objective is to develop techniques for assessment of accident risk in fusion reactor plants. The methodology developed for the Reactor Safety Study (WASH-1400) will be modified, as necessary, and applied to evaluating the potential risks of fusion power. Particular attention will be paid to those risks which are peculiar to fusion, such as tritium and lithium. Computer code modeling of the consequences of fusion reactor accidents for use in safety analysis and risk assessment is the result expected.
Keywords: THERMONUCLEAR REACTORS; SAFETY; HAZARDS; TRITIUM; LITHIUM.

94074 Lithium Spill Studies. Muhlestein, L.D. (Hanford Engineering Development Laboratory, Richland, WA, 99352). **Contract:** EY-76-C-14-2170. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fusion Energy. **Funding:** DOE-$200,000.
Related energy source: nuclear fusion(100). **R and D categories:** Environmental control technology.

The objectives of the project are to: characterize the reaction of liquid lithium with materials likely to be present in fusion facilities; and develop materials and methods for extinguishing lithium fires and for removing lithium smoke from the atmosphere. Laboratory and bench-scale tests will be performed to characterize the reaction of lithium with air, nitrogen, argon, carbon dioxide, concrete, and selected insulating materials. Tests to evaluate the effectiveness of various lithium fire extinguishing agents and methods will be performed, as will tests with various cleanup systems for removal of lithium smoke and aerosols.
Keywords: THERMONUCLEAR REACTORS; LITHIUM; LEAKS; FIRE HAZARDS; CHEMICAL REACTIONS; AIR; NITROGEN; ARGON; CARBON DIOXIDE; CONCRETES; CLEANING.

94102 Solvent Extraction Studies Using High-Molecular-Weight Amines. McDonald, C.W. (Texas Southern University, Department of Chemistry, Houston, TX, 77004). **Project number:** 56-115. **Contract:** EY-76-S-05-4535. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$35,000.
R and D categories: Physical and chemical processes and effects.

The objectives are to develop highly efficient extraction methods for removing toxic metals from aqueous solutions using high-molecular-weight amines and to develop ion-flotation methods utilizing high-molecular-weight amines and other surfactants as collectors to remove toxic metal ions from aqueous solutions. A series of high-molecular-weight amines and quarternary ammonium salts will be purchased and screened for use in the extraction and ion flotation studies. The efficiencies of the extraction and flotation will be determined by use of an atomic absorption spectrophotometer. The result expected is the development of laboratory-scale procedures which show promise to being scaled up for the rapid, economical removal of toxic metal ions from industrial wastewater.
Keywords: CADMIUM; COPPER; LEAD; SOLVENT EXTRACTION; AMINES; AQUEOUS SOLUTIONS; SCREENING; QUATERNARY COMPOUNDS; NICKEL.

94103 Analytical Separations. Fritz, J.S. (Ames Laboratory, 332 Metallurgy, Ames, IA, 50011). **Contract:** W-7405-ENG-82. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$68,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Health effects.

Research is directed at development of new and superior analytical methods for concentrating, separating, and determining pollutants in water and other analytical samples. Organic pollutants are concentrated on special resins and subsequently eluted thermally or with an appropriate solvent. The work in this area includes research on new resins for concentration and on chromatographic methods for separating the concentrated impurities. Metal ion impurities in water and other samples are concentrated on new, selective chelating resins developed in this laboratory.
Keywords: GROUND WATER; WATER; SEPARATION PROCESSES; WATER POLLUTION; ION EXCHANGE; CHROMATOGRAPHY; RESINS; IMPURITIES; CHEMICAL ANALYSIS.

94104 Recovery of Metal Values from Fly Ash. Burnet, G. (Ames Laboratory, Department of Chemical Engineering, Ames, IA, 50010). **Project number:** AK-01-02-03-02. **Contract:** W-7405-ENG-82. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$115,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This project is concerned with the removal of coal fly ash from combustion of coal and the recovery of metal values such as aluminium and iron, which are prominent constituents. The methods chosen depend on the selection of appropriate chemical processes for the separation of the constituents of the ash. Recent accomplishments include the recovery of approximately 90% of the alumina by an alkaline lime-sintering process.
Keywords: COAL; COMBUSTION; FLY ASH; METALS; ALUMINIUM; IRON; MATERIALS RECOVERY.

94105 Lasers in Analytical Chemistry. Yeung, E.S. (Ames Laboratory, Iowa State University, Gilman Hall, Ames, IA, 50011). **Contract:** W-7405-ENG-82. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Research. **Funding:** DOE-$190,000.
Related energy source: fossil fuels(65); nuclear fuels(general)(5); geothermal(10); solar(20). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

As new energy technologies become important, the need for new or refined analytical methods continues to grow. The present program is centered around the development of optical methods of analysis that may become useful in (1) the diagnosis of combustion processes at the combustion chamber, (2) the monitoring of trace elements in fuels and in fuel emissions so that the transport and the fate of pollutants can be better understood, (3) the monitoring of organic pollutants resulting from energy utilization so that they can be controlled, and (4) the monitoring of gaseous pollutants in air, again so they can be better controlled. Refinements on techniques such as Raman spectroscopy, atomic fluorescence spectroscopy, selective detectors in liquid chromatography, and infrared gas analysis are subjects of investigation. In general, refinements are towards producing either a more sensitive detection system or a more selective technique. In the last few years, our efforts have resulted in some of these kinds of improvements and are described in several publications listed below.
Keywords: COMBUSTION CHAMBERS; COMBUSTION KINETICS; ELEMENTS; MONITORING; TRACE AMOUNTS; ORGANIC COMPOUNDS; AIR POLLUTION; GASEOUS WASTES; CADMIUM; CALCIUM; CESIUM; CHROMIUM; COPPER; LEAD; MANGANESE; MERCURY; NICKEL; SULFUR; IODINE; LASERS; FLUORESCENCE SPECTROSCOPY; LIQUID COLUMN CHROMATOGRAPHY; RAMAN SPECTRA; INFRARED SPECTRA; SPECTROSCOPY; LASERS; USES.

95002 Marine Environmental Test Program. Kawahara, F.K. (Naval Undersea Research Center, San Diego, CA, 92152). **Project number:** 3058. **Contract:** EX-76-A-16-3058. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

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.
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.

95003 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). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$700,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

95005 Meteorological Effects of Thermal Energy Release. Eissenberg, D.M. (Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, TN, 37830). **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$1,100,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

The objectives are to determine the effects on the atmosphere of heat and moisture releases from large fossil and nuclear energy generating facilities; and to develop methods to mitigate potential adverse impacts of such releases. Atmospheric models will be developed and validated through the use of field studies and physical and mathematical modeling. The combined efforts of Oak Ridge National Laboratory, Penn State University, Battelle Pacific Northwest Laboratory, Argonne National Laboratory, and the Rand Corporation are applied to this effort.
Keywords: FOSSIL-FUEL POWER PLANTS; NUCLEAR POWER PLANTS; MATHEMATICAL MODELS; STRUCTURAL MODELS; MOISTURE; METEOROLOGY; WASTE HEAT; ENVIRONMENTAL IMPACTS; GASEOUS WASTES; LIQUID WASTES.

95006 HTGR Seismic Studies. Olsen, B.E. (General Atomic Company, P.O. Box 81608, San Diego, CA, 92138). **Project number:** 00791. **Contract:** EY-76-C-03-0167. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development. **Funding:** DOE-$500,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

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.

95007 HTGR Accident Initiation and Progression Analysis. Houghton, W.J. (General Atomic Co., P.O. Box 81608, San Diego, CA, 92138). **Project number:** 00790. **Contract:** EY-76-C-03-0167. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development. **Funding:** DOE-$900,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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.

95008 HTGR Safety Research. Joksimovic, V.W. (General Atomic Company, P.O. Box 81608, San Diego, CA, 92138). **Project number:** 00790. **Contract:** EY-76-C-03-0167. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

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.

95013 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). Div. of Reactor Research and Technology. **Funding:** DOE-$610,000.
Related energy source: nuclear fission(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

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.

95014 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). Div. of Reactor Research and Technology. **Funding:** DOE-$600,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

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.

95015 GCFR Accident Initiation and Progression Analysi Broido, J.H. (General Atomic Company, P.O. Box 81608, Sa Diego, CA, 92138). **Project number:** 00589. **Contract:** 0167. **Supporte by:** Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology. **Funding:** DOE-$580.000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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.

95016 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). Div. of Reactor Research and Technology. **Funding:** DOE-$540,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of the program are to: (1) understand the GCFR fuel element duct melt-through and fall-away phenomena for the loss-of-flow (LOF) accident with scram; (2) perform fuel cladding melting and relocation tests for the LOF accident without scram; and (3) perform similar GCFR accident simulation tests on test assemblies representing the GCFR control element.
Keywords: GCFR TYPE REACTORS; REACTOR SAFETY; RESEARCH PROGRAMS; LOSS OF FLOW; FUEL ELEMENTS; MELTDOWN; TEST FACILITIES; NUCLEAR FUELS; SIMULATION.

95030 Environmental Assessment of Advanced 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). Div. of Reactor Research and Technology. **Funding:** DOE-$360,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The environmental impact of the use of alternate fuels instead of mixed-oxide fuel for the LMFBR and its supporting fuel cycle is assessed. Expected effluents and control technology requirements for substituting alternate fuels for mixed-oxide fuel in LMFBR fuel cycle are analyzed. Resulting environmental impacts, using existing computer codes, are estimated.
Keywords: NUCLEAR FUELS; LMFBR TYPE REACTORS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; CHEMICAL EFFLUENTS; COMPUTER CODES; RADIOISOTOPES; SAFETY; RADIOACTIVE WASTES.

95032 Meteorological Studies. Van der Hoven, I. Jr. (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). Div. of Reactor Research and Technology. **Funding:** DOE-$250,000; NRC-$220,000.
Related energy source: nuclear fuels(general)(25); nuclear fission(75). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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 complete building wake effects studies.
Keywords: LMFBR TYPE REACTORS; SITE SELECTION; METEOROLOGY; AIR; COMPUTER CODES; RADIOACTIVE EFFLUENTS; MEASURING INSTRUMENTS; DISPERSIONS.

95033 Model Evaluation of Breeder Reactor Radioactivity Releases. Hoffman, F.O. (Oak Ridge National Laboratory, Building 7509, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** OH136. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology. **Funding:** DOE-$255,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Health effects.

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 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 parameter and model output 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; HUMAN POPULATIONS; RADIATION DOSES; MATHEMATICAL MODELS; FORECASTING; RISK ASSESSMENT; COMPUTER CODES; METEOROLOGY; SAFETY; TOXICITY.

95036 Sodium Cooled Breeder Reactor Safety Program. Griffith, J.D. (Department of Energy, Washington, DC, 20545). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology. **Funding:** DOE-$51,827,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

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.

95101 Commercial Application of Waste Heat from the Vermont Yankee Power Station. Gaines, E.P. Jr. (Vermont Yankee Nuclear Power Corporation, 77 Grove Street, Rutland, VT, 05701). **Project number:** 2869. **Contract:** EY-76-C-02-2869. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$15,000; EPA-$30,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The project objective is to investigate potential for beneficial use of power plant waste heat including assessment of the effect of regulations (such as the DeLaney Clause).
Keywords: VERMONT YANKEE REACTOR; WASTE HEAT UTILIZATION; ECONOMICS; AQUACULTURE; FISHES; WASTE HEAT; THERMAL EFFLUENTS.

95102 Commercial Nuclear Waste Management Terminal Storage R and D. Batch, J.M. (Battelle Memorial Institute, 505 King Avenue, Columbus, OH, 43201). **Project number:** AR-03-01. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$66,000,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

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.

95103 Waste Immobilization R and D. Walton, R. (Department of Energy, Office of Nuclear Waste Management, Washington, DC, 20545). **Project number:** AR-03-02. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$4,460,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

Technology will be developed that can be used in the commercial nuclear fuel cycle industry to reduce the volume of waste that must be managed and to convert liquid, solid and gaseous wastes to stable packaged forms for transport to and acceptance at terminal storage facilities.
Keywords: FUEL CYCLE CENTERS; RADIOACTIVE WASTE MANAGEMENT; SOLID WASTES; LIQUID WASTES; GASEOUS WASTES; SOLIDIFICATION; RADIOACTIVE WASTE PROCESSING; RADIOACTIVE WASTE STORAGE; WASTE TRANSPORTATION; GLASS; VITRIFICATION; CASKS; SAFETY.

95104 ***Gaseous and Airborne Waste R and D.*** Dempsey, J. (Department of Energy, Office of Nuclear Waste Management, Washington, DC, 20545). **Project number:** AR-03-02-04. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$1,515,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

Technology will be developed for the collection of various gaseous effluents associated with the commercial nuclear fuel cycle. R and D programs to develop and demonstrate techniques for use in commercial nuclear fuel plants will be conducted.
Keywords: FUEL CYCLE; FUEL CYCLE CENTERS; GASEOUS WASTES; RADIOACTIVE WASTE MANAGEMENT; AEROSOLS; RADIOACTIVE WASTE STORAGE; DEMONSTRATION PROGRAMS.

95105 **Power Plant Reject Heat Utilization.** Olszewski, M. (Oak Ridge National Lab., Oak Ridge, TN, 37830). **Project number:** AG-0409-02. **Contract:** W-7405-ENG-76. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$200,000; TVA-$600,000.
Related energy source: fossil fuels(10); nuclear fuels(general)(90). **R and D categories:** Operational safety; Environmental control technology; Integrated assessment.

The objective is to assess the potential for using power plant waste heat.
Keywords: NUCLEAR POWER PLANTS; FOSSIL-FUEL POWER PLANTS; WASTE HEAT; WASTE HEAT UTILIZATION.

95106 **Waste Management R and D.** Scheib, W. (Department of Energy, Office of Nuclear Waste Management, Washington, DC, 20545). **Project number:** JM-05-02. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$16,000,000.
Related energy source: nuclear fission(100).

The objective is to store solidified high-level radioactive waste indefinitely in tanks or to remove the waste from present tanks and convert to an acceptable form for terminal storage. Technology to reduce the volume of waste, immobilize the residue and package the waste in a manner acceptable for interim and terminal isolation will be developed.
Keywords: RADIOACTIVE WASTE MANAGEMENT; RADIOACTIVE WASTE PROCESSING; RADIOACTIVE WASTE STORAGE; SOLIDIFICATION; CASKS.

95107 **Defense Airborne Radioactive Waste R and D.** Dempsey, J. (Department of Energy, Office of Nuclear Waste Management, Washington, DC, 20545). **Project number:** JM-05-02-04. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$3,573,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

Technology will be developed for the collection of various gaseous effluents for filtering particulates, fixation of collected airborne wastes to provide stable solid forms and packaging for long term storage. Hot pilot plant scale demonstrations will be carried out on each fixation process. Process demonstrations will be carried out at DOE facilities where the technology is needed.
Keywords: RADIOACTIVE WASTE MANAGEMENT; GASEOUS WASTES; SOLIDIFICATION; RADIOACTIVE WASTE PROCESSING; RADIOACTIVE WASTE STORAGE; DEMONSTRATION PROGRAMS; PILOT PLANTS; AEROSOLS.

95108 **Defense Radioactive Waste Management R and D.** Scheib, W. (Department of Energy, Office of Nuclear Waste Management, Washington, DC, 20545). **Project number:** JM-05-03. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$11,180,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

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.

95109 **Sodium Combustion Product Plume Transport Studies.** Morewitz, H.A. (Atomics International Div., Rockwell International, 8900 De Sota Avenue, Canoga Park, CA, 91304). **Project number:** SA002, Subtask M. **Contract:** EY-76-C-03-0824. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology. **Funding:** DOE-$200,000.
Related energy source: nuclear fission(50); solar(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The test series will consist of a minimum of four release tests using 23 to 68 kg of 540 degrees C sodium. The sodium will be 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.

95110 **Dry Cooling Enhancement Program.** Johnson, B. (Battelle Pacific Northwest Laboratory, Richland, WA, 99352). **Contract:** EY-76-C-06-1830. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$350,000; EPRI; EPA-$50,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objectives are major cost reduction and major water consumption reduction. Advanced dry and dry/wet cooling systems needed in future years for powerplant expansions in water scarce regions will be evaluated.
Keywords: POWER PLANTS; COOLING SYSTEMS; ECONOMICS; WATER REQUIREMENTS; CONSUMPTION RATES; RESOURCE CONSERVATION; ENVIRONMENTAL IMPACTS.

95111 **Water Use Information System.** Fletcher, J.F. (Westinghouse Hanford Company, Hanford Engineering Development Laboratory, Richland, WA, 99352). **Contract:** EY-76-C-14-2170. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$125,000.
Related energy source: all(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

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 objectives are 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 predictive 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.
Keywords: THERMAL POWER PLANTS; CONDENSER COOLING SYSTEMS; WATER REQUIREMENTS; FORECASTING; INFORMATION SYSTEMS; DATA BASE MANAGEMENT; COMPUTERS; WATER RESOURCES; SURFACE WATERS; GROUND WATER; ESTUARIES; MATHEMATICAL MODELS.

95112 **Dispersion Modeling.** Coffey, R.S. (NUS Corporation, 4 Research Place, Rockville, MD, 20850). **Contract:** EN-77-C-02-4290. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Advanced Systems and Materials Production. **Funding:** DOE-$45,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Health effects.

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.

95113 **Environmental Assessment: Battery Energy Storage Test (BEST) Facility.** Lewis, P. (Public Service Electric and Gas Company, Newark, NJ, 07102). **Contract:** EY-76-C-02-2857.M001. **Support-**

ed by: Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems. **Funding:** DOE-$50,000.
Related energy source: fossil fuels(75); nuclear fuels(general)(25). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

The objective is to assess the probable impact on the environment which may result from the construction and operation of a National Battery Energy Storage Test (BEST) Facility adjacent to Sunnymeade Road Substation of Public Service Electric and Gas Company (PSE and G) in Hillsborough Township, Somerset County, NJ. An analysis was performed of the existing environmental parameters, the methods proposed for construction and operation of the facility. Then an assessment was performed of the potential environmental impact. The present Environmental Impact Assessment will lead to a Municipal Environmental Impact Statement in compliance with Hillsborough Township, NJ, Ordinance 75-8.
Keywords: ENERGY FACILITIES; CONSTRUCTION; OPERATION; ENVIRONMENTAL IMPACTS; ENERGY STORAGE; ELECTRIC BATTERIES.

95114 Hazard Assesment of Zinc-Chlorine Electric Vehicle Batteries. Zalosh, R. (Factory Mutual Research Corporation, 1151 Boston-Providence Turnpike, Norwood, MA, 02062). **Supported by:** Department of Energy, Chicago, IL (USA). Chicago Operations Office. **Funding:** DOE; EPRI.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The program will determine the consequences of various potential mishaps involving accidental release of chlorine. A major portion of the program will be devoted to tests and evaluation of chlorine evolution and dispersal following a spill of chlorine hydrate. The result expected is an analysis of the predictable risk of the use of zinc--chlorine batteries in electric vehicles.
Keywords: ELECTRIC BATTERIES; CHLORINE; ZINC-CHLORINE BATTERIES; ENVIRONMENTAL IMPACTS; HEALTH HAZARDS; RISK ASSESSMENT; ENVIRONMENTAL TRANSPORT; ELECTRIC-POWERED VEHICLES.

95115 Environmental Impact Assessment of Electric and Vehicle Batteries. Callahan, R. (Science Applications, Inc., 1200 Prospect Street, P.O. Box 2351, La Jolla, CA, 92038). **Contract:** EC-77-C-02-4526. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Energy Storage Systems. **Funding:** DOE-$49,000.
R and D categories: Characterization, measurement, and monitoring; Integrated assessment.

The objective is to conduct an assessment of the potential environmental impacts of near term and advance battery systems proposed for use in electric vehicles. Each battery system was analyzed relative to material mining, milling, manufacturing, usage, and recycling or disposal. The result of the project is an overview of potential technological and environmental problems associated with the battery program of DOE.
Keywords: ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES; ENVIRONMENTAL IMPACTS; METALS; TECHNOLOGY ASSESSMENT; RISK ASSESSMENT; CADMIUM; LEAD; ARSENIC.

95116 FY 78 Research Projects for the Supporting Research and Technology Plan, Noise Measurements for Wind Turbine Generators. Thomas, R.L. (NASA/Lewis Research Center, 2100 Brookpark Road, Cleveland, OH, 44135). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Technology. **Funding:** DOE-$10,000.
Related energy source: wind(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment.

The Supporting Research and Technology Plan (SR and T) is the fourth project plan of the overall wind energy Project Development Plan (PDP) for which NASA Lewis Research Center has project management responsibility. [The other three are concerned with the design, fabrication, testing and operation of major experimental Wind Energy Conversion Systems (WECS), namely: the 100 kW systems, the magawatt systems, and the smaller systems (less than 100 kW).] Specifically included in SR and T are noise tests, the purpose of which is to conduct a radial survey of wind turbine noise and to determine the low frequency spectrum level.
Keywords: WIND TURBINES; ENVIRONMENTAL IMPACTS; MONITORING; NOISE POLLUTION.

95117 Environmental Studies Related to Operations of Wind Energy Systems. Rogers, S.E. (Battelle Columbus Laboratories, 505 King Avenue, Columbus, OH, 43201). **Contract:** W-7405-ENG-92. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Technology. **Funding:** DOE.
Related energy source: wind(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment.

The general objective is to address the social and environmental impacts of the widespread use of wind systems. The specific objective is to establish the potential for secondary effects on the microclimate, biota, and airborne organisms, particularly birds, created by blade rotation of wind energy conversion systems to determine the compatibility of wind turbines with agricultural use. Large two-bladed, horizontal-axis wind turbine generators (WTG) were studied using the NASA Experimental Wind Turbine at NASA Lewis Research Center's Plum Brook Station as the model for field tests. The biophysical environment was the focus of the study.
Keywords: WIND TURBINES; ENVIRONMENTAL IMPACTS; ECOSYSTEMS.

95118 Electromagnetic Interference by Wind Turbines. Senior, T.B.A. (University of Michigan, Radiation Lab., Ann Arbor, MI, 48109). **Contract:** EY-76-S-02-2846. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Technology. **Funding:** DOE-$95,000.
Related energy source: wind(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment.

Generally, the project will contribute to the program objective of assessing, quantifying and working for ameliorate potential legal, social and environmental barriers to wind systems commercialization. Specifically, the project objective is to analyze and quantify the effect of wind turbines on the electromagnetic environment by means of theoretical analyses, laboratory simulations and field-tests. The emphasis in this third year of effort will be on: (1) up-dating siting guides to include near-zone effects on TV reception and the effects of small systems; (2) effect on circularly-polarized TV broadcasts; (3) refining assessment of TV-interference problem to determine criteria for practical severity of interference at a given WTG site; (4) effect on navigation aids; and (5) extending analysis to include vertical-axis wind turbines.
Keywords: WIND TURBINES; ENVIRONMENTAL IMPACTS; ELECTROMAGNETIC FIELDS.

95119 Gulf of Mexico Numerical Model: Phase I OTEC (Ocean Thermal Energy Conversion). Mellor, G. (Dynalysis of Princeton, 20 Nassau Street, Princeton, NJ, 08540). **Contract:** ET-78-C-02-5028. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$170,000.
Related energy source: ocean thermal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The project objective is to develop and validate a numerical model for the Gulf of Mexico to assess the effects of numerous OTEC (Ocean Thermal Energy Conversion) plants on the physical environment in terms of thermal resource and environmental impact. The approach is as follows: (1) develop or adapt an existing multilayer numerical model of the Gulf of Mexico basin, including realistic boundary conditions and bottom topography, to predict the time variable circulation and temperature distribution in the Gulf throughout the year; (2) validate the model predictions against existing data for the Gulf; (3) apply the model to the case of many OTEC plants in the Gulf to estimate the physical perturbations to the environment; (4) use the results of model application to provide guidelines for biological effects modeling and for OTEC siting; and (5) provide a usable technique for climatic changes assessment on a user basis.
Keywords: OCEAN THERMAL ENERGY CONVERSION; MATHEMATICAL MODELS; OCEAN THERMAL POWER PLANTS; ENVIRONMENTAL IMPACTS; GULF OF MEXICO; TOPOGRAPHY; TEMPERATURE DISTRIBUTION; SITE SELECTION; BOUNDARY CONDITIONS.

95120 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). Office of Energy Technology. **Funding:** DOE-$98,000.
Related energy source: ocean thermal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

95121 Seismic Monitoring of The Geysers Geothermal Field. Bufe, C. (U.S. Geological Survey, Office of Earthquake Studies,

Menlo Park, CA, 94025). **Contract:** EG-77-A-36-1018. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Geothermal Energy. **Funding:** DOE-$83,000.
Related energy source: geothermal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The project objectives are to: (1) determine attenuation and source characteristics of earthquakes occurring at The Geysers; (2) differentiate between earthquakes natural to the geothermal area and those induced by production activities; and (3) define active faults at The Geysers, determine cumulative slip with time, and predict cumulative slip if microearthquake activity continues at its present level. The approach is to monitor seismic activity at The Geysers using The Geysers-Clear Lake automated seismograph network augmented by 3 additional stations; obtain wide band spectral information from 4 three-component seismographs; collect data over four-month period; and analyze results to determine possible seismic discriminants. A hypocenter map of earthquakes at The Geysers has been prepared. Comparisons of pre-production seismicity with present seismicity indicates an increase in earthquake activity at The Geysers.
Keywords: GEYSERS GEOTHERMAL FIELD; SEISMIC SURVEYS; SEISMICITY; EARTHQUAKES; GEOLOGIC FAULTS; MICROEARTHQUAKES; MAPS.

95122 Effect of High Intensity Fields on Near-Human Primates. Feldstone, C. (Southwest Research Institute, P.O. Box 28510, San Antonio, TX, 78284). **Contract:** ET-78-C-01-2875. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems. **Funding:** DOE-$456,000.
Related energy source: all(100). **R and D categories:** Integrated assessment; Health effects; Ecological/biological processes and effects.
Keywords: ELECTROMAGNETIC FIELDS; BIOLOGICAL EFFECTS; HEALTH HAZARDS; POWER TRANSMISSION LINES; POWER TRANSMISSION; ANIMALS.

95123 Environmental Effects of Solar Power Systems. Edney, E.B. (UCLA, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Avenue, Los Angeles, CA, 90024). **Project number:** EY-76-C-03-0012. **Contract:** EY-76-C-03-0012. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Planning and Technology Transfer. **Funding:** DOE-$100,000.
Related energy source: solar(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The project objectives are to characterize local flora, fauna, soil, water and microclimate conditions at the Barstow site before construction, and develop a plan for ecological amd microclimate monitoring during construction, operation and dismantling of the plant; to determine the effects of STPS collector fields on local soils, flora, fauna and microclimates; and to develop a management plan for future solar thermal power systems environmental research. The contractor will use standard ecological and climatic monitoring techniques to record soil conditions, nature and number of local flora and fauna, local temperature, wind speed and humidity. Measurements will be made over a period of three seasons. A plan for monitoring the site will be developed based on the data gathered in the initial site characterization and the results of previous monitoring at other sites. Monitoring will be carried out at a simulated mock-up of a heliostat field. Monitoring will include measurements of temperature, wind speed, soil moisture, erosion and compaction and number and species of local flora and fauna. This project will be carried out at Arizona State University by Duncan Patten of the Department of Microbiology on a subcontract to the UCLA Laboratory.
Keywords: SOLAR THERMAL POWER PLANTS; ENVIRONMENTAL IMPACTS; HELIOSTATS; CONFIGURATION; SIMULATION; MONITORING; ECOSYSTEMS; CLIMATES; SOILS; WATER QUALITY; CONSTRUCTION; OPERATION; WIND; HUMIDITY; AMBIENT TEMPERATURE.

95124 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). Office of Energy Technology. **Funding:** DOE-$100,000.
Related energy source: ocean thermal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

95125 Industrial Hygiene-Solvent Refined Coal Pilot Plant. Schmalzer, D.K. (Pittsburg and Midway Coal Mining Co., P.O. Box 2900, Shawnee Mission, KS, 66201). **Contract:** EX-76-C-01-496. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Processing. **Funding:** DOE-$40,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objectives of this project are to define and measure the extent of solvent refined coal (SRC) pilot plant personnel exposure to potentially hazardous materials, and to propose engineering control measures to reduce or eliminate the hazards. The approach consists of a comprehensive monitoring program, including in-plant air sampling and in-plant surveys of physical agents (noise, lighting). It includes, in addition to the usual air quality parameters, measurements for respirable dusts, benzene solubles, polynuclear aromatics, organic solvent vapors, asbestos fibers, etc. The results are: (1) pilot plant characterization with respect to potential occupational safety and health hazards; and (2) controls for elimination or reduction of hazards.
Keywords: COAL LIQUEFACTION; SRC PROCESS; PILOT PLANTS; INDUSTRIAL MEDICINE; HEALTH HAZARDS; AIR POLLUTION CONTROL; AIR SAMPLERS; MONITORING; DUSTS; ORGANIC SOLVENTS; POLYCYCLIC AROMATIC HYDROCARBONS; SAFETY; ASBESTOS; INHALATION.

95126 Determination of Trace Elements in the SRC Liquefaction Process. Schmalfer, D.K. (Pittsburgh and Midway Coal Mining Co., P.O. Box 2900, Shawnee Mission, KS, 66201). **Contract:** EX-76-C-01-496. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Processing. **Funding:** DOE-$30,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective of the program is to determine the fate of various trace metals and other elements in the Solvent-Refined Coal (SRC) process, particularly those of environmental interest such as mercury, arsenic, lead, cadmium and selenium. Appropriate neutron activation and atomic absorption spectroscopy techniques of required sensitivity have been developed and applied to SRC process streams to determine concentration, distribution and fate of 34 trace elements. Studies will be continued for different process configuration and coals.
Keywords: COAL LIQUEFACTION; SRC PROCESS; ELEMENTS; TRACE AMOUNTS; ANTIMONY; ARSENIC; CADMIUM; CALCIUM; CHLORINE; CHROMIUM; COPPER; LEAD; MANGANESE; MERCURY; NICKEL; SELENIUM; ACTIVATION ANALYSIS; ABSORPTION SPECTROSCOPY; ENVIRONMENTAL EFFECTS; POLLUTION CONTROL; ENVIRONMENTAL TRANSPORT.

95127 Environmental Monitoring: SRC Pilot Plant. Schmalzer, D.K. (Pittsburg and Midway Coal Mining Co., P.O. Box 2900, Shawnee Mission, KS, 66201). **Contract:** EX-76-C-01-496. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Processing. **Funding:** DOE-$10,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

Baseline studies of air and water quality were performed before the pilot plant was constructed. Studies during plant operation indicate virtually no measurable impact on air and water quality in the surrounding environment. Foliage studies at areas that would receive plant emissions and at control areas indicate no discernable effect upon vegetation. Monitoring studies will continue throughout the period of pilot plant operation.
Keywords: COAL LIQUEFACTION; SRC PROCESS; PILOT PLANTS; ENVIRONMENTAL EFFECTS; MONITORING; CHEMICAL EFFLUENTS; EMISSION.

95128 Monitoring of Trace Components for the Hanna IV In-Situ Gasification Test of the Linked Vertical Well Concept. Magee, R.A. (Radian Corporation, P.O. Box 9948, Austin, TX, 78766). **Project number:** EF-77-C-03-1502. **Contract:** EF-77-C-03-1502. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$30,000; EPA-$100,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This project will monitor the low Btu gas produced during Hanna IV experiment to provide needed control/utilization data. The work will consist of monitoring the low Btu product gas during the full lifetime of the Hanna IV in-situ coal gasification experiment.

The product gas stream will be characterized for particulate matter, trace metals and trace components. These data are essential to design environmental control technology to meet Federal and state emission standards as well as to determine the feasibility of various end-use options. Initial reverse combustion linkage attempts at the Hanna IV experiment began in November 1977, but the presence of unpredicted highly permeable zones caused the link to rise to the top of the coal seam and greatly influenced the quality of the produced gas (very low heating value). Because of these problems, the experiment has been temporarily shut down for evaluation and redesign. Preliminary results have been obtained from the gasification phase monitoring. The monitoring has been discontinued while experimental modifications are underway. Contract and interagency agreement extension/modification requests are underway. When the Hanna IV gasification phase begins (December 1978), the monitoring will be initiated and continued until gasification is terminated.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; LOW BTU GAS; MONITORING; PROCESS CONTROL; PARTICLES; ELEMENTS; TRACE AMOUNTS; ENVIRONMENTAL EFFECTS; COMBUSTION; EMISSION; AIR POLLUTION CONTROL; BOREHOLE LINKING; WYOMING.

95129 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-77-S-03-1761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$111,000; EPA-$111,000. **Related energy source:** fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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. Approaches include short- and long-term (limited chronic) toxicity tests of wastewaters, biodegradation, biotransformation, and bioaccumulation in specific aquatic biota. Comparative evaluation of various process waters and their fractions will be made. Recommendations for surface and subsurface water contamination levels will be made. Recommendations for appropriate water control systems will be made.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; WASTE WATER; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; TOXICITY; BIODEGRADATION; BIOLOGICAL STRESS; WATER POLLUTION CONTROL; RECOMMENDATIONS; CHEMICAL EFFLUENTS; FISHES; GROUND WATER; SURFACE WATERS.

95130 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:** ET-77-S-03-1761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$100,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

95131 Biochemical Studies with Aqueous Effluents Derived from In Situ Fossil Fuel Processing. Nelson, K.F. (University of Wyoming, Rocky Mountain Institute of Energy and Environment, School of Pharmacy, Laramie, WY, 82071). **Project number:** RMIEE TA No. 016. **Contract:** ET-77-S-03-1761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$22,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The objective of this project is to evaluate key biochemical and physiological effects of aqueous effluents derived from in situ fossil fuel processing on different model biological systems. These studies will (1) pursue the development of simple protocols suitable for comparative evaluation of numerous water samples; (2) provide data for interpreting toxicological observations; and (3) provide data useful in predicting effects of environmental exposure in animals (including fish) and humans. The work to date has demonstrated an induction of cytochrome P-450 liver enzyme activity resulting from retort water ingestion by rats. This inductive activity was absent in rainbow trout. The effect on human hepatocyte cultures is currently being evaluated. This work will be extended to the active fraction of retort water.
Keywords: OIL SHALES; IN-SITU RETORTING; ENVIRONMENTAL EFFECTS; WASTE WATER; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; TOXICITY; SAMPLING; ANIMALS; FISHES; MAN; RATS; LIVER; ENZYMES; CYTOCHROMES; INGESTION.

95132 Interactions of Soil Microorganisms with Aqueous Effluents Derived from In Situ Fossil Fuel Processing. Williams, S.E. (University of Wyoming, Rocky Mountain Institute of Energy and Environment, College of Agriculture, Division of Plant Science, Laramie, WY, 82071). **Project number:** RMIEE TA No. 018. **Contract:** ET-77-S-03-1761. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$83,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of this project are: (1) to determine the effects of in situ derived process waters on native soil microorganisms; (2) to determine the effect of soil microorganisms on the constituents in process waters; and (3) to characterize the microbial contents of process waters. The approach is a combination of field and laboratory experimentation. The results will be of value in determining requirements for control technology of process related wastewaters, assessing the effects of catastrophic spillage, development of new organisms for wastewater treatment, and understanding the changes in water constituents during soil migration of release effluents. It has been shown that Standard Methods for bacterial activity are not suitable for characterizing fossil fuel processing waters. Microbiological activity primarily responsible for chemical instability of process waters.
Keywords: FOSSIL FUELS; IN-SITU PROCESSING; GROUND WATER; BACTERIA; MICROORGANISMS; SOILS; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; WASTE WATER; WATER TREATMENT.

95133 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 Research Center. **Funding:** DOE-$25,000.
Related energy source: coal(50); oil shales and tar sands(50). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

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.

95134 Mineralogical and Geochemical Study of the Colorado Oil Shale. Slaughter, M. (Colorado School of Mines, Department of Chemistry and Geochemistry, Golden, CO, 80401). **Project number:** ET-77-S-03-1768. **Contract:** ET-77-S-03-1768. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$62,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective of this project is to quantitatively determine the elemental and mineralogical analyses of oil shale on a microstratigraphic scale. An electron microphage analysis will be used for this purpose. The final report will describe the experiments, results in detail, and interpretation of their geochemical and environmental significance.
Keywords: OIL SHALES; ELECTRON MICROPROBE ANALYSIS; MINERALS; STRATIGRAPHY; GEOCHEMISTRY.

95135 Coal Conversion Technology, Environmental and Control Technology. Lorenzi, L. (Department of Energy, Pittsburgh Energy Technology Center, 4800 Forbes Avenue, Pittsburgh, PA, 15213). **Project number:** 2064. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$150,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives of this program are to evaluate present treatment and control practices at pilot plant facilities and determine future needs for commercialization of these processes by: (1) assessing and evaluating current environmental effects in control technology applications at DOE-owned and sponsored pilot plants; (2) reviewing and documenting state-of-the-art and related alternatives to existing control technology and treatment; (3) providing specific recommendations as to alternative treatment and control application; (4) assessing and evaluating the environmental treatment techniques used in these pilot plants for water and solid waste handling and disposal; (5) evaluating suitability of this control technology at demonstration facilities; and (6) outlining areas of needed research.
Keywords: COAL LIQUEFACTION; COAL GASIFICATION; PILOT PLANTS; ENVIRONMENTAL EFFECTS; US DOE; WASTE WATER; SOLID WASTES; WASTE DISPOSAL; POLLUTION CONTROL; RECOMMENDATIONS; COMMERCIALIZATION; RESEARCH PROGRAMS; CHEMICAL EFFLUENTS.

95136 Environmental Assessment of the HYGAS Process. Anastasia, L.J. (Institute of Gas Technology, 4201 West 36th Street, Chicago, IL, 60632). **Project number:** FE 2433. **Contract:** EX-76-C-01-2433. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Processing. **Funding:** DOE-$263,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of the HYGAS pilot plant Environment Assessment Program is to set up and operate systems for sampling, analysis, and data evaluation which will provide information to: quantify and identify air, water, and solid waste residuals; correlate environmental data with processing conditions to help develop predictive methods for scale-up to larger plants; and participate in data and information exchange with other DOE development programs and other U.S. government contractors.
Keywords: COAL GASIFICATION; HYGAS PROCESS; PILOT PLANTS; ENVIRONMENTAL EFFECTS; SAMPLING; AIR POLLUTION; WASTE WATER; SOLID WASTES; CHEMICAL EFFLUENTS; EMISSION.

95137 Environmental Assessment of Coal Gasification Processes. Massey, M.J.; Luthy, R.G. (Carnegie-Mellon University, 500 Forbes Avenue, Pittsburgh, PA, 15213). **Project number:** FE 2496. **Contract:** EX-76-S-01-2496. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Processing. **Funding:** DOE-$559,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objectives of the work to be done are: to develop an indepth understanding of the potential environmental impact of coal gasification processes; to improve the initial understanding of the relationships between gasifier effluent production and process variables; to assist in the coordination of industrial hygiene sampling and analysis for various gasification plants; and to review and evaluate other aspects of the pilot plant related environmental effort.
Keywords: COAL GASIFICATION PLANTS; PILOT PLANTS; ENVIRONMENTAL IMPACTS; CHEMICAL EFFLUENTS; INDUSTRIAL MEDICINE; EMISSION; ANTIMONY; ARSENIC; SULFUR.

95138 Effluent Inventory and Control Technology Review. Kotowski, J.A. (Science Applications, Inc., 1205 Prospect Street, La Jolla, CA, 92037). **Project number:** 31-109-38-3764. **Contract:** 31-109-38-3764. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$30,000.
Related energy source: coal(20); oil shales and tar sands(80). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

A program is reported that is designed to collect and analyze effluent data from in site tar sands production, in site oil shale production, underground coal gasification, the Anvil Points facility, PON No. 22 facilities, and the Dow facility. Analysis will include the following effluent data review and bibliography definition of uncontrolled effluent levels: review of applicable control techniques; definition of controlled effluent levels; and recommendations for additional work.
Keywords: ANVIL POINTS RESEARCH FACILITY; OIL SHALE DEPOSITS; COAL DEPOSITS; IN-SITU PROCESSING; IN-SITU GASIFICATION; OIL SHALES; COAL GASIFICATION; RECOMMENDATIONS; LIQUID WASTES; SAMPLING; CHEMICAL ANALYSIS; POLLUTION CONTROL; OIL SHALE PROCESSING PLANTS; COAL GASIFICATION PLANTS.

95139 Analysis of Off-Gas Utilization/Control Concepts for an In Situ Oil Shale Report. Kotowski, J.A. (Science Applications, Inc., 1205 Prospect Street, La Jolla, CA, 92037). **Contract:** W-31-109-38-3764. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$90,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

A program is reported that is designed to determine the feasibility of utilization at the off-gases from in situ shale oil production and control of pollutants in the off-gases. This includes characterization of the effluent gases, evaluation of potential utilization of the off-gases, consideration of process parameters which affect off-gas characteristics, a technical and economic evaluation of utilization/control options, a detailed evaluation of feasible options, and a technology development plan for utilization/control at off-gases.
Keywords: OIL SHALES; IN-SITU RETORTING; GASEOUS WASTES; WASTE PRODUCT UTILIZATION; FEASIBILITY STUDIES; CHEMICAL COMPOSITION; POLLUTION CONTROL; TECHNOLOGY ASSESSMENT; ECONOMIC ANALYSIS.

95140 Removal of Ammonia and Alkalinity from Oil Shale Retort Water. Linstedt, K.D. (University of Colorado, Department of Civil, Environmental and Architectural Engineering, Boulder, CO, 80309). **Project number:** EF-77-S-04-4044. **Contract:** EF-77-S-04-4044. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$48,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

A program is reported that is designed to evaluate the weak acid ion exchange systems for removal of ammonium ions and alkalinity from oil shale retort water. Specifically, a variety of weak acid ion exchange resins will be identified which have the capacity to remove ammonium and alkalinity. These resins will be tested for resistance to fouling and regeneration on both bench scale and pilot plant scale.
Keywords: OIL SHALES; RETORTING; WASTE WATER; DEAMINATION; AMMONIA; REMOVAL; ION EXCHANGE.

95141 Stark Sampling Program, Synthane Pilot Plant. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Contract:** EY-76-C-02-4065. **Supported by:** Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Research Center. **Funding:** DOE-$72,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The objectives of this project are: (1) to provide documentation with emission flow rates for the thermal oxidizer; and (2) to provide characterization and quantification of these emissions based on process conditions and coals used.
Keywords: COAL GASIFICATION; SYNTHANE PROCESS; PILOT PLANTS; AIR POLLUTION; MONITORING; EMISSION; SAMPLING.

95142 Hazardous and Other Undesirable Elements and Compounds in Supplementary Gaseous and Liquid Fuels from Coal. Shar-

key, A.G. Jr. (Pittsburgh Energy Research Center, 4800 Forbes Avenue, Pittsburgh, PA, 15213). **Project number:** 7079. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$75,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this project are: to provide data concerning contaminants in process streams and to assist in the design of proper purification procedures for producing environmentally acceptable supplemental fuels. Products from coal gasification and liquefaction including gas, oil, tar, water, and char will be investigated for toxic or hazardous components. Analytical techniques will be developed for determining organic and inorganic constituents. Trace elements that possibly are toxic in the vapor form or produce hazardous compounds will be investigated by spark-source mass spectrometry, neutron activation, atomic absorption, and other techniques. Organic material associated with these streams will be analyzed by high-resolution mass spectrometry, combined gas chromatography--mass spectrometry, and other appropriate spectral techniques. Organic and inorganic contaminants will be evaluated also in terms of standard lists of hazardous compounds such as Threshold Limit Values (American Conference of Government Industrial Hygienists, U.S. Coast Guard List), lists prepared by the National Research Council, the Toxic Substance List published by HEW in 1971, and recent lists of carcinogens released by OSHA.
Keywords: COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; BY-PRODUCTS; TOXIC MATERIALS; HEALTH HAZARDS; ELEMENTS; TRACE AMOUNTS; ACTIVATION ANALYSIS; ABSORPTION SPECTROSCOPY; SPARK MASS SPECTROMETERS; MASS SPECTROSCOPY; GAS CHROMATOGRAPHY; ORGANIC COMPOUNDS; HAZARDOUS MATERIALS; CHEMICAL ANALYSIS; PURIFICATION; CHEMICAL EFFLUENTS.

95143 Environmental Monitoring of Pricetown, West Virginia, In Situ Coal Gasification Field Test. Eli, R.N. (University of West Virginia, Civil Engineering Department, Morgantown, WV). **Project number:** EY-77-C-21-8087. **Contract:** EY-77-C-21-8087. **Supported by:** Department of Energy, Morgantown, WV (USA). Morgantown Energy Research Center. **Funding:** DOE-$75,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

95144 Development of Methodology for Fractionation of Dissolved Organic Constituents in Aqueous Effluents Derived from In Situ Fossil Fuel Processing. Huffman, E.W.D. Jr. (Huffman Laboratories, Inc., P.O. Box 350, Wheat Ridge, CO, 80033). **Project number:** PL73331. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$10,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objective of this project is to devise reproducible schemes for the separation of dissolved constituents in aqueous effluents derived from in situ fossil fuel processing. The scheme should provide sufficient sample for subsequent bioenvironmental and toxicological evaluation, should be hierarchial in its sequence, should take into consideration bioavailability concepts, and should be aligned with separations possible through wastewater treatment options. A method based on the DOC fractionation analysis and resulting in fractionation according to inorganic/organic constituents and subfractionation according to hydrophobic/hydrophilic organics thence acid, base, and neutral types has been developed.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; CHEMICAL EFFLUENTS; FRACTIONATION; HYDROLOGY; ORGANIC COMPOUNDS; WASTE WATER; WATER TREATMENT.

95145 Chemical and Physical Interactions of Soil with Wastewaters Produced by In-Situ Oil Shale Retorting. Leenheer, J.A. (U.S. Geological Survey, Water Resources Division, Denver, CO, 80225). **Project number:** PL73765. **Contract:** PL73765. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$33,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to determine the chemical and physical interactions and effects of (1) soil upon wastewater compositions, and (2) wastewater upon soil compositions. This is a site-specific study using wastewaters, soils, natural waters, and sediments obtained from the LETC Rock Springs experimental in situ oil shale processing facility. The work will be of value in defining the needs for control technology of wastewaters and assessing the consequence of surface spillage or disposal.
Keywords: IN-SITU PROCESSING; OIL SHALE PROCESSING PLANTS; WYOMING; SEDIMENTS; WASTE WATER; CHEMICAL REACTIONS.

95146 Animal Toxicity Evaluation of Waters Derived from In Situ Oil Shale Processing. Larson, K.A. (Elars Bioresearch Laboratories, Inc., P.O. Box 2211, Fort Collins, CO, 80522). **Project number:** PL73778. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$46,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Operational safety; Environmental control technology; Health effects; Ecological/biological processes and effects.

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 will also be used to assess appropriate protocols for further, comparative evaluations of similar type 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 dermal irritation, acute dermal LD-50, acute oral LD-50 in three species, acute intraperitonial LD-50 in three species, sub-acute 90-day feeding, modified dominant lethal teratogenicity, 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.

95147 Organic Solute Transport Study of Wastewaters Produced by In Situ Oil Shale Retorting. Leenheer, J.A. (U.S. Geological Survey, Water Resources Division, Denver, CO, 80225). **Project number:** PL82962. **Contract:** PL82962. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** EPA-$18,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this project is to determine the type and magnitude of the organic solute sorption processes and interactions with consolidated subsurface soils, sediments and aquifers and unconsolidated surface soils as may be associated with the release of in situ-produced wastewaters. This project has fundamental significance with respect to determining the transport, changes in composition and ultimate bioavailability and fate of organic solutes in retort water accidentally, intentionally, or unavoidably released from the in situ oil shale process. Both laboratory and site-specific field monitoring work is in progress. Changes in the composition of waters reentering retort zones have been evaluated. The first chemical speciation of inorganic sulfur compounds was achieved under this contract.
Keywords: OIL SHALES; IN-SITU RETORTING; OIL SHALE PROCESSING PLANTS; WASTE WATER; ORGANIC COMPOUNDS; AQUEOUS SOLUTIONS; SOILS; MONITORING; ADSORPTION; SULFUR COMPOUNDS; INORGANIC COMPOUNDS; SYNTHESIS; SORPTIVE PROPERTIES.

95148 Water Impacts of In Situ Energy. Kerr, B. (Laramie Energy Technology Center, Laramie, WY, 82071). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this project are to determine impacts of underground coal gasification on surrounding groundwater systems; to investigate potential impacts on surface waters; and to develop environmental control strategy. Specifically, the program is designed to: (1) acquire baseline water quality data; (2) collect and analyze samples; (3) determine water quality impacts; and (4) prepare recommendations regarding any mitigating measures that may be necessary for any future underground coal gasification tests.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; GROUND WATER; WATER POLLUTION; SURFACE WATERS; POLLUTION CONTROL; WATER QUALITY; SAMPLING; RECOMMENDATIONS; CHEMICAL EFFLUENTS.

95149 Systems Analysis and Establishment of Design Criteria. Demetriades, S.; Maxwell, C. (57D Research Corporation, P.O. Box C, Arcadia, CA, 91006). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE. **Related energy source:** coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to develop engineering information for designers of MHD generator channels and evaluate the results of development testing; to develop analytical models, computer programs, and display techniques for utilization with data relative to MHD phenomena in MHD channels; and to perform analysis of experimental data and analytical conclusions. A subtask which involves environmental and safety related research is designed to evaluate the environmental impact of MHD power plants. The approach involves research and analysis to obtain engineering data, analytical models and computer programs and information concerning environmental impacts of MHD.

Keywords: MHD POWER PLANTS; MHD GENERATORS; MHD CHANNELS; DESIGN; MATHEMATICAL MODELS; COMPUTER CALCULATIONS; FLOW MODELS; ENVIRONMENTAL IMPACTS.

95150 Coal Gasification Environmental Problems from Trace Metals in By-Products. VanMeter, W. (Montana University, Missoula, MT, 58901). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this project are: to conduct tests to characterize coal gasifier ash and other waste materials with regard to the amounts of topic, water-soluble chemical species they contain and to determine the rates at which they are released by leaching treatments. Representative ash and other waste samples will be obtained from several operating gasification pilot plants. The samples will be leached with distilled and natural ground water, an ammonium acetate solution, and sulfuric acid, using standard column chromatography techniques. The ammonium acetate (an ionic, buffered medium) will cause the release of many ions that are not removed by simple solubility in water, yet it will not mask the subsequent analysis of the toxic species. The sulfuric acid will indicate the amounts of metals that may be released over a long time. A qualitative and quantitative elemental analysis will be performed on the leachates obtained to determine whether or not ground and surface water contamination may result from the interaction of natural forces with the fly ash, slag, and other by-products of coal gasification plants.

Keywords: COAL GASIFICATION; COAL GASIFICATION PLANTS; ASHES; SOLID WASTES; PILOT PLANTS; LEACHING; CHEMICAL ANALYSIS; FLY ASH; SLAGS; BY-PRODUCTS; WASTE WATER; ELEMENTS; TRACE AMOUNTS; ENVIRONMENTAL EFFECTS.

95151 Development Program for MHD Direct Coal-Fired Power Generation Test Facility. Dicks, J.B. (University of Tennessee, Tullahoma Space Institute, Tullahoma, TN, 37388). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives are to design and construct an 8 lb/sec total gas flow direct coal-fired MHD power generator test facility; to design, fabricate, install and test MHD components in the 8 lb/sec facility; and to perform tests in an existing facility to support the design of the 8 lb/sec facility. An existing test facility will be used to develop engineering data for the design of a larger facility and its MHD components. Components will be tested in this larger facility.
Keywords: COAL-FIRED MHD GENERATORS; TEST FACILITIES; DESIGN.

95152 Mechanical Perturbation Studies of MHD Superconducting Magnets. Patrick, N. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60438). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective is to develop basic information on the effect of local mechanical perturbations on the overall cryogenic stability of large superconducting MHD magnets. Analytical and experimental studies of local relative motions of conductors which result in pulsed heating will be related to methods for the design and analysis of winding and support configurations.
Keywords: MHD GENERATORS; SUPERCONDUCTING MAGNETS; DISTURBANCES; SUPERCONDUCTING COILS; SUPPORTS; MOTION; MECHANICAL VIBRATIONS.

95153 Support in Planning and Managing DOE's Superconducting MHD Magnet Development Program. Supported by: Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective is to provide support in planning and managing DOE's superconducting MHD magnet development program.
Keywords: MHD GENERATORS; SUPERCONDUCTING MAGNETS; MANAGEMENT; PLANNING; DESIGN.

95154 Develop Reference Designs for Superconducting MHD Magnets for Both Experimental and Base Local Plants. Detra, R. (Avco-Everett Research Laboratory, 2385 Reverse Beach Parkway, Everett, MA, 02149). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective is to design superconducting magnets for MHD application. Safety considerations are incorporated into the design work.
Keywords: MHD GENERATORS; SUPERCONDUCTING MAGNETS; DESIGN; SAFETY.

95155 CDIF (Computer Development and Integration Facility) Project Management Support and Related MHD Development Effects. Meglen, J.D. (Montana Energy and MHD Research and Development Inst., Inc., P.O. Box 3809, Butte, MT, 59701). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Operational safety.

The objectives are to provide engineering information for use in the design/development of MHD generators and subsystem components and to prepare for the operation and management of the Component Development and Integration Facility. Several subtasks involve environmental and safety related investigations.
Keywords: MHD GENERATORS; TEST FACILITIES; DESIGN; OPERATION; MANAGEMENT; ENVIRONMENTAL IMPACTS; SAFETY.

95156 Study of Coal-Associated Wastes Resulting from Mining, Processing, and Utilization. Leonard, V.W. (West Virginia University, Morgantown, WV, 26506). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives of this project are to: (1) investigate waste by-products associated with conversion and use of coal; (2) characterize by-products physically and chemically; (3) suggest safe disposal methods for these materials; and (4) describe environmental impact. This study, which currently is studying the utilization of waste products from coal conversion plants, consists of the following five tasks: (1) develop Sulphurtain process; (2) examine potential use of acid mine drainage sludge for purification of sewage and waste waters; (3) study use of fly ash for neutralizing strip mine spoil; (4) prepare fired structural materials (bricks and blocks) using coal-fired power plant ashes and sodium; and (5) examine and evaluate underground disposal of coal wastes.
Keywords: COAL MINING; MINERAL WASTES; BY-PRODUCTS; ACID MINE DRAINAGE; SLUDGES; SEWAGE; WASTE WATER; PURIFICATION; SPOIL BANKS; ASHES; BRIQUETTING; BUILDING MATERIALS; WASTE PRODUCT UTILIZATION; WASTE DISPOSAL; ENVIRONMENTAL IMPACTS; FLY ASH; PH VALUE; FABRICATION.

95157 Study of Contaminants in Oil Shale Residuals. Smidt, C. (Denver Research Institute, Denver, CO, 80200). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives are to characterize the contaminants in oil shale residuals and determine the potential for their management to meet environmental quality standards. The approach will include: (1) investigating spent shale characteristics from an environmental standpoint; (2) refining analytical methods for quantitative determination of trace elements in spent shale; (3) conducting solubilization studies of organic trace compounds in the presence of inorganic/soluble organic complexes with trace elements; and (4) establishing a cooperative cofunded effort with EPA, FEA, and NSF.
Keywords: SPENT SHALES; WASTE MANAGEMENT; ENVIRONMENTAL IMPACTS; CHEMICAL ANALYSIS; TRACE AMOUNTS; QUANTITATIVE CHEMICAL ANALYSIS.

95159 Biological Degradation of the Soluble Organic Components in Retort Water. Yen, T.F. (University of Southern California, Los Angeles, CA, 90007). **Contract:** ET-78-S-03-1877. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE.

Related energy source: oil shales and tar sands(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to convert organics in in situ oil shale retorting process water to retrieval products or carbon dioxide by cultivating bacterial cultures in retort water.

Keywords: OIL SHALES; IN-SITU RETORTING; WASTE WATER; WATER TREATMENT; BIOCONVERSION; BIODEGRADATION; CARBON DIOXIDE; BACTERIA; GROWTH; ORGANIC COMPOUNDS.

95160 Laboratory Determination of Leaching Rates from Oil Shale Retorted Under Simulated In Situ Retorting Conditions. Parker, H.W. (Texas Tech University, Lubbock, TX, 79409). **Contract:** EY-76-G-20-4011. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE.

Related energy source: oil shales and tar sands(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to determine the rate of leaching of inorganic salts from oil shale during and after in situ processing by measuring water quality parameters after leaching of oil shale processed under controlled conditions.

Keywords: OIL SHALES; IN-SITU RETORTING; SPENT SHALES; LEACHING; BENCH-SCALE EXPERIMENTS; WATER QUALITY; GROUND WATER; WATER POLLUTION.

95161 Pollutant Control Through Staged Combustion of Pulverized Coal. Wendt, J.O.L. (University of Arizona, Tucson, AZ). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

95162 Fossil Energy Environment and Conservation Concerns. Kerr, R.D. (Laramie Energy Technology Center, Laramie, WY, 82071). **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE.

Related energy source: fossil fuels(100). **R and D categories:** Integrated assessment.

Environmental and conservation concerns are vitally important to fossil energy technology development. In all cases, a concurrent environmental research plan is implemented during the process development phase. The objective of this program is environmental research to address the long-term concerns associated with in situ, modified in situ, and surface processing of fossil fuels.

Keywords: FOSSIL FUELS; IN-SITU PROCESSING; PROCESSING; COAL GASIFICATION; IN-SITU GASIFICATION; OIL SHALES; OIL SANDS; ENVIRONMENTAL IMPACTS; ENERGY CONSERVATION; INFORMATION NEEDS.

95163 Environmental Aspects of In-Situ Oil Shale Processing. Poulson, R.E. (Laramie Energy Technology Center, Laramie, WY, 82071). **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE.

Related energy source: oil shales and tar sands(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

95164 Water Conservation with In-Situ Oil Shale Development. Thomas, J.F. (University of California, East End of Hearst Avenue, Berkeley, CA, 94720). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.

Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

This work will identify the effect of in situ oil shale processing on the water resources of the Upper Colorado River Basin. The work will identify both impacts and mitigating measures using a two-stage process consisting of planning and laboratory measurements. By identifying these impacts and developing control strategies and management plans before development of a commercial industry, the disruption of the oil shale region can be minimized. The potential impact of in situ oil shale processing on the water resources of the Upper Colorado River Basin is primarily related to two factors: water use characteristics of the technology, and the surface water and groundwater hydrology in the vicinity of the oil shale deposits. Some specific problems related to each of these two broad areas include the contamination of underground waters as a consequence of groundwater flow through abandoned in situ retorts and the disposal of effluents produced during oil shale retorting. The accomplishments of research directed at these specific problems are as follows: (1) the effect of retort operating conditions on the chemical composition of retort waters was investigated; (2) the partitioning of some 50 major and minor elements, between the spent oil shale, shale oil, retort water, and offgas was studied; (3) continuous flow and batch laboratory studies were conducted to determine the quantity and type of organics leached from spent shale; (4) biological treatability studies of retort water were completed; and (5) a hydraulic model of the aquifer system connected by in situ retorts was developed and used to predict flow conditions through abandoned in situ retorts.

Keywords: OIL SHALES; IN-SITU RETORTING; LIQUID WASTES; WATER POLLUTION; SURFACE WATERS; GROUND WATER; HYDROLOGY; COLORADO RIVER BASIN; WATER QUALITY; ENVIRONMENTAL IMPACTS.

95165 Groundwater Chemical Changes During In Situ Oil Shale Retorting. Kloepper, D.L. (Engineering Enterprises, Inc., Golden, CO, 80401). **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center; Colorado School of Mines, Golden (USA). Research Inst. **Funding:** EPA-$239,000; CSMRI-$9,000.

Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to model the environmental transport and fate of the solutes released to surface and subsurface waters. The work involves the gathering of pre-retorting hydrologic, water quality, and mineralogic data for use in predicting changes in groundwater quality as a result of the in situ retorting process. The principal objectives of the data analysis to be obtained are to: (1) determine the continuity of the lithology of the oil shale; (2) reduce the data pertaining to the mineralogy of the strata to a manageable and logical form; (3) define and attempt to quantify the mineralogical parameters that would most likely influence the composition of the groundwater; and (4) define the composition of the organic part of the oil shale so that an estimate may be made as to the possible readsorption of inorganic and organic groups which would be liberated after retorting.

Keywords: OIL SHALES; IN-SITU RETORTING; WATER POLLUTION; SURFACE WATERS; GROUND WATER; ENVIRONMENTAL TRANSPORT; LITHOLOGY; MINERALOGY; HYDROLOGY; WATER QUALITY.

95166 Water Quality Data Storage and Analysis. Pelton, V. (University of Wyoming, Water Resources Research Institute, Laramie, WY, 82071). **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$6,000.

Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This project will computerize water quality data from oil shale 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.

95167 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:** EW-78-C-20-0018. **Supported by:** Department of Energy, Laramie, WY (USA). Laramie Energy Research Center. **Funding:** DOE-$74,000.

Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and

monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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. The entire design treatments will bc placed in appropriate sequence.

Keywords: IN-SITU PROCESSING; WASTE WATER; WATER TREATMENT; OXIDATION; AEROBIC CONDITIONS; BIOCONVERSION; ECONOMICS; WATER QUALITY; PH VALUE; AMMONIA; TOXICITY; OIL SHALES; COAL GASIFICATION; BIOMASS; GROUND WATER; MICROORGANISMS.

95168 Westinghouse ETF (Engineering Test Facility). Supported by: Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective is to develop MHD ETF design criteria.

Keywords: MHD GENERATORS; DESIGN.

95169 MHD High Performance Demonstration Experiment. Garrison, G.W. (Arnold Engineering Development Center, Arnold AFS, TN, 37384). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective is to demonstrate MHD generator performance efficiency of 20 percent enthalpy extraction with greater than 60 percent turbine efficiency. Several subsystems could involve safety related considerations. Components of a high performance demonstration facility will be assembled and tested.

Keywords: MHD GENERATORS; THERMAL EFFICIENCY; PERFORMANCE TESTING; TEST FACILITIES; DEMONSTRATION PROGRAMS.

95170 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). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

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.

95171 Water Treatment in Demonstration Plants. (Water Purification Associates, Cambridge, MA). **Contract:** EF-77-C-01-2635. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

Plants converting coal to other fuels can consume large amounts of water, both as a source of hydrogen and to be evaporated for cooling. Furthermore, most of these plants take in water of good quality for treatment to boiler feed or for use as circulating cooling water and put out highly contaminated water, which condenses out of process streams. To avoid pollution and to minimize net consumption of good quality water, it is necessary that effluent waters be treated for reuse within the plant. Six specific conceptual designs of integrated water treatment plants will be made, and it will be shown how the various water treatment plants can be operated, on a demonstration plant size, so as to gather information for improved designs when commercial-size plants are built. Whereas designs will be provided using the best-known standard technology, additional designs will also be made using novel and innovative technolgies. If the return can be shown to be adequate, specific research in these technologies will be recommended.

Keywords: COAL PREPARATION PLANTS; COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; WASTE WATER; WATER TREATMENT; WATER TREATMENT PLANTS; DESIGN; DEMONSTRATION PLANTS; LIQUID WASTES; BIOCHEMISTRY; PHENOLS; WATER QUALITY.

95172 Hot Gas Cleanup. Supported by: Department of Energy, Morgantown, WV (USA). Morgantown Energy Research Center. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

A project is reported that is devoted to establishing the hazardous and corrosive substances and their mechanisms in the effluent of thermally subjected coal. The program will deal with the treatment or removal of the undesirable materials from hot effluent while maintaining the sensible heat to increase thermal efficiency of its utilization. Undesirable materials being considered relative to end-use applications include H2S, SOx, NOx, alkali, halogens, tars, particulates, and organics. A task force on hot gas cleanup has reviewed the potential applications and advantages of hot gas cleanup for contaminant control in low-Btu gasification and fluidized-bed combustion cycles. Research needs to support the development and selection of cleanup techniques for end uses of those technologies were assessed. The final report of this task force reviewed the chemical basis of some control technologies, and identified some research required for the development of process stream contaminant conditioning and removal techniques. equilibrium concentrations of coal gasification and combustion product gases determined by free energy minimization of feed elements were also reported. The kinetics of iron oxide sulfidation was compared in a report on the rate of sulfidation of various metal oxide systems. Iron oxide, while rate limited for sufficiently small pellet sizes, absorbs H2S 10 to 100 times faster than observed at diffusion limits for other sorbent oxides.

Keywords: COAL GASIFICATION PLANTS; COAL; COMBUSTION PRODUCTS; FLUE GAS; GASEOUS WASTES; HYDROGEN SULFIDES; SULFUR OXIDES; NITROGEN OXIDES; HALOGENS; TAR; PARTICLES; ORGANIC COMPOUNDS; REMOVAL; POLLUTION CONTROL; FOSSIL-FUEL POWER PLANTS.

95173 Sulfur Emission Control for Lignite and Subbituminous Coal Combustion. Supported by: Department of Energy, Grand Forks, ND (USA). Grand Forks Energy Research Center. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

Work is reported on development of alternative methods for control of SOx emissions from the burning of low-sulfur lignite and Western subbituminous coals, and further, to reduce cost, improve reliability, increase removal efficiencies, and improve the characteristics of wastes to alleviate disposal problems. Although most Western coals are low in sulfur content, few can be burned without SOx emission controls under the present Federal New Source Performance Standards (NSPS) and anticipated revisions will require control for all coals. Wet scrubbing with lime or limestone slurries is costly and somewhat unreliable. Scrubber tests using alkaline fly ash are carried out in a 130-scf/m laboratory wet scrubber at GFERC and a 5000-acf/m pilot scrubber at the Square Butte Electric Cooperative Plant at Center, North Dakota. SOx removals of up to 95 percent have been achieved in the laboratory under favorable conditions of low sulfur content and high alkalinity. In addition, laboratory tests are conducted on the physical properties and solution chemistry of fly ash and scrubber sludge to assess potential disposal problems. Testing on the 5000-acf/m scrubber was successfully completed, and a commercial scrubber was constructed by the Square Butte Electric Cooperative for a new 450-Mw cyclone boiler fired on North Dakota lignite. SOx removals of up to 85 percent were attained using only fly ash at a typical coal sulfur content of 0.8 percent; under worst conditions of 1.3-percent coal sulfur content, supplementary lime was required to reduce emissions to NSPS levels.

Keywords: LIGNITE; SUBBITUMINOUS COAL; COMBUSTION PRODUCTS; FLUE GAS; SCRUBBING; FLY ASH; BENCH-SCALE EXPERIMENTS; SULFUR OXIDES; REMOVAL; SORPTIVE PROPERTIES; DESULFURIZATION.

95174 Environmental Aspects of Enhanced Oil Recovery. Supported by: Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center. **Funding:** DOE.
Related energy source: oil and gas(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

A project is reported that is designed to determine the magnitude and duration of environmental damage that might possibly result from the injection of enhanced oil recovery chemicals into oil-bearing geologic formations. The specific objectives are to: deter-

mine the rates of migration of EOR compounds in the oil reservoir, establish the products of the natural degradation of EOR compounds in the subsurface environment, and determine the adsorption and chromatographic properties of EOR compounds at subsurface conditions of temperature and pressure. Computer programs to process laboratory data on dispersion (for determination of the coefficient of linear dispersion of miscible fluids in porous media) and for chromatographic transport, assuming equilibrium Langmuir adsorption isotherms apply, have been prepared, and experiments have begun. A third program for analysis of non-equilibrium rate-controlled chromatography is about 75 percent complete.
Keywords: PETROLEUM DEPOSITS; ENVIRONMENTAL EFFECTS; ADSORPTION; CHROMATOGRAPHY; MISCIBLE-PHASE DISPLACEMENT; OIL WELLS; WELL STIMULATION; ENHANCED RECOVERY.

95175 Waste Oil Recycling. Supported by: Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center. **Funding:** DOE.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

Research is reported that is conducted to develop and evaluate new or modified technology for reclaiming used lubricating oils, obtain compositional data on lubricating oil basestocks and/or feedstocks as a basis for upgrading reclaiming technology, demonstrate technical and economic feasibility of the process found most promising, extend successful technology to the reclamation of selected industrial oils, and develop useful roles for byproducts derived from these processes. Advanced technology for efficient, economical, and clean re-refining of used automotive lubricating oils is required to stimulate the re-refining industry, thereby conserving natural petroleum resources and reducing environmental pollution. Present work includes the processing of 1000 gallons of used oil by the BERC-developed technology; a detailed study to investigate engineering parameters related to design considerations for a large-scale demonstration plant; and the first phase of a closed-loop composition study which is nearing completion.
Keywords: WASTE OILS; RECYCLING; TECHNOLOGY ASSESSMENT; ECONOMICS; FEASIBILITY STUDIES; DEMONSTRATION PLANTS; PLANNING.

95176 Hot Gas Desulfurization. Schrodt, J.T. (University of Kentucky, Lexington, KY). **Contract:** EY-76-S-05-5076. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

This project seeks to develop and critically evaluate a high-temperature coal-derived fuel gas desulfurization process that utilizes gasifier coal ashes as sulfur sorbents. Efforts are focused on gathering bench-scale sorption data and formulating models suitable for the preliminary design and analysis of both fixed- and fluid-bed systems. A comparison of high- and low-temperature fuel gas usage in combined-cycle gas turbine and steam-boiler power plants indicates higher efficiencies can be achieved using hot fuels. Gasifier technology has progressed to the stage of full development and demonstration; however, high-temperature fuel gas desulfurization remains an area requiring further research and development. The hot ash process effectively removes hydrogen sulfide and carbonyl sulfide from coal-derived fuel gases at gasifier exit temperatures and pressures by utilizing hot, waste ashes from coal gasifiers.
Keywords: HOT GAS CLEANUP; DESULFURIZATION; FUEL GAS; COAL GASIFICATION; SORPTION; FLUIDIZED BED; PACKED BED; GAS TURBINES; BOILERS; GAS GENERATORS; HYDROGEN SULFIDES; CARBON OXYSULFIDE; ASHES; REGENERATION; MATHEMATICAL MODELS; REMOVAL; SAMPLING.

95177 Environmental Impacts: Water-Related Site and Plant Design Criteria. (Water Purification Associates, Cambridge, MA). **Contract:** EX-76-C-01-2445. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The feasibility of siting specific coal conversion plants in the coal bearing regions of the United States as a function of the local environmental impacts that can be expected from water-related site, process, and plant design criteria is being determined. The work involves detailed studies of 40 to 50 plant-site combinations in the central and eastern coal bearing regions, and 40 to 50 plant-site combinations in the western coal-bearing regions. The general site and process criteria expected to be derived are: range of water requirements and the conditions for narrowing the range and optimizing the use of water; ranges of residual solid wastes and drainage runoffs, their quantity and nature, and the conditions for narrowing the ranges and minimizing the disposal and drainage problems; localities where local water-related environment impacts are large, moderate, or small; localities where some processes are more suitable than others to minimize local water-related environmental impacts; and rank-ordering in importance of the site and process criteria themselves in estimating local environmental impacts at individual sites.
Keywords: COAL GASIFICATION PLANTS; ENVIRONMENTAL IMPACTS; SITE SELECTION; WATER RESOURCES; DESIGN; WATER REQUIREMENTS; SOLID WASTES; COAL LIQUEFACTION PLANTS; COAL PREPARATION PLANTS; ENERGY BALANCE; ECONOMICS; HYGAS PROCESS; BI-GAS PROCESS; LURGI PROCESS; SYNTHANE PROCESS; SYNTHOIL PROCESS; SRC PROCESS; GROUND WATER; SURFACE WATERS; RISK ASSESSMENT.

95178 Leaching Rates from Retorted Oil Shale. (Texas Tech University, Lubbock, TX). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$76,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Research is reported that is devoted to determining the dominate mechanisms by which groundwater may leach in situ retorted oil shale. These investigations will assist in determining the possible environmental impact of in situ oil shale retorting and suggest means for minimizing this impact. Samples of oil shale and groundwater are taken from specific sites so that the site specific implications of the research may be also considered. It has been demonstrated that groundwater leaching of oil shale continues for indefinite periods of time, presumably controlled by slow mineralogical reactions, in the resulting high pH leachates. For these tests the Colorado oil shale was retorted for 30 hours at 780 degrees C, then leached with groundwater for up to 700 hours. The resulting pH during leaching was 12. Saturating the retorted oil shale with groundwater 55 days prior to leaching failed to significantly reduce leaching rates. X-ray diffraction studies demonstrated that analcite was destroyed and that decomposition of dolomite to calcite and periclase was the dominant carbonate reaction during retorting at 780 and 630 degrees C. Sufficient other minerals were decomposed to cause the high pH leachate, since brucite has a negligible solubility at pH 12. Leaching experiments with Utah oil shale and groundwater are in progress.
Keywords: OIL SHALES; IN-SITU RETORTING; GROUND WATER; LEACHING; ENVIRONMENTAL IMPACTS; BENCH-SCALE EXPERIMENTS; SOLVENT PROPERTIES; PH VALUE; DOLOMITE; DECOMPOSITION; TIME DEPENDENCE.

95179 Clean Solid and Liquid Fuels from Coal. Gary, J.H.; Golden, J.O. (Colorado School of Mines, Golden, CO). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

This contract investigates processing of coal to clean solid and/or liquid fuels. Research is being carried out in five different areas: (1) kinetics and mechanism of coal hydrodesulfurization and liquefaction during dissolution in a bath reactor; (2) development of a disposable shift reaction catalyst for the CO-steam coal liquefaction system; (3) screening of conventional petroleum catalysts for hydrodenitrogenation of a coal-derived liquid; (4) reactor configuration and kinetic studies for coal liquefaction/hydrodesulfurization in a continuous-flow pilot plant; and (5) analytical studies aimed at improving techniques for analysis of coal liquefaction products and heteroatom content of reactants and products.
Keywords: COAL LIQUEFACTION; CHEMICAL REACTION KINETICS; DESULFURIZATION; DENITRIFICATION; CATALYSTS; CHEMICAL REACTORS; COAL LIQUIDS; CHEMICAL COMPOSITION; HYDROGENATION; COAL; SCREENING.

95180 Environmental Effects from Leaching of Coal Conversion Byproducts. Van Meter, W.P.; Erickson, D.E. (University of Montana, Missoula, MT). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

Most of the trace mineral content of coal will remain with the solid residues or byproducts of a gasification facility. Surface landfill or strip-mine backfill are among the more attractive disposal options for this material. Either would subject the material to probable percolation or infusion by precipitation or groundwater. This project will study solid byproducts from existing pilot plant or full-scale facilities by column leaching methods with the purpose of determining whether potentially hazardous amounts of toxic elements may be leached into ground or surface water. This information will provide a basis for decisions concerning the ultimate disposal of wastes from coal conversion plants.
Keywords: COAL GASIFICATION PLANTS; SOLID WASTES; WASTE DISPOSAL; LEACHING; GROUND WATER; SUR-

FACE WATERS; WATER POLLUTION; TRACE AMOUNTS; ELEMENTS; MANGANESE; NICKEL; MERCURY.

95181 Occupational Health Problems in Fossil Energy Development. (Flow Research, Inc., Kent, WA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

Technical assistance is being provided to assure that possible health and safety problems associated with innovative fossil fuel technologies are identified and dealt with. Pilot plant programs and activities were reviewed. Available literature and data were reviewed to assess the toxic, carcinogenic, and other hazardous components for which standards or data exist. Site visits were made to energy research centers and pilot plants. The results will be used to recommend approaches to occupational health. A manual workbook for health and safety matters in fossil energy plants is being prepared. Investigation of existing occupational health and safety activities has included acquisition of published and unpublished materials, development and distribution of a questionnaire, and site visits. Two reports have been submitted. One report concludes that existing programs tend to stress safety more than health and to emphasize compliance and control of hazards. Consequently, most health and safety data currently available are not ideal for epidemiological surveillance. The other report describes possible methods of linking data, of follow-up for mortality studies, and of constructing work histories or exposure data. In the second phase, methods for epidemiological linkage of data were developed. The specific problems of linking morbidity indicators with work or exposure patterns were addressed. It was found that potential health problems could be categorized into three causal types: general industrial, coal related, or associated with high-temperature and high-pressure processes. Each hazard level was related to levels of program control in four main health and safety activities. From this, recommendations were developed for recordkeeping, for health and medical programs, and for industrial hygiene practices. A detailed outline for a health and safety workbook has been submitted.
Keywords: FOSSIL FUELS; ENERGY SOURCE DEVELOPMENT; HEALTH HAZARDS.

95182 Treatment of Phenolic Wastewater with Anaerobic-Activated Carbon Filters. Suidan, M.T. (Georgia Institute of Technology, Atlanta, GA). **Contract:** EF-77-G-01-2756. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This research involves the development of an advanced wastewater treatment system capable of handling high strength phenolic wastewater and consisting of an anaerobic biological filter using activated carbon as a contact media. Phenols are present in appreciable concentrations in the liquid wastes generated by the coal gasification industry. The high and continuously fluctuating concentration of phenol renders the treatment of such wastewaters by conventional methods unreliable and unstable. The proposed process tends to stabilize the treatment system by the presence of activated carbon which acts as a buffer to store excessive concentrations of phenol and to release them back to the solution when the influent concentration decreases. The proposed process also produces methane rich gaseous products which could be utilized as an energy source within the plant. Activities were centered around ordering equipment and materials and preparing shop drawings from construction of the experimental apparatus.
Keywords: COAL GASIFICATION; WASTE WATER; PURIFICATION; ACTIVATED CARBON; FILTERS; PHENOLS; REMOVAL; ANAEROBIC CONDITIONS; WATER TREATMENT; SAMPLING.

95183 Desulfurization with Transition Metal Catalysts. Bisch, J.J. (State University of New York at Binghamton, Binghamton, NY). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

This study evaluates the mechanism and efficiency of novel, homogeneous, transition-metal desulfurizing agents for organosulfur compounds. Because the molecular structures present in native coal contain organosulfur subunits, efficient, homogeneous desulfurizing agents may be useful in studies of the structure of coal itself. Moreover, these same agents, if active catalytically, would be valuable in freeing fuels or organic chemicals obtained by coal pyrolysis from the contaminating organosulfur components.
Keywords: FOSSIL-FUEL POWER PLANTS; FLUE GAS; DESULFURIZATION; NICKEL COMPLEXES; CATALYTIC EFFECTS; ORGANOMETALLIC COMPOUNDS; COAL LIQUIDS; ORGANIC SULFUR COMPOUNDS; HETEROCYCLIC COMPOUNDS; CHEMICAL REACTION KINETICS.

95184 Ash Removal from Coal Derived Liquids. Henry, J.D. Jr. (West Virginia University, Morgantown, WV). **Contract:** EY-76-S-05-5105. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

A process will be investigated which involves the extraction of hydrophobic coated mineral matter from a coal-derived liquid to an aqueous phase or collection of the mineral matter at the interface between the processes such as filtration and centrifugation to remove mineral matter from coal derived liquids.
Keywords: COAL LIQUIDS; DEASHING; ASHES; WET ASHING; SURFACTANTS; SOLVENT EXTRACTION; FILTRATION; CENTRIFUGATION; COALESCENCE; REMOVAL.

95185 Particulate Removal by Self-Agglomeration in a Cyclone. Tsao, K.C. (University of Wisconsin at Milwaukee, Milwaukee, WI). **Contract:** EF-77-G-01-2753. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

This program studies high-temperature and/or high-pressure particulate removal through a multi-inlet, multi-pass cyclone with in situ combustion for potential application in a combined gas-steam turbine cycle operating jointly with a pressurized fluidized-bed power plant. Other objectives are to conduct an experimental test on the proposed new particulate removal mechanism, to emphasize the practicability of the hardware design, and to verify the technical and economical feasbility on future utilization.
Keywords: CYCLONE SEPARATORS; MATHEMATICAL MODELS; COMBINED-CYCLE POWER PLANTS; FLUIDIZED-BED COMBUSTION; FLY ASH; REMOVAL.

95186 Environmental Support Services: Synthane Pilot Plant. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects.

The Synthane pilot plant program provides support services in development, management, and review of environmental criteria applicable to Synthane pilot plant operations to insure environmentally acceptable operations. These environmental support activities incorporate five major areas: air monitoring, water monitoring, solid waste evaluation, noise assessment, and occupational health activities. A six-month ambient air monitoring study was begun in August 1976 as a follow-up to an earlier study. In addition, a meteorological station was established to determine the most appropriate locations for ambient air monitoring trailers. Two ambient air monitoring trailers are situated to capture airborne emissions from the Synthane pilot plant. Source sampling of the thermal oxidizer was conducted to determine compliance with air pollution regulations as well as to assist in the construction of a dispersion model for the site.
Keywords: SYNTHANE PROCESS; PILOT PLANTS; AIR POLLUTION; WATER POLLUTION; NOISE POLLUTION; AIR POLLUTION MONITORS; MONITORING; OPERATION.

95187 High-Temperature Fuel Gas Cleaning and Sulfur Removal with Molten Salts. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

This program will develop a molten salt scrubbing process for cleaning low-Btu gas by the removal of sulfur compounds and particles. Operating at temperatures in the range of 1100 to 1500 degrees F, the process wil conserve sensible heat to maximize overall efficiency of the combined cycle while meeting gas turbine inlet gas quality requirements. The work is presently concerned with operation of a Process Development Unit for a period sufficient to develop process parameters and to evaluate equipment components. The combined cycle entails gasification of coal to produce low-Btu gas, hot gas cleaning, and electrical power generation by clean gas combustion and expansion through a gas turbine. Turbine exhaust gases are used to raise steam in a waste heat boiler to power a steam turbine. This combination of gas and steam cycles is a potentially more efficient method for power generation than direct combustion of coal in a conventional steam plant. The Pacific Northwest Laboratories (PNL) hot gas cleaning step preserves the sensible heat in the fuel gas and may provide additional fuel values as a result of pyrolysis of tars and oils. Previous work at the PDU scale of operation in a batch mode confirmed the ability of a venturi scrubber to achieve efficient sulfur compound removal and to circulate salt without the use of a mechanical pump. Sulfur removal efficiency ranged from 95 to 99 percent with overall sulfur removal being limited by COS which was inefficiently extracted due to the very short residence time in the single stage venturi-de-entrainer contac-

tor. Particle removal efficiency closely approached turbine gas specifications and salt carryover was low.
Keywords: FUEL GAS; FLUE GAS; DESULFURIZATION; CLEANING; HOT GAS CLEANUP; MOLTEN SALTS; LOW BTU GAS; IIIGH TEMPERATURE; PROCESS DEVELOPMENT UNITS; COAL GASIFICATION; COMBINED-CYCLE POWER PLANTS; SULFUR COMPOUNDS; REMOVAL; SCRUBBERS; EFFICIENCY; PARTICLES.

95188 Degradation of Organic Components in Retort Water. (University of Southern California, Los Angeles, CA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$90,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

Oil shale retort water from simulated in-situ processes is loaded with soluble materials and therefore presents serious disposal and purification problems. An investigation is reported which will provide a practical and economical method of minimizing environmental impairment and reclaiming the water from the oil shale retorting process. Studies are to be conducted on biological and electrolytic treatments for degrading soluble organics by employing different strains of bacteria and for recovering other economically valuable materials by applying various currents or voltages. Studies of aerobic-activated sludge treatment showed that the reductions of chemical oxygen demand (COD) in filtered retort water ranged from 37 to 43% at concentrations between 100 (undiluted) and 20% (diluted) of retort water. Most of the reduction was achieved during the first 3 days. The aerobic treatment of retort water with mutant species (Phenobac and Polybac) indicated that after 21 days the total organic carbon (TOC) reduction for samples with sludge was 50 to 55% and 45% for those without sludge. The results of utilizing a rotating biological contactor (RBC) or biodisc for retort water treatment showed that a total of 20 to 45% of TOC reduction was obtained from a concentration of 10 to 80% of retort water. The results of acclimation of bioflocculant Desulfovibrio to utilize the soluble organics indicated good and promising growth up to 40% in retort water.
Keywords: OIL SHALES; IN-SITU RETORTING; LIQUID WASTES; WASTE WATER; ELECTROCHEMISTRY; ORGANIC COMPOUNDS; DECOMPOSITION; BIODEGRADATION; SLUDGES; AEROBIC DIGESTION; CHEMICAL OXYGEN DEMAND.

95189 Environmental Guidelines for Fossil Energy Sites. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment.

Environmental guidelines are being developed and criteria reviewed for site evaluation, analysis, and selection for coal conversion processes. The guidelines, developed as a function of the technology, would highlight the significant environmental impacts and resource needs of one process versus another, based on specific site conditions. Detailed project planning efforts were completed, which resulted in the preparation of an expanded work plan for future contractor efforts. Reviews of RFP submissions indicated that the proposals were funded into two categories: those with high levels of understanding of the coal conversion and utilization technologies and low levels of knowledge in the socioeconomic areas and vice versa. Selection and finalization of the contracts occurred in September. Subsequent monthly meetings with the contractors have produced draft chapters of the guidelines document.
Keywords: COAL; IN-SITU PROCESSING; COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; ENVIRONMENTAL IMPACTS; RECOMMENDATIONS; SITE PREPARATION; SITE SELECTION; ENVIRONMENTAL POLICY.

95190 Coal Conversion Process Wastes: Environmentally Acceptable Disposal. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Environmentally sound waste-disposal procedures are being developed for bench, PDU, and pilot-scale coal conversion process wastes. Based on these procedures, potential waste-handling problems and solutions for large-scale or commercial facilities will be identified. Work has been initiated to obtain qualitative and quantitative data to characterize liquid and solid wastes generated at the PERC site from ongoing coal conversion process research. The characterizations include physical, chemical, and toxicological properties and/or expected disposal alternatives. Bench-scale apparatus has been assembled to develop a preliminary experimental protocol to determine the leaching potential of solid residuals.
Keywords: COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; WASTE PROCESSING; SOLID WASTES; LIQUID WASTES; WASTE DISPOSAL; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; TOXICITY; ENVIRONMENTAL POLICY.

95191 Coal Conversion Environment and Control. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

A project is reported that is devoted to evaluating developing coal conversion processes with respect to their environmental impacts and assessing the applicability of control methods for achievement of environmental goals. Areas will be identified where additional data are required to assess the applicability of control technology and preliminary cost comparisons will be established between appropriate alternative control methods. Literature studies have been conducted to determine the available base of information on the characteristics of discharge streams, especially water streams, in coal conversion processes. Both first-generation and advanced coal-gasification/liquefaction processes have been considered. Performance characteristics of control equipment applied to coal conversion process streams with contaminated streams from other energy industries have been performed. A plan for the development of data from an existing commercial coal-gasification facility has been developed. Visitation to the site was completed, and arrangements are being made to follow up with experimental studies. The capabilities of university organizations to provide support to this project have been reviewed and evaluated. This fixed-bed, low-Btu gasification facility should pose a most severe treatment problem.
Keywords: COAL GASIFICATION PLANTS; COAL LIQUEFACTION PLANTS; LIQUID WASTES; GASEOUS WASTES; POLLUTION CONTROL; ENVIRONMENTAL IMPACTS; EVALUATION.

95192 Energy Conservation in Coal Conversion. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$150,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

A project is reported that is devoted to developing an energy requirement survey methodology for coal conversion processes to identify and document energy conservation opportunities and to provide guidelines for selection, analysis, and implementation of energy conservation techniques. The efficiencies of several first- and second-generation commercial-sized coal-gasification reactors were calculated and the results presented at the International Conference on Energy Use Management, October 1977. The first-law thermodynamics efficiency (enthalpy balance), second-law efficiency (effectiveness), and cold-gas efficiency (chemical energy content of gaseous products) were developed as an improved procedure for making industrial process (coal conversion/utilization) energy requirement audits and surveys. Incorporating both first- and second-law concepts, DEA identifies, documents, and assesses the quantity (enthalpy) and quality (availability) of energy used in the processes. The DEA concept was also presented at the International Conference. A Special Research Support Agreement (SRSA) between FERC and Carnegie-Mellon University was carried out to explore the potential for energy conservation in the C.F. Braun conceptual commercial Synthane process.
Keywords: COAL GASIFICATION PLANTS; THERMODYNAMICS; RECOMMENDATIONS; ENERGY CONSERVATION; EFFICIENCY; ENTHALPY; AVAILABILITY.

95193 Environment and Energy Conservation Support Services. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE-$100,000.
Related energy source: fossil fuels(100). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

Support in the areas of environment and energy conservation is being provided with emphasis on document preparation and review of these programs. Support services have included providing essential support services for data review; providing assistance in planning and implementing the FE program; coordinating activities between Headquarters and the field offices; participating on the Source Selection Board for the selection of a proposal for the development and application of a methodology for monitoring social and economic impacts of demonstration projects; participating on the Fossil Energy Environmental Advisory Board for PON-8, Coal Liquids Refinery Facility; and reviewing and evaluating various FE program documents (generated within DOE as well as other Federal agencies) such as Program Approval Documents (PADs), Environmental Developmental Plans (EDPs), environmental assessments

(coal programmatic), annual reports, speciality reports, proposed programs, and general proposals.
Keywords: US DOE; FOSSIL-FUEL POWER PLANTS; ENERGY CONSERVATION; ENVIRONMENTAL POLICY; SOCIAL IMPACT; ECONOMIC IMPACT; MANAGEMENT; COAL LIQUEFACTION PLANTS; MEASURING METHODS; POLLUTION CONTROL.

95194 Wastewater Study of PERC. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

Variations of wastewater flow rates and pollution constituents from the PERC site will be qualified, and alternatives will be developed for sound wastewater disposal practices for PERC stormwaters based on the data collected. A wastewater analysis program has recently been implemented to analyze and quantify wastewater outflow from the PERC site into the main outfall pipe, which carries similar stormwater from the Bureau of Mines and Mining Enforcement and Safety Administration (MESA), into Lick Run. The entire site discharge is subject to the regulations of an NPDES permit granted by the EPA. A preliminary evaluation of PERC stormwater flows and quantitative determinations of pollution potential is necessary to assess the existence of environmental problems and to suggest viable alternatives for their resolution. The sample technique consisted of selected 5-day periods during which round-the-clock sampling was conducted. The samples collected were analyzed for key organic and inorganic pollutants by both chemical and instrumental techniques.
Keywords: US DOE; PITTSBURGH; RESEARCH PROGRAMS; ENERGY FACILITIES; WASTE WATER; WATER POLLUTION; CHEMICAL ANALYSIS; PITTSBURG ENERGY TECHNOLOGY CENTER.

95195 Environmental Assessment of the PERC Site. (Pittsburgh Energy Research Center, Pittsburgh, PA, 15213). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

An environmental assessment program is reported for analyzing and quantifying the nature of waste materials emitted into the environment by the PERC facilities and will recommend procedures for control where required. A room-by-room survey is currently being carried out at PERC to: identify the use of occupationally and environmentally harmful substances (types, quantities, and manner of use will be determined); estimate the quantities of the various types of pollutants released into the environment (via product, air, wastewater, and solid waters); identify occupationally and/or environmentally harmful practices in handling and disposal of various waste products; and evaluate and propose alternative handling and disposal techniques for the generated wastes. The information is being collected through interviews with personnel and their supervisors, reviewing past purchase orders and requisitions, materials inventory, and inspection of working practices. After analysis of these data, handling and disposal methods will be proposed.
Keywords: US DOE; PITTSBURGH; RESEARCH PROGRAMS; ENERGY FACILITIES; GASEOUS WASTES; LIQUID WASTES; MONITORING; AIR POLLUTION; WATER POLLUTION; ENVIRONMENTAL EFFECTS; EVALUATION; PITTSBURG ENERGY TECHNOLOGY CENTER.

95196 Formation of NOx and Other Products from Chemically Bound Nitrogen. (Exxon Research and Engineering Company, Linden, NJ). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

95197 Flyash Removal by Electrostatic Precipitation. Supported by: Department of Energy, Grand Forks, ND (USA). Grand Forks Energy Research Center. **Funding:** DOE-$330,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

Research is reported that is devoted to developing a reliable basis for designing and sizing Electrostatic Precipitators (ESPs) for high-resistivity Western coals, based on data that can be obtained from laboratory procedures performed on relatively small samples of coal derived from core drilling. New methods of fly ash conditioning will also be investigated. No satisfactory basis now exists for sizing ESPs for high-resistivity fly ash, other than the practice of a wide margin of overdesign, which has resulted in unnecessary cost and inadequate control. Another objective is to determine, characterize, and develop control measures for fine particulate generated during the combustion of lignite and Western subbituminous coals. Construction of a new pilot-scale ESP was completed and shakedown tests were performed on it and the furnace. A problem with carbon burnout in the controlled-turbulence combustors was solved by adjusting the proportions of primary, secondary, and tertiary air. Plans for testing of nahcolite and trona (naturally occurring forms of sodium bicarbonate) for ESP conditioning and flue gas desulfurization have progressed in cooperation with Utah Power and Light (UP and L), including baseline testing at the Naughton Power Plant on a high-resistivity fly ash from Kemmerer, Wyoming, subbituminous coal. Laboratory studies were performed on the dielectric properties of fly ash to complement extensive work on resistivity.
Keywords: COMBUSTION PRODUCTS; FLY ASH; ELECTROSTATIC PRECIPITATORS; DESIGN; ELECTROSTATIC SEPARATION; SULFATES; LIGNITE; SUBBITUMINOUS COAL.

95198 Hot Low-Btu Gas Desulfurization. (Air Products and Chemicals, Inc., Allentown, PA). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

A program is reported that is designed to develop information necessary to accelerate commercialization of the iron process for hot gas desulfurization. Specific objectives are to determine experimentally the conditions that yield elemental sulfur during regeneration of sulfided sorbents; to perform economic analysis to determine process cost sensitivity of several variables; to determine safe conditions for regeneration of sulfided sorbents based on mathematical model and actual data; and to apply APCI model to data obtained by MERC. Results of this work will generate necessary information for improving economics of the hot iron oxide desulfurization process. Removal of hydrogen sulfide from the producer gas while hot, instead of cooling it, may improve the thermal efficiency of coal conversion by up to about 5 percent. A new bench-scale pilot unit was designed and constructed. Analytical procedures were finalized. Economic analysis of different possible iron oxide process configuration is in progress. Mathematical analysis has been done to determine regeneration conditions that limit the maximum temperature in the bed to a safe allowable value. A mathematical model developed under a previous contract will be checked by testing reactor data from MERC.
Keywords: LOW BTU GAS; DESULFURIZATION; COST; HOT GAS CLEANUP; HYDROGEN SULFIDES; REMOVAL; MATHEMATICAL MODELS; BENCH-SCALE EXPERIMENTS; ECONOMIC ANALYSIS; COAL GASIFICATION; THERMAL EFFICIENCY; IRON OXIDES; SORPTIVE PROPERTIES; COMMERCIALIZATION.

95199 Direct Sampling and Characterization of Gaseous Species. Milne, T.A.; Greene, F.T. (Midwest Research Institute, Kansas City, MO). **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

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.

95200 Development of Conceptual Designs for Water Treatment in Demonstration Plants. Goldstein, D.J. (Water Purification Associates, 238 Main St., Cambridge, MA, 02142). **Project number:** EF-77-C-01-2635. **Contract:** EF-77-C-01-2635. **Supported by:** Department of Energy, Washington, DC (USA). Office of Fossil Energy. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives of this project are to provide conceptual designs for integrated water treatment plants for incorporation into coal gasification demonstration plants which will produce pipeline gas and fuel gas; to develop a test program for the non-standard treatment technologies; and to provide data for optimizing, and demonstrating the adequacy of, the water treatment plant conceptual designs. The work is divided into the following four technical phases: (1) conceptual designs for water treatment technologies; (2) ultimate disposal of residuals; (3) integrated water treatment plants; and (4) development of a test program.
Keywords: COAL GASIFICATION; COAL GASIFICATION PLANTS; DEMONSTRATION PLANTS; WASTE WATER; WATER TREATMENT; WATER TREATMENT PLANTS; DESIGN; OPTIMIZATION; SOLID WASTES; WASTE DISPOSAL; PERFORMANCE TESTING.

95201 Assessment of Underground Coal Gasification on Groundwater. Virgona, J.E. (Laramie Energy Technology Center, Laramie, WY, 82071). **Project number:** GK 0101. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology. **Funding:** DOE.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this project is to determine the necessary environmental control technology required to mitigate impacts of underground coal gasification on groundwater quality. The work will consist of collection and analyses of pre- and post-operational water samples to quantify changes in groundwater quality as a result of underground coal gasification. These data will be compared with proposed and existent standards for groundwater quality to first determine whether a need exists for control technology to mitigate impacts of the technology. In addition, the data will be input to existent hydrologic models to estimate long term impacts under different hydrologic conditions that exist at the Laramie Energy Technology Center's field site in Hanna, Wyoming. The effects of coal sorption of organic and inorganic constituents in the groundwater migrating from the gasification zone after test completion will also be determined.
Keywords: COAL GASIFICATION; IN-SITU GASIFICATION; ENVIRONMENTAL EFFECTS; GROUND WATER; WATER QUALITY; HYDROLOGY; POLLUTION CONTROL; COAL; SORPTIVE PROPERTIES.

95202 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). Office of Energy Technology. **Funding:** DOE.
Related energy source: solar(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

95203 Woodburning Plant-Visibility. Leonard, E.M. (Los Alamos Scientific Lab., P.O. Box 1663, S-2, MS 606, Los Alamos, NM, 87545). **Project number:** D513. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$150,000.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to determine the effects on visibility of woodburning power plants and compare these effects with those of coal and oil for similar size plants, and to document the basic characteristics of woodburning plants including stack heights, temperature and velocity of emissions, composition of emissions and meteorological conditions at the plant site. A number of actual plant studies at both existing and proposed sites will be conducted. Photographs of actual emissions will be compared with computer generated photos of the emissions. Both long range transport effects and short range dispersion will be considered. The project includes model development and model verification.
Keywords: WOOD; COMBUSTION PRODUCTS; FOSSIL-FUEL POWER PLANTS; PLUMES; EMISSION; TEMPERATURE MEASUREMENT; VELOCITY; METEOROLOGY; COMPARATIVE EVALUATIONS; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; SULFUR; AIR POLLUTION; CLIMATES; HYDROCARBONS.

95204 Management Support to Fuels from Woody Biomass Program. Van Hook, R.I. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** AJ 01-0001. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$150,000.
Related energy source: biomass(100). **R and D categories:** Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

This project is designed to (1) provide technical assistance to the DOE Division of Distributed Solar Technology in developing and demonstrating the technology for economic production and harvesting of woody biomass for energy through support of 27 R and D contractors (university, industry, consulting firms) in 22 states in species screening, stand establishment, improved management strategies, and improved collection-transportation-storage techniques; and (2) develop and maintain an in-house R and D program which complements contractor research in the areas of environmental effects of sewage sludge utilization, nutrient and organic matter depletion associated with forest residue removal, and regional implications of intensive silvicultural practices.
Keywords: BIOMASS; WOOD; WOOD WASTES; BIOMASS PLANTATIONS; MANAGEMENT; DEMONSTRATION PROGRAMS; FORESTS; CULTIVATION TECHNIQUES; SEWAGE SLUDGE; ENVIRONMENTAL EFFECTS; ENVIRONMENTAL IMPACTS; NITROGEN.

95205 Environmental Assessments of Nonproliferation Alternatives. Rohwer, P.S. (Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN, 37830). **Project number:** 01446. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$200,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated 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.

95206 Model Evaluation of Breeder Reactor Radioactivity Releases. Hoffman, F.O. (Oak Ridge National Laboraory, Building 7509, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** OH 136. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy,

Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$255,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects.

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 parameter and model output, 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.

95207 Radiation Shielding Information Center. Maskewitz, B.F. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** OH015. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$385,000; NRC-$120,000.
Related energy source: nuclear fission(85); nuclear fusion(15). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The scope of the Radiation Shielding Information Center includes: physics of interaction of radiation with matter, radiation production and radiation transport (especially neutrons and gamma rays), transport of radioactive material, radiation detectors and measurements, engineering design techniques, shielding materials properties, computer codes and models useful in research, design, and radiological assessment, and nuclear data compilations. The Center provides radiation transport information, computer codes, and computer-readable data upon request. It maintains data bases on the DOE RECON system: shielding literature and computer code literature.
Keywords: RADIATION PROTECTION; INFORMATION CENTERS; BIOLOGICAL SHIELDING; RADIONUCLIDE MIGRATION; RADIATION EFFECTS; GAMMA RADIATION; NEUTRONS; COMPUTER CODES; NUCLEAR DATA COLLECTIONS; CROSS SECTIONS; DATA COMPILATION; PHOTONS; ELECTRONS; RADIOACTIVITY; IONIZING RADIATIONS.

95208 Fossil Energy Environmental Project. Boston, C.R. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$1,020,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The overall objectives of this project are to provide DOE with program assistance in the performance of environmental assessment functions related to the expansion of fossil energy conversion technologies, to perform assigned technical assistance tasks, and to conduct programmatic environmental investigations which are critical to the early realization of advanced fossil energy technologies. Work is focused in four principal areas: environmental assessment; guidance to demonstration plant contractors regarding environmental obligations; experimental studies of stored solids from coal conversion; and interactive assistance to contractors regarding environmental monitoring needs. The latter activity started with two high Btu gasification plants and expanded to include two low-medium Btu gasification plants and two solvent-refined-coal plants. The Stored Solids Program which was initiated last year has now produced leaching results on solid wastes from pilot plants employing six different gasification processes. In addition, leachates from six different feed coals have also been studied under simulated storage pile conditions.
Keywords: FOSSIL FUELS; ENERGY CONVERSION; TECHNOLOGY ASSESSMENT; ENVIRONMENT; DEMONSTRATION PROGRAMS; COAL GASIFICATION; SRC PROCESS.

95209 Support to Inexhaustible Energy Supply Study Group. Hulburt, C.W. (SRI International, 1611 North Kent Street, Arlington, VA, 22209). **Project number:** 06370. **Contract:** EY-76-C-03-0115. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$16,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

Primarily qualitative or semi quantitative evaluation of environmental/toxicological areas of concern related to energy developments with emphasis on the impacts (possible or probable) of low-level chronic exposure. Inputs were provided in draft form for review and integration into the overall study of which this was but a small part.
Keywords: ENERGY SOURCE DEVELOPMENT; THERMAL POWER PLANTS; CHEMICAL EFFLUENTS; RADIOACTIVE EFFLUENTS; THERMAL EFFLUENTS; EARTH ATMOSPHERE; TERRESTRIAL ECOSYSTEMS; AQUATIC ECOSYSTEMS; AIR POLLUTION; WATER POLLUTION; THERMAL POLLUTION; SULFUR OXIDES; NITROGEN OXIDES; SULFATES; NITRATES; CARBON DIOXIDE; CARBON MONOXIDE; HYDROCARBONS; PHOTOCHEMICAL OXIDANTS; PARTICLES; CONTAMINATION; CHRONIC EXPOSURE; METALS; ORGANIC COMPOUNDS; RADIOISOTOPES; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS; TOXICITY; CARCINOGENESIS; MUTAGENESIS; RISK ASSESSMENT; INFORMATION SYSTEMS.

95210 Environmental Assessment for Enhanced Oil Recovery. Hildebrand, S.G. (Oak Ridge National Laboratory, P.O. Box X, Building 1505, Oak Ridge, TN, 37830). **Project number:** 00147. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Energy Technology. **Funding:** DOE-$100,000.
Related energy source: oil and gas(100). **R and D categories:** Integrated assessment.

The objective of this project is to prepare ten draft environmental impact assessments (following 10 CFR Part 711) for site specific enhanced oil recovery pilot projects co-sponsored by private industry and DOE. Draft environmental assessments will be prepared based on project specific information supplied by appropriate project officers, staff visits to project sites, interaction with appropriate state agencies, and available literature. As of August, 1978, six draft assessments [(1) Columbia Gas Transmission Corp., WV, Feb 78; (2) Pennzoil Corp., WV, Feb 78; (3) Cities Service, KS, Jul 78; (4) Phillips, OK, Jul 78; (5) BERC--Nowata, OK, Jul 78; and (6) Gary Operation Co., MT, Aug 78] have been submitted for DOE review and comment. Four additional draft assessments [(1) Penn Grade Crude Oil Assn., PA, Sep 78; (2) Cities Service, LA, Oct 78; (3) Shell Oil Co., LA, Oct 78; and (4) Kewanee Oil Co., OK, Oct 78] will be completed by October, 1978.
Keywords: ENHANCED RECOVERY; ENVIRONMENTAL IMPACTS; DEMONSTRATION PROGRAMS; PETROLEUM; OIL WELLS; WELL STIMULATION; WEST VIRGINIA; KANSAS; OKLAHOMA; MONTANA; PENNSYLVANIA; LOUISIANA.

95211 Waste Management Information Support. Pfuderer, H.A. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** ON5709A. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management. **Funding:** DOE-$85,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

A program is reported in which information support is provided to research in the area of low-level radioactive waste management and disposal. Emphasized are factors affecting the migration of radionuclides away from the disposal site. The information is disseminated in the form of searches on the computerized data file, biannual bibliographies published from the contents of the data file, and quarterly shallow land burial newsletters.
Keywords: RADIOACTIVE WASTE MANAGEMENT; RADIOACTIVE WASTE DISPOSAL; INFORMATION SYSTEMS; RADIONUCLIDE MIGRATION; BIBLIOGRAPHIES; UNDERGROUND STORAGE.

96008 Technology Assessment of Alternative Transportation Fuels. Dickson, E.M. (SRI International, 333 Ravenswood Ave., Menlo Park, CA, 94025). **Project number:** EY-76-C-03-0115. **Contract:** EY-76-C-03-0115. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$200,000.
Related energy source: coal(60); oil shales and tar sands(40). **R and D categories:** Environmental control technology; Integrated assessment.

An examination of socio-technical feasibility of alternative transportation fuels (from coal and oil-shale to liquid fuels and electrification) is being made. The following topics are being investigated: feasibility/impact assessments; institutional/policy questions; tradeoff analyses; social impacts; coal depletion models; futures scenarios; diesel cars; and workshop/symposium support.
Keywords: TECHNOLOGY ASSESSMENT; TRANSPORTATION SYSTEMS; FUELS; FUEL SUBSTITUTION.

96009 Electric Vehicle Impact Assessment Study. Hamilton, W.F. (General Research Corporation, Science and Technology Division, 5383 Hollister Ave., P.O. Box 6770, Santa Barbara, CA, 93111). **Project number:** EY-76-C-03-1180. **Contract:** EY-76-C-03-1180. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$260,000.
Related energy source: coal(30); oil and gas(30); nuclear fission(10); hydroelectric(10); conservation(20). **R and D categories:** Environmental control technology; Integrated assessment.

The following objectives will be investigated: electric vehicle cars, state-of-art review, future batteries, future electric cars, basic driving requirements, applicability/costs/marketability, comparative use of fuel/energy, availability of energy for recharging, impacts on use of fuels/energy, air quality impacts, noise and other impacts, supplies/resources of key materials, economic impacts, workshops and annual report to Congress support.
Keywords: ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES; ECONOMIC IMPACT; COST; MARKET; TECHNOLOGY ASSESSMENT; AIR QUALITY; ENVIRONMENTAL IMPACTS.

96021 Marine Diesel Bottoming Cycle. Contract: EM-78-R-01-4224. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$120,000.
Related energy source: oil and gas(50); conservation(50). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

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: prepare preliminary design; assess economic, environment and safety characteristics, technological feasibility, operational reliability and maintainability, and potential for industry utilization; and 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: SHIPS; DIESEL ENGINES; BOTTOMING CYCLES; RANKINE CYCLE; FEASIBILITY STUDIES; ECONOMICS; ENERGY CONSERVATION; SAFETY; DESIGN; RANKINE CYCLE ENGINES.

96022 Evaluation of the Market Potential and Environmental Effects of Increased Western Coal Transportation in the Great Lakes and Northeastern U.S. Regions. Asbury, J. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** 49400. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$55,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

These studies are characterized by: definition of demand; transport capability; energy cost comparison; environmental studies; planning and management guidelines development; etc.
Keywords: USA; REGIONAL ANALYSIS; COAL; TRANSPORT; ENVIRONMENTAL EFFECTS; MARKET; ENERGY DEMAND; COAL INDUSTRY.

96023 Automotive Microcarburetor. Csonka, A.B.; Csonka, J.J. (FERRO Technical Co., 109 Larchmont Road, Buffalo, NY, 14214). **Contract:** EC-C-02-4352. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$194,000.
Related energy source: conservation(100).

The project's objective is to procure and test a microcarburetor on a dynamometer engine and on an engine in a late-model vehicle chassis. The inventor claims that due to its superior air-fuel mixture preparation characteristics, the microcarburetor is capable of extending the lean limit fuel-air mix enough to effect significant fuel economy improvement and decrease engine emissions. The principal investigator will construct a device prototype with DOE funding and it will be tested at JPL. Final results will include an assessment of the device's potential and a comparison of it to a modified conventional carburetor. No results are available at this time.
Keywords: AUTOMOBILES; INTERNAL COMBUSTION ENGINES; CARBURETORS; RESEARCH PROGRAMS; DESIGN; PERFORMANCE TESTING; FUEL ECONOMY; FUEL-AIR RATIO; AIR POLLUTION CONTROL.

96024 Near Term Electric Vehicle Program (Phase II). Rowland, E.A. (General Electric Company, Schenectady, NY, 12301). **Project number:** 1294. **Contract:** EY-76-C-03-1294. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$2,500,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology.

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; RESEARCH PROGRAMS; DESIGN; SAFETY; PERFORMANCE TESTING; LIFE-CYCLE COST.

96025 Near Term Electric Vehicle Program (Phase II). Rowlett, B.H. (AiResearch Manufacturing Co., Division of Garrett Corp., 2525 W. 190 Street, Torrance, CA, 90509). **Project number:** 1213. **Contract:** EY-76-C-03-1213. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$2,500,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology.

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; RESEARCH PROGRAMS; DESIGN; PERFORMANCE TESTING; LIFE-CYCLE COST; SAFETY.

96026 Study of Coal-Oil and Coke-Oil Emulsions for Use as Marine Contingency Fuels. Donovan, L.J. (Booz, Allen and Hamilton, Inc., 4330 East West Highway, Bethesda, MD, 20014). **Project number:** 1175. **Contract:** EY-76-C-03-1175. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$50,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of this program is to investigate the technical and economic feasibility of using coal-oil and coke-oil emulsions in marine fuels. Previous research and ongoing research programs will be identified. Propulsion system requirements will be assessed. Logistics, production, and storage system requirements will be established. Economic analyses will be performed. Candidate contingency fuel systems will be recommended and a coal-oil and a coke-oil contingency fuel program will be developed. The program will focus on the coal-oil fuels technology and will cover all aspects required to make the fuel readily available.
Keywords: COAL; COKE; FUEL OILS; EMULSIONS; FEASIBILITY STUDIES; PRODUCTION; STORAGE; ECONOMICS; MARITIME TRANSPORT; FUEL SLURRIES.

96027 Study of Alternate Fuels/Energy Sources to Non-Highway Transportation. Cart, E.N. (Exxon Research and Engineering Co., Government Research Labs., P.O. Box 8, Linden, NJ, 07036). **Project number:** EC-77-C-05-5438. **Contract:** EC-77-C-05-5438. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$130,000.
Related energy source: all(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The objective is to assess the potential for implementation of alternative fuels in non-highway transportation systems in the near, mid and far time frames. The methods employed are to: (1) survey existing information of prime movers and fuels; (2) rank R and D needs through assessing energy source and fuel availability, performance and systems compatibility, capital requirement and economics, environment and safety impacts, and military and foreign fuels compatibility; and (3) recommend a research and development program. DOE-TEC opportunities to aid implementation of alternate fuels with high technological compatibility with prime movers, favorable cost per unit energy saved, and high potential for utilization will be identified.
Keywords: AIR TRANSPORT; MARITIME TRANSPORT; RAIL TRANSPORT; FUELS; AVAILABILITY; PERFORMANCE; ECONOMICS; ENVIRONMENTAL IMPACTS; ENERGY SOURCE DEVELOPMENT; SYNTHETIC FUELS; TRANSPORTATION SECTOR; FUEL SUBSTITUTION.

96028 Pipeline Bottoming Cycle Study. Rossbach, R.J. (General Electric Company, Advanced Energy Programs, Space Division, P.O. Box 15132, Cincinnati, OH, 45215). **Project number:** EM-77-C-03-1381. **Contract:** EM-77-C-03-1381. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$78,000.

Related energy source: oil and gas(70); conservation(30). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The objective of this program is to assess the energy savings and market potential for pipeline applications of the organic Rankine bottoming cycle. The approach is to select 3 potential demonstration sites; prepare preliminary design; and assess the economics, environment and safety, technological feasibility, operational reliability and mantainability, and potential for industry utilization. Program plans leading to demonstration results are to be developed. The program is expected to develop information on which to base determination of energy savings and market potential of pipeline bottoming cycles, and to decide whether or not to proceed to the next phase of a demonstration program.

Keywords: PIPELINES; BOTTOMING CYCLES; RANKINE CYCLE POWER SYSTEMS; DEMONSTRATION PROGRAMS; ENERGY CONSERVATION; ECONOMICS; RELIABILITY; FEASIBILITY STUDIES; MARKET.

96029 Design Data for Hydrogen Engine. Adt, R.R. (University of Miami, Department of Mechanical Engineering, Coral Gables, FL, 33124). **Project number:** 1212. **Contract:** E(04-3)-1212. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$100,000.

This hydrogen engine research effort is designed to provide preliminary, but comprehensive, hydrogen-fueled automotive engine characteristics for future reference. Results of the testing on conventionally aspirated and fuel injected four cylinder engines will establish basic data parameters to permit the design of a first generation hydrogen engine (as distinct from a modified gasoline engine).**Keywords:** HYDROGEN FUELS; INTERNAL COMBUSTION ENGINES; DESIGN.

96030 Electric Vehicle Handling. (Department of Transportation, National Highway Traffic Safety Administration, 2100 2nd Street SW, Washington, DC, 20590). **Project number:** EM-78-I-01-4242. **Contract:** EM-78-I-01-4242. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$150,000.
R and D categories: Operational safety.

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; HYBRID ELECTRIC-POWERED VEHICLES; STABILITY; OPERATION; BRAKES; PERFORMANCE TESTING; SIMULATION; AUTOMOBILES.

96031 Environmental Development Planning/EHV Environmental Assessment. Bernard, M.J. (Argonne National Laboratory, Argonne, IL, 60439). **Project number:** Schedule 189. **Contract:** Schedule 189--49991. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$300,000.
R and D categories: Operational safety; Environmental control technology; Integrated assessment.

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 Demonstration and R and D Programs.

Keywords: ELECTRIC-POWERED VEHICLES; HYBRID ELECTRIC-POWERED VEHICLES; RESEARCH PROGRAMS; ENVIRONMENTAL EFFECTS; ENERGY CONSERVATION.

96032 Stratified Charge Retrofit System. Leshner, E. (Fuel Injection Development Corp. (FIDCO), 110 Harding Avenue, Bellmawr, NJ, 08030). **Contract:** E(04-3)-1237. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$120,000.
Related energy source: conservation(100).

The objective of this project was to procure a Stratified Charge Retrofit System and to test and evaluate its performance in single cylinder engines, multi-cylinder engines, and in a multi-cylinder engine-powered vehicle. A contract was entered into with the principal investigator under the terms of which he provided a device prototype for testing and evaluation at JPL. Final results indicated that due to limitations on the amount of excess air the device could admit to the engine intake manifold, its fuel economy improvement potential is limited.

Keywords: INTERNAL COMBUSTION ENGINES; RETROFITTING; STRATIFIED CHARGE ENGINES; RESEARCH PROGRAMS; FUEL ECONOMY.

96033 Methanol Fuel Modifications for Highway Vehicle Use. Keller, J.L. (Union Oil Co. of California, Research Department, Brea, CA, 92621). **Project number:** 3683. **Contract:** EY-76-C-04-3683. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$240,000.
Related energy source: oil and gas(100).

The aim of this project was to assess the effectiveness of fuel modifications (methanol and higher alcohols) in solving the most important problems brought about by the use of alcohol-based fuels in current IC engines. Extensive physical testing of modified fuels in bench apparatus and in vehicles was the approach to this assessment. A final report draft was submitted March 1978.

Keywords: METHANOL; ALCOHOL FUELS; PERFORMANCE TESTING; BENCH-SCALE EXPERIMENTS; INTERNAL COMBUSTION ENGINES; PHYSICAL PROPERTIES; ROAD TESTS; EXHAUST GASES; FUEL SUBSTITUTION; AUTOMOBILES.

96034 Alternative Fuels Data Bank. Hurn, R. (Bartlesville Energy Research Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** CS-01-01-03-1. **Contract:** CS-01-01-03-1. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$40,000.
Related energy source: all(100).

The alternative fuels data bank program is designed to provide a source of current technical information concerning the utilization of alternate fuels for vehicle/transport applications. The primary input to this system comes from both published research and progress reports from ongoing research and development activities.

Keywords: AUTOMOTIVE FUELS; FUEL SUBSTITUTION; VEHICLES; TRANSPORTATION SECTOR; USES; DATA ACQUISITION.

96035 Investigation of Alcohol/Gasoline Blends. Hurn, R. (Bartlesville Energy Research Center, P.O. Box 1398, Bartlesville, OK, 74003). **Project number:** 2245. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$100,000.
Related energy source: oil and gas(100).

The objectives are: (1) characterization of alcohol/gasoline blends; and (2) performance testing of alcohol/gasoline blends and straight methanol in spark-ignition internal combustion engine.

Keywords: ALCOHOL FUELS; GASOLINE; MIXTURES; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; METHANOL; PERFORMANCE TESTING; AUTOMOTIVE FUELS; SPARK IGNITION ENGINES; FUELS.

96036 *Characterization of Alcohol/Gasoline Blends.* Adt, R.R. (University of Miami, Department of Mechanical Engineering, Coral Gables, FL, 33124). **Project number:** ID 5216. **Contract:** E-(40-1)-5216. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation. **Funding:** DOE-$250,000.
Related energy source: oil and gas(100).

The objective of this project is basic investigation of spark-ignited internal combustion engine operation with alcohol/gasoline blend fuels, including performance, emissions and induction/combustion relationships. Fuels to date have been blends using up to 30 percent chemical grade methanol. Future activities will include fuel-grade methanol and special alcohol/gasoline formulations.

Keywords: ALCOHOL FUELS; METHANOL; PERFORMANCE TESTING; SPARK IGNITION ENGINES; GASOLINE; MIXTURES; EXHAUST GASES; COMBUSTION KINETICS; AUTOMOBILES.

96037 Catalyzed Combustion. Robben, F.A. (Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, CA, 94720). **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications. **Funding:** DOE-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

This present investigation is concerned with the development of surface catalysis as a means of improving combustion efficiency and reducing combustion generated pollution. The objectives of this work are, through combined experimental and theoretical efforts, to develop satisfactory analytical and numerical models for the important practical aspects of surface catalyzed combustion. The approach chosen has been to examine catalytic combustion in a well character-

ized system in which most of the important physical and chemical processes found in larger scale catalytic combustors are present. Combustion in the boundary layer of a heated catalytic flat plate is ideally suited to such a study. Three optical diagnostic techniques have been used for boundary layer measurements: laser Doppler velocimetry for the measurement of velocity, and Rayleigh scattering and deflection mapping density measurements. The primary results to date have involved the flow of H2/air mixtures over a platinum catalytic surface. Regions have been determined in which both surface and gas phase reactions are important. Numerical computations of the boundary layer flow using a detailed reaction mechanism and various catalytic surface boundary conditions have been carried out. Comparisons of considerable insight into the interaction between gas phase and surface reaction are made. The present anticipated results are to properly model the important mechanisms which lead to the combustion heat release in the boundary layer of catalytic surfaces. This will be followed by a study of methods to reduce pollutant generation by use of catalyzed combustion. Primary emphasis will be placed on combustion of alternate and low-grade fuels containing organically-bound nitrogen and with low hydrogen-carbon ratio.
Keywords: COMBUSTION; EFFICIENCY; MATHEMATICAL MODELS; CATALYSIS; PLATINUM; HYDROGEN; AIR; BOUNDARY LAYERS; COMBUSTION KINETICS; AIR POLLUTION.

96101 Biomedical Effects Associated with Energy Transmission Systems. Ehret, C.E. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Contract:** W-31-109-ENG-38. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems. **Funding:** DOE-$192,000.
Related energy source: all(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

The objectives of this program are: (1) to investigate the effects of electric fields on the circadian regulatory aspects of physiological and behavioral patterns in rats by determining the occurrence of phase or of period changes in ongoing circadian rhythms during continuous or phased exposure to electric fields; and (2) to measure a set of metabolic and neurophysiological end points temporally interrelated in the diel cycle in mice. Each study will contribute to the determination of allowable 60 Hz field strengths for human populations in proximity to high tension transmission lines and switchgear. Exposure chambers have been designed to accommodate animals singly housed in metal-free cages, and to allow exposure to fields up to 100 kV/m. In the rat study, animal cages have been designed to include measures of core temperature, body weight, gross motor activity and behavioral responses to adventitious stimuli (operant conditioning), all measured automatically and in long time series. In the mouse study, metabolic parameters will be monitored during exposure and at intervals during an extended follow-up period. In this study, we shall determine whether ELF (Extremely Low Frequency) fields can modify the diel cycles of energy metabolism, motor activity, and temperature, and whether these modifications are associated with decrements in work performance, disease morbidity and survival.
Keywords: ELECTRIC FIELDS; PHYSIOLOGY; BEHAVIOR; RATS; BIOLOGICAL EFFECTS; METABOLISM; DAILY VARIATIONS; HUMAN POPULATIONS; HEALTH HAZARDS; POWER TRANSMISSION LINES; MORTALITY; EPIDEMIOLOGY; CENTRAL NERVOUS SYSTEM.

96102 Proof of Concept Experimentation, Fuel Plantation Research. Stubbs, J. (USDA Forest Service, S.E. Forest Experiment Station, P.O. Box A, Aiken, SC, 29801). **Contract:** EY-76-A-0903. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Solar Energy. **Funding:** DOE-$209,000.
Related energy source: fossil fuels(50); biomass(50). **R and D categories:** Ecological/biological processes and effects.

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 useable biomass with a lower energy expenditure per unit produced. Research studies supported through cooperators in FY 1979 fit into five broad classifications, listed in order of decreasing emphasis: (1) reclamation of drastically disturbed or low productive sites using soil amendments and mycorrhizal treatments, (2) field evaluation of southern pine seedlings selected and bred for resistance to Cronartium fusiforme, (3) reforestation of moderately productive upland sites with Liquidambar styraciflua and various soil amendments, (4) classification of understory plant communities, and (5) recoverable logging residues remaining following timber harvest operations. Most of this research requires several years of tree growth before the effect of treatments becomes apparent. Hence, many of the above projects will continue into FY 1980.
Keywords: BIOMASS PLANTATIONS; FORESTS; MANAGEMENT; LAND RECLAMATION; PINES; CLASSIFICATION; WOOD WASTES; RECOVERY; BIOSYNTHESIS; INSECTS; SYNERGISM; RESINS; MYCORRHIZAS.

96103 Radiative and Passive Cooling. Martin, M.R. (Lawrence Berkeley Laboratory, 90-3086, Berkeley, CA, 94720). **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications. **Funding:** DOE-$230,000.
Related energy source: solar(75); other advanced(25).

The feasibility of using radiative and passive cooling systems for air conditioning in various parts of the country is being investigated. This effort includes a determination of atmospheric infrared emission characteristics to identify geographical regions in which selective and non-selective radiators might be effective. This will be accomplished by use of atmospheric radiation models, and by an experimental program of sky radiation measurements. If the performance and economics of radiative cooling systems appear favorable, studies of infrared absorptance and emittance of candidate radiator materials will be carried out.
Keywords: RADIATIVE COOLING; PASSIVE SOLAR COOLING SYSTEMS; FEASIBILITY STUDIES; PERFORMANCE; ECONOMICS; INFRARED RADIATION; EMISSIVITY; ABSORPTIVITY.

96106 Navajo Winterization Project. Pendley, R.E. (Los Alamos Scientific Laboratory, P.O. Box 1663, S-2, MS 606, Los Alamos, NM, 87545). **Project number:** F469. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Buildings and Community Systems. **Funding:** DOE-$113,000.
Related energy source: conservation(100).

The purpose of this project is to (1) provide technical assistance and advice to the Navajos, participate in joint research projects with the tribe, and act as a liaison between the Navajos and U.S. government authorities; and (2) assist the Navajo Community College in winterization of Navajo dwellings.
Keywords: RESIDENTIAL BUILDINGS; AMERICAN INDIANS; ENERGY CONSERVATION; NATIONAL GOVERNMENT.

96107 Passive Solar. Roach, J.F. (Los Alamos Scientific Laboratory, P.O. Box 1663, S-2, MS 606, Los Alamos, NM, 87545). **Project number:** D492. **Contract:** W-7405-ENG-36. **Supported by:** Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications. **Funding:** DOE-$35,000.
Related energy source: solar(100). **R and D categories:** Characterization, measurement, and monitoring.

The project objective is to examine the economic feasibility of passive solar energy for residential space heating. Solar system costs are developed on a state by state basis, as well as the total number of houses, and projected energy savings. The analysis includes sensitivity to heating loads, alternative energy costs, prices, and the use of insulation.
Keywords: PASSIVE SOLAR HEATING SYSTEMS; RESIDENTIAL BUILDINGS; SOLAR SPACE HEATING; HEATING LOAD; ECONOMIC ANALYSIS; COST; THERMAL INSULATION.

96108 Ventilation of Buildings. Hollowell, C.D. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Buildings and Community Systems. **Funding:** DOE-$1,200,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The broad goals are to coordinate and conduct research, development and demonstration projects on ventilation requirements and mechanical ventilation systems in order to provide a consistent set of recommendations for the establishment of energy efficient ventilation standards and ventilation system designs for residential, institutional and commercial buildings. The approach will be to assess current ventilation requirements and establish criteria in order to determine safe, comfortable, energy efficient ventilation standards for specific classes of buildings. The impact of energy efficient heating, ventilating and air conditioning systems in buildings on human comfort and health will be studied with the cooperation of government agencies, professional societies and academic institutions. These studies will consider the effect of various physical, physiological and psychological factors on humans.
Keywords: VENTILATION SYSTEMS; COMMERCIAL BUILDINGS; RESIDENTIAL BUILDINGS; PUBLIC BUILDINGS; STANDARDS; ENERGY CONSERVATION; AIR CONDITIONING; HEATING SYSTEMS.

97031 Information as a Function of Plant Size and Criteria Appropriate for Optimum Plant Mix for a Synthetic Fuel Plant Mix. Nesbitt, D.M. (Stanford Research Institute, Menlo Park, CA, 94025).

Supported by: Department of Energy, Washington, DC (USA). Office of Policy and Evaluation. **Funding:** DOE.
Related energy source: oil and gas(50); oil shales and tar sands(50). **R and D categories:** Operational safety; Integrated assessment.

The objective is to develop a framework for selecting from a set of commercial demonstration plant proposals. The approach is to model the technical, economic, environmental, social, and management aspects of alternative demonstration plant candidates when this is combined with a general energy model (in this case the SRI energy model) selection criteria can be determined.
Keywords: DEMONSTRATION PLANTS; SYNTHETIC FUELS; MATHEMATICAL MODELS; SOCIO-ECONOMIC FACTORS; OPTIMIZATION; ENVIRONMENTAL IMPACTS; ENERGY MODELS.

97101 National Energy Strategy Study (NESS) Impact Assessment Project. Wilbanks, T.J. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** KK 02 01 00 0/ 18900002. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Planning and Regulatory Program Evaluation. **Funding:** DOE-$550,000.
Related energy source: all(100). **R and D categories:** Integrated assessment.

The objectives of the project are: (1) to provide environmental and social impact information and perspectives during identification and evaluation of energy initiatives for NESS; and to prepare a policy EIS for NESS. The project is being completed in 3 phases: (1) assessment preparation--environmental characterizations/data and quick response modelling capability are developed; (2) initiatives evaluation--use of tools in assessment preparation to provide environmental evaluations; and (3) EIS preparation. To date a six volume set of environmental characterizations for energy technologies has been produced.
Keywords: ENERGY SOURCE DEVELOPMENT; ENVIRONMENTAL IMPACTS; SOCIAL IMPACT; RISK ASSESSMENT; MATHEMATICAL MODELS; EARTH ATMOSPHERE; SURFACE WATERS.

97102 Assessment of Occupational Health and Safety Problems Related to Production of Synthetic Fuels. Hall, E. (1302 18th Street NW, Room 301, Washington, DC, 20036). **Project number:** EJ-78-X-01-5172. **Contract:** EJ-78-X-01-5172. **Supported by:** Department of Energy, Washington, DC (USA). Div. of Environmental Planning and Program Evaluation. **Funding:** DOE-$9,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Operational safety; Integrated assessment.

The contractor will prepare a report on the major occupational health and safety issues surrounding the development of a synthetic fuels industry. The report will summarize: (1) the status of current R and D efforts; (2) the relevant experience of other countries with synthetics; and (3) a comparison of synthetics to existing processes such as refining and coking in terms of occupational health. This report will then be used to determine occupational health and safety implications of legislative proposals for synthetics which result from the National Energy Plan II. The report will clearly cite the major issues and will represent a consensus of view points of various experts in DOE.
Keywords: SYNTHETIC FUELS INDUSTRY; HEALTH HAZARDS; SAFETY.

97103 Economic and Energy Impacts of Revised New Source Performance Standards for Electric Utilities. Stauffer, H.; Lamantia, C. (ICF, Inc., 1850 K Street, NW, Washington, DC, 20520). **Supported by:** Department of Energy, Washington, DC (USA). Div. of Utilities. **Funding:** DOE-$65,000.
Related energy source: coal(50); oil and gas(50). **R and D categories:** Integrated assessment.

The objective of this project is to estimate the economic, energy, and emissions impacts of alternative revisions to New Source Performance Standards for coal-fired electric power plants. A linear-programming macro-model of the coal and electric utilities industries will be used to determine coal production and consumption impacts, oil consumption impacts, electricity cost impacts, and sulfur-dioxide emissions impacts of alternative standards of emissions for SO2.
Keywords: FOSSIL-FUEL POWER PLANTS; ENVIRONMENTAL IMPACTS; ECONOMIC IMPACT; POLLUTION REGULATIONS; ENERGY CONSUMPTION; COST; SULFUR DIOXIDE.

98011 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: fossil fuels(100). **R and D categories:** Health effects.

The project objective is to develop a rapid method for testing environmental contaminants, including energy related pollutants, for liver tumor initiating or promoting activity. The experimental approach involves the exposure of partially hepatectomized rats to carcinogen or carcinogen promoter treatments. Subsequently, the distribution of marker enzymes in pre-neoplastic hepatocytes is examined histochemically and compared with the distribution of tumor types (relative degrees of differentiation) that ultimately emerge. If consistent treatment related shifts in tumor types occur, and if these shifts can be correlated with changes in enzyme marker distribution patterns then the marker patterns can be used to differentiate between initiators and promoters. In addition, partially hepatectomized rats are given single treatments with hydrocarbons and other energy related pollutants in various combinations after which they are given dietary phenobarbital. Positive correlation of tumor yield and the formation of pre-neoplastic foci would indicate the correlation of tumor yield and the formation of pre-neoplastic foci would indicate the suitability of this system for studies of pollutant interactions in tumor formation. It is expected that this project will eventually permit the use of early biochemical changes as a means of categorizing tumorigenic stimuli prior to the emergence of tumors.
Keywords: POLYCYCLIC AROMATIC HYDROCARBONS; LIVER; HEALTH HAZARDS; NEOPLASMS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; BIOLOGICAL MODELS; RATS; BIOLOGICAL EFFECTS; SYNERGISM; MUTAGEN SCREENING; TISSUES.

98021 Determination of Normal and Hypernormal Concentrations of Energy-Related Trace Element Pollutants in the Human Body Using Teeth as an Indicator. Stang, L.G. Jr. (Brookhaven National Laboratory, Medical Department, Upton, NY, 11973). **Project number:** 4021. **Supported by:** Department of Energy, Washington, DC (USA). **Funding:** DOE-$50,000.
Related energy source: all(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The immediate goals are to develop and demonstrate a practical, simple, rapid, and inexpensive method for determining and monitoring traces of potentially toxic energy-related elements in the human body. Utilizing this method, concentrations of such elements will be determined in statistically large numbers of individuals with known case histories in order to define existing baseline concentrations of these elements. This will also provide quantitative data needed for determining the relationship between increases above this baseline for a given element and parameters (measured by others) such as the health of the individual, the ambient concentration of the element, and occupational factors relevant to energy technology. A longer-range goal is to determine trace element concentrations in deceased populations and compare the results with those from living groups to measure the extent, if any, to which present baseline concentrations for particular elements may already be higher than normal (as determined from the dental remains of individuals who lived prior to environmental pollution from energy-related sources), and to measure the present rates at which these baselines are increasing. The significance of this work is that it develops a convenient basis for indicating the human impact of many energy-related potential environmental pollutants for which even the normal body concentration is unknown.
Keywords: TEETH; BIOADSORBENTS; BIOASSAY; SKELETON; BODY; METABOLISM; CHEMICAL EFFLUENTS; TRACE AMOUNTS; POPULATION DYNAMICS; BASELINE ECOLOGY; POLLUTION; ENVIRONMENTAL IMPACTS; CHEMICAL COMPOSITION; BIOLOGICAL INDICATORS.

98030 Fly Ash in Cells. 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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Particles of fly ash interact with the lung at the cellular level and produce alterations in the morphology and function of individual cells. The response of a given cell such as a pulmonary macrophage depends in part on the burden of foreign chemical elements contained in the fly ash particles associated with that particular cell. It has been shown that the chemical composition of fly ash varies greatly from particle to particle. Individual cells therefore are exposed to a range of elements and concentrations depending on which set of particles they pick up. If we are to make an accurate correlation between the type and concentration of elemental exposure on the one hand and the cellular response on the other, it is helpful to apply scanning electron microscopic x-ray analysis which can provide data on individual cell exposure to foreign elements and can also examine changes in cell morphology resulting from this expo-

ıre. By correlating light microscopic observations on the same cell rior to SEM analysis, certain cell functions not readily seen by ɔEM alone (viability, phagocytic index) can also be determined on an individual cell basis. This is particularly important in cases where a single cell change can be amplified biologically as in the recently demonstrated mutagenic effect of fly ash extracts.
Keywords: FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; EARTH ATMOSPHERE; AIR POLLUTION; FLY ASH; INHALATION; MAN; BIOLOGICAL EFFECTS; CHEMICAL COMPOSITION; LUNGS; PATHOLOGICAL CHANGES; MACROPHAGES; MORPHOLOGICAL CHANGES; BIOLOGICAL FUNCTIONS; ELECTRON MICROSCOPY; X-RAY FLUORESCENCE ANALYSIS.

98033 Toxic Air Pollutants. White, M. (Lawrence Berkeley Lab., Berkeley, CA, 94720). **Project number:** 004033. **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: fossil fuels(100). **R and D categories:** Health effects.

The lung adenoma system in mice is being used as the basic carcinogenic effect in the initial experiments with air pollutant gases. It is a sensitive system for detecting and measuring cocarcinogenic effects, since multiple lung tumors induced are readily detected and counted and their numbers are proportional to dose. The method is to superimpose the action of a suspected carcinogen on the effects of urethane and to study both tumor yield and latent period. The first air pollutants to be studied are NO2 and SO2. These gases were chosen because they occur widely and there are reports in the literature that they cause changes in the numbers of cells from which adenomata arise.
Keywords: AIR POLLUTION; NITROGEN OXIDES; SULFUR DIOXIDE; CARCINOGENESIS; URETHANE; SYNERGISM; MAN; BIOLOGICAL MODELS; MICE; LUNGS; ADENOMAS; LATENCY PERIOD; DOSE-RESPONSE RELATIONSHIPS.

98034 Chemical Mutagenesis and Carcinogenesis. Bartholomew, J.C.; Hearst, J.; Tinoco, I.; Rapoport, H. (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: fossil fuels(100). **R and D categories:** Health effects.

The objective of the project is to understand the mechanism of action of environmental pollutants in the production of mutations and carcinogenesis. The research approach will include attempts to determine how environmental pollutants interact with DNA and chromatin, determine the structure of the complex between these agents and DNA, and what effects these agents have on cellular functions. This project will characterize the present known mutagens. It should lead to predictions of the types of chemical structures which are most dangerous mutagens, and determine the relationship between mutagenesis and carcinogenesis. Our work has already suggested a number of assays for the detection of chemical carcinogens, and it may allow development of nutritional protocols or compounds which can prevent mutations and inhibit chemical carcinogenesis.
Keywords: AIR POLLUTION; WATER POLLUTION; MUTAGENESIS; CARCINOGENESIS; BIOCHEMICAL REACTION KINETICS; DNA; CHROMATIN; BIOASSAY; MUTAGENS; CARCINOGENS; CHEMICAL REACTIONS.

98040 Effects and Fates of Petroleum Hydrocarbons in the California Coastal Environment. Spies, R.B. (Lawrence Livermore Lab., P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** RPIS-0404. **Contract:** W-7405-ENG-48. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$80,000; EPA-$70,000.
Related energy source: oil and gas(100). **R and D categories:** Ecological/biological processes and effects.

This project investigates the effect and fate of petroleum hydrocarbons in the coastal environment. Ecological consequences of chronic exposure to petroleum are emphasized through studies of communities of natural oil seeps. Description of diverse communities in oil-contaminated sediments has led to the formulation of hypotheses relating to environmental exposures, toxicity of the oil, adaptation and trophic enrichment. Current research is testing these hyɔotheses using interdisciplinary (Ecology, Organic Geochemistry, Biochemistry and Physiology) approaches to a real world system. The long term objective is to establish a generic picture of the interaction of petroleum hydrocarbons with coastal ecosystems.
Keywords: PETROLEUM; TOXICITY; COASTAL WATERS; SEDIMENTS; SEEPS; AQUATIC ECOSYSTEMS; COASTAL REGIONS; CALIFORNIA; ENVIRONMENTAL IMPACTS; BIOLOGICAL EFFECTS.

98041 Morphologic Variants in Damaged Sperm. Wyrobek, A.J. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** 004041. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$60,000.
Related energy source: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The objectives of our studies have been: (1) to adapt existing and to develop new sperm assays for assessing the germinal toxicity and mutagenicity of industrial and energy related compounds; and (2) to develop methods for extrapolating to man the genetic implications of findings with animals. Our major accomplishments of the past three years have been: (1) the adaptation of the mouse sperm morphology assay to show that hydrocarbons can induce sperm abnormalities; (2) major advances in adapting flow and static, slide-based technologies as automated, quantitative assays of hydrocarbon induced changes in sperm shaping; (3) the finding that genotype plays a major role in the magnitude of sperm abnormalities seen after exposure; and (4) the finding that genetic differences in the liver metabolism of hydrocarbons are poor indicators of increased sperm abnormalities. Semen assays provide an invaluable bridge between animal models and man. Our continuing aims are to use the latest technological and biological advances in semen analyses to improve the effectiveness of animal models for identifying potential germ cell toxins and mutagens and for predicting the potential human hazards of industrial and energy related compounds.
Keywords: SPERMATOZOA; MORPHOLOGY; HYDROCARBONS; BIOASSAY; MUTAGENESIS; RABBITS; HAMSTERS; MICE; X RADIATION; GENETIC RADIATION EFFECTS; BIOLOGICAL MODELS; LIVER; METABOLISM; RADIOSENSITIVITY.

98042 Mouse Oocyte System as a Monitor of Chemical Toxicity. Dobson, R.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-452, Livermore, CA, 94550). **Project number:** EPA-PS-78-1. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$75,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Integrated assessment; Health effects; Ecological/biological processes and effects.

The research objective is to detect and measure chemical cytotoxicity of energy-related agents (hydrocarbons, metals, and other pollutants) using the mouse oocyte system as an in-vivo method. Oocytes are irreplaceable cells easily killed by certain chemicals. The experimental approach is to quantify this cell killing by enumerating surviving oocytes in ovaries from exposed animals and comparing with controls, thus obtaining dose-response data from the intact animal. It has been found that mouse oocytes are a versatile tool in chemical toxicology. Sensitivity is high for many energy-related agents, notably polycyclic aromatic hydrocarbons (PAHs), important fuel-combustion pollutants. Quantitative dose-response data are being collected for a large number of chemicals. Highlighting the work so far is the discovery, coming jointly from chemical studies and research on radiation, that a period of special risk from chemical exposures may occur in the human before birth. Tritium experiments disclosed that monkey oocytes suffer massive destruction in the fetus from chronic exposure in utero. This combined with parallels between chemically and radiation-induced effects and the prominent prenatal chemical damage found in mice warns of possible high vulnerability, not previously recognized, to chemical exposures in late gestation in man.
Keywords: MICE; OOCYTES; BIOLOGICAL INDICATORS; CHEMICAL EFFLUENTS; HYDROCARBONS; METALS; POLYCYCLIC AROMATIC HYDROCARBONS; CARCINOGENS; BIOLOGICAL EFFECTS; REPRODUCTION.

98044 Quantitative Mutagenesis Testing in Mammalian Cellular Systems. Hatch, F.T. (Lawrence Livermore Laboratory, P.O.Box 5507, L-452, Livermore, CA, 94550). **Project number:** 004044. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$150,000.
Related energy source: fossil fuels(90); geothermal(10). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The primary objective of this program is the development, validation, and application of multiple-marker, in vitro assays using mammalian cells to quantify the mutagenic effects of pollutants arising from energy extraction, conversion, and utilization. The simultaneous use of multiple markers can test whether the genetic loci involved differ in sensitivity or mechanism for damage and may increase the generality and reliability of the assay for compounds having diverse interaction with the genetic material. The systems were initially validated with data from standardized dose response

protocols and are now being applied to complex organic mixtures from crude effluents. Because most of the suspected mutagens associated with energy by-products and effluents require metabolic activation, activation techniques will be used which can be coupled with the in vitro mammalian assay. Many problems are to be expected in exposing crude effluents to mammalian cells with an in vitro activation system (general toxicity, inhibitory or synergistic effects among mutagens, chemical transformation), and the bioassays must be adapted to accept crude mixtures and fractionated samples. The mutagenesis assay at multiple gene loci may be a very sensitive detector or genetic damage induced by complex pollutants associated with effluents from alternate energy sources.
Keywords: ANIMAL CELLS; MUTAGENESIS; BIOLOGICAL INDICATORS; BIOASSAY; METABOLISM; HYDROCARBONS.

98050 Lung Cell Injury and Repair After Inhaled Particulate Acid Sulfates. Brownstein, D.G. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004050. **Contract:** EY-76-C-04-1013. **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:** Health effects.

Studies utilizing experimental animals exposed to particulate acid sulfates indicate that as respiratory irritants these compounds may be directly cytotoxic or induce injury through host mediated autonomic reflexes such as laryngo or bronchospasm. Studies are in progress to evaluate the relative contribution of cytotoxicity and host reflexes in lung cell injury and repair induced by particulate acid sulfates. Histopathological and cytokinetic assessments of tissue alterations are being used as guides for more detailed evaluations of tissue changes to a variety of particulate acid sulfate exposure levels and deviations. These include ultrastructural and histochemical studies as well as evaluations of intra- and extra-cellular enzymes. Epidemiological studies implicate particulate acid sulfates in exacerbations of pulmonary infections. Studies are therefore in progress to study synergisms between particulate acid sulfates and several pulmonary pathogens of rodents.
Keywords: SULFATES; AEROSOLS; INHALATION; BIOLOGICAL REPAIR; LUNGS; PARTICLES; TOXICITY; ANIMALS; BIOLOGICAL EFFECTS; RESPIRATORY TRACT CELLS; ULTRASTRUCTURAL CHANGES; COAL; COMBUSTION.

98051 Deposition, Retention and Dosimetry of Inhaled Sulfates. Snipes, M.B. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004051. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$115,000.
Related energy source: coal(100). **R and D categories:** Health effects.

Sulfur compounds, especially oxides and sulfates, are important release or reaction products associated with the conversion of fossil fuels to energy. Condensation of these compounds and/or reaction products result in respirable parameters of experimental animals. It is important to define distribution patterns in lung for these inhaled irritants and determine their mechanisms of physiological change to better understand the magnitude of risk for humans exposed to these materials. This research project is designed to provide information necessary for relating dose to effect after inhalation of these toxicants by animals. Specific studies have been developed to examine the 3-dimensional distribution of inhaled toxicant as a function of time after exposure and changes in deposition and retention of test aerosols deposited in lung before, during, or after inhalation of sulfuric acid mists. Studies have been initiated using Fischer-344 rats and Beagle dogs to (1) examine toxicant distribution in the lung after inhalation of sulfuric acid mist; and (2) determine the distribution and retention of inhaled monodisperse inert particles after inhalation of sulfuric acid mist.
Keywords: RATS; BEAGLES; AEROSOLS; INHALATION; TOXICITY; LUNGS; TIME DEPENDENCE; SULFURIC ACID; DEPOSITION; RETENTION; TISSUE DISTRIBUTION; SULFATES; PATHOLOGICAL CHANGES; COAL; COMBUSTION.

98052 Metabolism and Toxicity of Inhaled Metal Effluents from Combustion Processes. Cuddihy, R.G. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004052. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$60,000.
Related energy source: coal(100). **R and D categories:** Health effects.

A variety of trace metals are found in atmospheric aerosols which are formed from natural and anthropogenic processes. Further study of the biological importance of trace metals is needed because they may be toxic in themselves or in combination with other atmospheric components and they may also be useful as easily measured tracers to determine man's overall environmental exposure. This study concentrates on trace metal characteristics of effluents from energy production, especially those related to the combustion of fossil fuels. Selected metals which merit further stud in this project include cadmium, vanadium, arsenic and selenium These are being incorporated into condensation aerosols of the meta oxides and into aerosols containing oxysulfate forms. Beagle dogs, Syrian hamsters and Fischer rats are being exposed to the aerosols by inhalation. Deposition, retention and metabolism of the inhaled metals are being studied in the animals over several hundreds of days after exposure. Their effects on lung cell macrophages and Type II alveolar cells are also being assessed. This includes in vitro and in vivo studies of cell viability and function. These data will be used to provide population dosimetry models useful for interpreting the environmental and human health significance of airborne metal aerosols.
Keywords: METALS; TRACE AMOUNTS; AEROSOLS; CADMIUM; VANADIUM; ARSENIC; SELENIUM; BEAGLES; RATS; HAMSTERS; INHALATION; DEPOSITION; METABOLISM; RETENTION; RESPIRATORY TRACT CELLS; HEALTH HAZARDS; COAL; BIOLOGICAL EFFECTS; TOXICITY; COMBUSTION.

98053 Effect of Acid Sulfate on Pulmonary Clearance Mechanisms. Brownstein, D.G. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004053. **Contract:** EY-76-C-04-1013. **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:** Health effects.

Epidemiological studies have indicated an increased incidence of mortality from respiratory disease during periods of elevated sulfur oxide levels. Since laboratory studies have not shown SO2 alone to significantly affect pulmonary clearance, this project is examining the effect of oxidation products of SO2 on pulmonary clearance mechanisms. Specifically, acid sulfates such as ammonium sulfate and sulfuric acid aerosols are being evaluated. Acute effects of acid sulfates on the ability of rats to clear labelled particulates from ciliated airways and deep lung are being evaluated. In addition, the ability of mice to withstand respiratory infections after acute and sulfate exposures is being studied. Similar studies will be performed on animals chronically exposed to graded levels of acid sulfates ranging from ambient air concentrations to high concentrations. The results will indicate whether or not acid sulfates increase the susceptibility of animals to pulmonary infections and thus whether existing health protection standards and control technology are adequate. In addition, their role in reducing clearance of particles from the deep lung may be an additive factor in assessing hazards from toxic particulates.
Keywords: LUNG CLEARANCE; RATS; AMMONIUM SULFATES; SULFURIC ACID; SULFATES; INHALATION; MICE; COAL; COMBUSTION.

98054 Cardiopulmonary Injury and Repair After Inhaling Sulfate Aerosols. Mauderly, J.L. (Lovelace Inhalation Toxicology Research Institute, P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004054. **Contract:** EY-76-C-04-1013. **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:** Health effects.

Both conventional and fluidized bed coal combustion result in the release of particulate sulfates which are thought to pose a health hazard via inhalation. Estimates of the impact of inhaled sulfates have been partially based on data on the effects of acute exposures on guinea pig respiratory function. Since it is now recognized that there are problems in interpreting these previous data, one goal of this project is to provide additional information using current methodology. Little information is available on effects of chronic inhalation of sulfates. A second goal will be to study functional and morphological effects of intermediate to long-term exposures of rats and dogs. One hour exposures of guinea pigs to 1 to 15 mg 0.9 mu MMO H2SO4/cubic m elicited bronchoconstrictive responses in only 6% of the subjects. These data and results of LC50 studies indicate a lower sensitivity to H2SO4 than previously reported. Functional and LC50 responses of guinea pigs to sulfates will be further characterized. Responses of guinea pigs, dogs and rats will be compared. Dogs and rats will be exposed chronically to H2SO4 and functional and morphological endpoints will be evaluated.
Keywords: AEROSOLS; SULFATES; INHALATION; HEALTH HAZARDS; FLUIDIZED-BED COMBUSTION; COAL; RATS; DOGS; GUINEA PIGS; MORPHOLOGICAL CHANGES; RESPIRATORY SYSTEM; SULFURIC ACID; RESPIRATORY SYSTEM; BIOLOGICAL REPAIR; COAL; COMBUSTION.

98055 Cytogenetic Studies of Lung Cells Following Inhalation o Fly Ash, Chemical Mutagens and Effluents from Power Relate Industry. Brooks, A.L. (Lovelace Inhalation Toxicology Researc.. Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004005. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$126,000.
Related energy source: coal(100). **R and D categories:** Health effects.

Experiments are being directed toward understanding hanges at the cellular level following inhalation of particulate matter (fly ash) and polycyclic hydrocarbons released from coal-powered electrical plants. An effort is under way to characterize the deposition and retention of neutron activated fly ash which will be useful in calculating dose of fly ash to lungs following protracted exposures. About 10% of the inhaled fly ash is retained in the Syrian hamster with an 83-day half-life. Studies on the induction of AHH following inhalation are in progress. Early results indicate that the enzyme level in the liver of the Chinese hamster can be induced with benzo(a)pyrene. The major effort is directed toward development of methods for evaluating cytogenetic changes in lung cell populations following inhalation of power plant effluents. Cell populations being studied are macrophages, tracheal epithelium and Type II epithelial cells. The cytogenetic changes and enzyme activation data will serve as an index of biological and mutagenic activity which, coupled with retention, distribution and cell turnover data, may be useful in evaluating hazards and predicting long-term effects of these materials in human populations.
Keywords: RESPIRATORY TRACT CELLS; FLY ASH; MUTAGENS; POLYCYCLIC AROMATIC HYDROCARBONS; INHALATION; FOSSIL-FUEL POWER PLANTS; BIOLOGICAL EFFECTS; HEALTH HAZARDS; CHEMICAL EFFLUENTS; RETENTION; HAMSTERS.

98057 Fine Particles: Improved Generation and Sizing Methods. Kanapilly, G.M. (Lovelace Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM, 87115). **Project number:** 004057. **Contract:** EY-76-C-04-1013. **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:** Characterization, measurement, and monitoring.

Fine particle aerosols of trace metals, sulfates and some organic chemicals with particle diameters ranging from 0.01 to 0.5 mu-m are expected to be significant air pollutants originating from fossil fuel combustion and use. In this study improved methods are being developed for the generation of fine particle aerosols suitable for inhalation studies and instrumental methods for the characterization of significant properties of these fine particle aerosols. Vapor condensation methods are being used to produce fine particle aerosols in the size range of 0.01 to 0.5 mu-m. These aerosols are produced continuously with the desired physicochemical properties, sizes, mass and number of concentration. Several instrumental methods are used for the routine determinations of size characteristics of aerosol particles ranging in size between 0.01 and 0.5 mu-m. Results are compared and differences are evaluated with respect to the physicochemical principles involved in the instrumental measurements. Reliable methods have been or are being developed for the generation of ultrafine particle aerosols of ammonium sulfate, pyrene, As2O3, SeO2, CdO, MnO2 and vanadium oxide. Basic information on the mechanism and kinetics of formation of ultrafine particles from vapors, their properties and behavior are also obtained from this study.
Keywords: AEROSOL GENERATORS; SULFATES; METALS; TRACE AMOUNTS; PARTICLE SIZE; AEROSOLS; AMMONIUM SULFATES; ARSENIC OXIDES; SELENIUM OXIDES; CADMIUM OXIDES; MANGANESE OXIDES; VANADIUM OXIDES; PYRENE; INHALATION.

98063 Evaluation of the Dose-Effect Relationships for the Immune Response of Biologically Active Agents Associated with Oil Shale Technology. Cram, L.S. (Los Alamos Scientific Laboratory, H-10, MS 888, Los Alamos, NM, 87545). **Project number:** 004063. **Contract:** F-311. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The purpose of this project is to assess the potential of the products and byproducts of fossil fuel technology (specifically, oil shale production) for the ability to cause damage to the immune system. The products to be assessed are chosen on the basis of their likelihood of being released into the environment. Specifically, we have been testing water-soluble extracts from spent oil shale for their ability to depress immune function of hamsters in vitro. We can demonstrate the ability of a water-soluble extract to depress the :sponsiveness of hamster spleen cells to T-cell mitogens. The cur-:nt plan is to have large amounts of spent shale on the surface exposed to the elements. If there exists a significant water-soluble pollutant in the spent shale, it could easily find its way into surface and ground water.
Keywords: FOSSIL FUELS; OIL SHALE INDUSTRY; IMMUNOLOGY; HEALTH HAZARDS; HAMSTERS; IMMUNE REACTIONS; CHEMICAL EFFLUENTS; SPLEEN; SURFACE WATERS; GROUND WATER; WATER POLLUTION; ENVIRONMENTAL TRANSPORT; HYDROCARBONS.

98064 Detection of Early Changes in Lung Cell Cytology by Flow-Systems Analysis Techniques. Steinkamp, J.A. (Los Alamos Scientific Laboratory, MS 888, Los Alamos, NM, 87545). **Project number:** 004064. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$50,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.

The objective of this health effects program is the development of cytological and biochemical indicators for estimating damage to respiratory tract cells in animals exposed (inhalation) to toxic agents associated with extraction, conversion, and utilization of synthetic fuels from oil shale. The primary objective is the application of advanced flow-systems technologies to develop automated methods for assaying damage to respiratory tract cells. The experimental approach was to select the Syrian hamster as a model; to characterize lung cell samples (lung lavages) by measuring cytological and biochemical properties using flow multiparameter analysis and sorting instrumentation; and to expose the animals to physical and chemical toxic agents. Cellular parameters include DNA, protein, specific enzyme activities, immunologic functions, and nuclear and cytoplasmic size. Recent progress was achieved in completing fabrication of a new dual-laser flow cytometric system for use in lung cell studies, analysis of cells based on DNA and protein, experiments in lavaging hamster lungs with proteolytic enzymes to increase cell yield, and exposure of hamsters to oil shale particulates and ozone. Although the initial oil shale exposures did not yield dramatic results, ozone produced marked changes in DNA content distributions. Plans are to continue development of cytological and biochemical markers to measure early atypical cellular changes, alveolar macrophage function, cell-cycle kinetics, and dose-damage relationship as a function of exposure.
Keywords: RESPIRATORY TRACT CELLS; CELL FLOW SYSTEMS; OIL SHALES; HAMSTERS; DNA; ENZYMES; TOXICITY; BIOLOGICAL EFFECTS; CYTOLOGY.

98065 Trace Element Damage Assessment in Mammalian Cells. Tobey, R.A. (Los Alamos Scientific Lab., MS 886, Los Alamos, NM, 87545). **Project number:** 004065. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$50,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.

The objective of this research project is to provide the EPA/DOE with guideline information relevant to risk assessment and determination of biochemical effects resulting from exposure to subacute levels of hazardous energy-related pollutants. We have developed a cultured cell model system which allows both identification/classification of toxic DNA-interactive agents and also determination of the effects of pollutants on cellular metabolism. Studies with mutagens/carcinogens of known mechanism of action demonstrate that agents may be classified into discrete categories on the basis of induced chromosomal aberrations and patterns of post-treatment redistribution of cells in the cell cycle (i.e., separation of mono- and bifunctional alkylating agents, intercalcating agents, antimetabolites, protein synthesis inhibitors, etc.). Biochemical studies yield data on cytotoxicity, dose-response relationships and on pollutant transport, intracellular distribution, cellular damage and cell-specific protective mechanisms. For example, parameters of prime importance in cadmium cytotoxicity are intracellular partitioning of the metal and kinetics of induction of cadmium-binding metallothionein rather than the total cellular content of cadmium. Although studies to date have focused on cadmium, for which a great deal of comparative whole animal/human data are available, future studies will concentrate on elements of greater importance in oil shale processing such as chromium, nickel, vanadium, cerium and arsenic.
Keywords: DNA; CHROMOSOMAL ABERRATIONS; DOSE-RESPONSE RELATIONSHIPS; BIOCHEMICAL REACTION KINETICS; CADMIUM; TOXICITY; BIOCHEMISTRY; METABOLISM; TRACE AMOUNTS; CHROMIUM; NICKEL; VANADIUM; CERIUM; ARSENIC.

98066 Oil Shale Toxicity, Protection, and Repair. Enger, M.D.; Hildebrand, C.E. (Los Alamos Scientific Laboratory, MS 886, H-9, Los Alamos, NM, 87544). **Project number:** 004066. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$55,000.
Related energy source: oil shales and tar sands(100). **R and D categories:** Health effects.

Toxic and mutagenic effects of oil shale inorganic components will be defined. Mechanisms involved in producing, protecting against, or repairing damage will be investigated at the cellular and molecular levels. Results will aid in defining the potential for toxic, carcinogenic or mutagenic effects in humans and in establishing dose response and threshold levels for pollutant-elicited damage.

Keywords: SPENT SHALES; TOXICITY; BIOLOGICAL EFFECTS; CARCINOGENESIS; MUTAGENESIS; DOSE-RESPONSE RELATIONSHIPS; NICKEL; CHROMIUM.

98067 Effects of Energy-Related Pollutants on Karyotype Stability in Mammalian Cells. Deaven, L.L. (Los Alamos Scientific Laboratory, Cellular and Molecular Biology, H-9, MS 886, Los Alamos, NM, 87545). **Project number:** 004067. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$50,000.

Related energy source: oil shales and tar sands(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The objectives of this project are to study and evaluate the clastogenic properties of certain toxic materials associated with energy production and to develop rapid, automated methods for detecting these chromosome changes in mammalian cells. We have utilized a variety of methods and techniques ranging from classical chromosome aberration analysis to flow cytometry with advanced instrumental design for these studies. Our basic system has been Chinese hamster (line CHO) cells in vitro. Toxic agents associated with fossil fuel utilization were applied to these cells and evaluated for their potential to induce chromatid or chromosome aberrations, sister chromatid exchanges, and/or cellular toxicity. We have demonstrated that, while cadmium can be a potent clastogen, this effect is highly dependent on culture conditions during cellular exposure. Our results show that serum type and concentration, as well as previous exposure to nontoxic levels of this metal, determine the cellular response with regard to chromosome aberration induction. These observations explain, at least partially, why previous reports on the clastogenic properties of Cd++ are controversial. They demonstrate the need for standardized protocols for the study of heavy metals and for detailed analyses at the cellular level before meaningful interpretations of in vivo data can be made.

Keywords: ANIMAL CELLS; CHROMOSOMAL ABERRATIONS; CARCINOGENESIS; MUTAGENESIS; BIOLOGICAL MODELS; TOXINS; CADMIUM; TOXICITY.

98068 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. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$70,000.

Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

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.

98086 Rapid Assays for Carcinogenic By-Products. Tennant, R.W. (Oak Ridge National Laboratory, 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: fossil fuels(100). **R and D categories:** Health effects.

The objective is to develop mammalian cell system for reproducible and sensitive assay of potential carcinogens, as a model system for the mechanism of carcinoma induction and for the detection of epithelial-tropic RNA tumor viruses. Initially, rat epithelial cells are tested as the target in an in vivo/in vitro host-mediated system. Several methods have been applied to select against the common overgrowth of fibroblasts. Rat lung epithelial cells were derived by the in vivo/in vitro host-mediated approach, from rats treated with dimethylnitrosamine. Proliferative epithelial cells appeared within 3 days after initiation of the cultures. After seven days in culture, proliferating cells were established from all treated rats, but not from untreated controls.

Keywords: CARCINOGENESIS; ANIMAL CELLS; BIOLOGICAL MODELS; NEOPLASMS; MUTAGENS; RATS; LUNGS; EPITHELIUM; VIRUSES; CHEMICAL EFFLUENTS.

98087 Toxicity of PAH with Tracheal Transplant. Netteshein P. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y Oak Ridge, TN, 37830). **Project number:** 004087. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The success and usefulness of the heterotopic tracheal transplant model for studies on respiratory tract carcinogenesis depends on the development of good carcinogen delivery system. It was observed that high variability in in-vivo release of energy-related pollutant like BP and DMBA from beeswax pellets was due to the toxic alterations of tissues caused by carcinogen released at high rates. Pellets composed of beeswax:cholesterol in the ratios of 1:1 and 1:9 showed markedly reduced and consistent rates of PCH release. At a ratio of 1:9 the overall release rate of BP was approximately 1 mu-g/day compared to approximately 7 mu-g/day for pellets with a pure beeswax matrix (100 mu-g BP pellets). Thus the major problem of using the tracheal transport model for quantitative tumor induction studies with PCHs appears to be solved. Our future work will involve: (1) refinement of PCH delivery system by dip-coating beeswax pellets with different polymeric material; (2) development of devices for controlled release of water-soluble carcinogens such as N-methyl-N-nitrosourea; and (3) development of devices for controlled release of particulates such as asbestos fly ash. Since these particulates are practically insoluble in any biocompatible medium, we are planning to develop some form of biodegradable matrix.

Keywords: RESPIRATORY SYSTEM; CARCINOGENESIS; BENZOPYRENE; POLYCYCLIC AROMATIC HYDROCARBONS; TRACHEA; ASBESTOS; FLY ASH; AEROSOLS; PARTICLES; BIOLOGICAL MODELS; LABORATORY EQUIPMENT; NEOPLASMS; INDUCTION.

98088 Role of Irritant Gases: Respiratory Tract. Dalbey, W.E. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 004088. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective is to study the co-carcinogenic or promoting effects of irritant gases on hamsters treated with a systemic carcinogen and to define better the effects of irritant gases on pulmonary phospholipids. Groups of 50 Syrian golden hamsters received 10 weekly injections of 0.5 mg of diethylnitrosamine (DEN) and weekly exposures to 30 ppM formaldehyde or 10 ppM nitrogen dioxide. The lifetime exposures were begun during or after the DEN injections to differentiate between co-carcinogenic and promoting effects. Respiratory tissues, rendered semi-transparent by a clearing technique, are evaluated primarily on a subgross level. A second promotion study was begun using formaldehyde after a single injection of 3.5 mg of DEN, a dose indicated by previous ancillary experiments. Similar studies have begun using an aerosol of croton oil, a known promoter of skin tumors, to test the validity of the promotion concept in the respiratory tract. The effects of nitrogen dioxide on pulmonary phospholipids and cell proliferations are also being investigated. The clearing technique has been proven to be an acceptable method for scoring respiratory tumors. Preliminary data from the lifetime studies indicate a possible co-carcinogenic action by formaldehyde. Preliminary dose-toxicity studies with croton oil are completed and long-term exposures are being initiated. The sequential pulmonary phospholipid response to acute NO2 exposure has been defined; multiple exposures with adapted lungs are being similarly investigated.

Keywords: CARCINOGENESIS; BIOLOGICAL MODELS; HAMSTERS; FORMALDEHYDE; NITROGEN DIOXIDE; ORGANIC NITROGEN COMPOUNDS; GASES; PHOSPHOLIPIDS; AEROSOLS; CROTON OIL; METABOLISM; SYNERGISM; AIR POLLUTION.

98089 Organ and Cell Culture Studies. Marchok, A.C. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 004089. **Contract:** W-7405-ENG-26. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$90,000.

Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Our main objective is to determine the capacity of respirator epithelium to recover from toxic and carcinogenic insults and to define conditions favoring such a recovery. Our approach is to attempt to define criteria by which various epithelial lesions can be classified in terms of their biological potential (i.e., growth behavior, nutritional requirements, cell turnover, etc.) and correlate it with histopathological and cytopathological criteria. We use tracheal

ansplants to induce in a predictable manner and location various pes of lesions. Explants are then cut from the carcinogen-exposed ..acheas and placed in short-term organ culture. The types of epithelial lesions are classified from the cells exfoliated into the medium. As criteria for correlating the explant histology and the exfoliative cytology are developed, we will study the growth behavior, the reversibility of the pathological changes, and the oncogenic potential of the epithelial cells from the specific lesions using an explant-outgrowth-cell culture system developed by us. The development of this in vivo--in vitro system will permit the quantitative study of the effects of toxic, carcinogenic, and co-carcinogenic agents on a major target of pollutants, the respiratory epithelium.
Keywords: RESPIRATORY SYSTEM; EPITHELIUM; TOXICITY; CARCINOGENESIS; BIOLOGICAL MODELS; TRACHEA; INDUCTION; NEOPLASMS; MUTAGEN SCREENING; CYTOLOGY; CARCINOGENS; PATHOLOGICAL CHANGES.

98090 **Selected Teratogenic Test Systems.** 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: fossil fuels(80); nuclear fuels(general)(20). **R and D categories:** Health effects.

Little is known about the teratogenic effects of environmental agents that might be of significance in nonnuclear energy production or consumption. We are developing a rapid teratogenic prescreen that is directly applicable to human risk evaluation in that it involves in vivo treatment, morphological endpoints, and a system sensitive to even small disturbances. Homeotic shifts and quantitative characters in the axial skeleton are used as endpoints in tests for possible effects of environmental agents in a strain of mice chosen because its natural potentialities cause it to straddle the developmental thresholds for these easily scored characters. By exploring the sensitivity pattern of the strain with x rays, we have determined the embryonic periods of maximum sensitivity for the induction of the specific effects. In this labile situation, the effects of even small environmental disturbances are recognizable. The strain chosen is also favorable in that it is genetically responsive to the induction by polycyclic aromatic hydrocarbons of an enzyme system that can convert such compounds into their active metabolites. This is an added advantage in testing for possible teratogenic effects of the products of coal-related technologies.
Keywords: TERATOGENESIS; MUTAGEN SCREENING; CHEMICAL EFFLUENTS; BIOLOGICAL MODELS; RISK ASSESSMENT; X RADIATION; EMBRYOS; POLYCYCLIC AROMATIC HYDROCARBONS; GENETIC RADIATION EFFECTS; BIOLOGICAL EFFECTS; BENZOPYRENE; METABOLISM.

98110 **Alveolar Clearance of Metal Oxides.** Sanders, C.L. (Battelle Pacific Northwest Laboratory, 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: fossil fuels(70); nuclear fission(30). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

98111 **Terrestrial Effects of Oil Shale Development.** Wildung, R.E. (Battelle Pacific Northwest Lab., 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.
elated energy source: oil shales and tar sands(100). **R and D categoes:** Characterization, measurement, and monitoring; Physical and emical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

98112 **Fossil Fuel Effects on Freshwater Ecosystems.** Becker, C.D. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** 004112. **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: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

Our research objectives are to characterize the waste products of a developing coal-conversion process, solvent refined coal (SRC), on the basis of a pilot plant sited at Fort Lewis, Washington; to determine the environmental fate and effects of SRC waste products; and to ultimately obtain sufficient information to predict impacts of ecologically significant SRC waste products on aquatic biota, water quality and possibly, man.
Keywords: SOLVENT-REFINED COAL; COAL PREPARATION PLANTS; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; WATER QUALITY; WASHINGTON; PILOT PLANTS; WATER POLLUTION; BIOLOGICAL EFFECTS.

98118 **Effects of Sulfur Pollutants.** Loscutoff, S.M. (Battelle Pacific Northwest Laboratory, P.O. Box 999, Richland, WA, 99352). **Project number:** 004118. **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: fossil fuels(100). **R and D categories:** Operational safety; Health effects.

The purpose of this project is to determine if experimental animals, particularly animals with pulmonary abnormalities which mimic human lung diseases, can be protected from exposures to sulfuric acid aerosols. Sensitive humans develop respiratory and cardiovascular difficulty during episodes of high sulfur pollution due to the inhalation of atmospheric sulfur compounds. It is not economically feasible to remove all sulfur compounds from the emissions of fossil-fuel-burning plants and even with more stringent emission standards, epidemiologic studies have shown that sensitive individuals will still be affected during high pollution episodes. It would, therefore, be desirable if a means could be found to protect these persons during periods of high sulfur pollution. This project will determine (using animal models) whether inhibiting bronchoconstriction caused by exposure to sulfur pollutants will protect sensitive animals from complications associated with pollutant exposure. If protection is found using animal models, a means of protecting sensitive humans may be suggested.
Keywords: FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; SULFURIC ACID; AEROSOLS; AIR POLLUTION; BIOLOGICAL EFFECTS; INHALATION; MAN; RESPIRATORY SYSTEM DISEASES; BIOLOGICAL MODELS; LABORATORY ANIMALS; BRONCHI; PATHOLOGICAL CHANGES; CARDIOVASCULAR DISEASES; SULFUR COMPOUNDS; TOXICITY.

98121 **Applications of Holography.** Hildebrand, B.P. (Battelle Pacific Northwest Lab., 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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This research project is aimed at developing new instrumentation, based on holography, for measuring the size, spatial distribution, and velocity of particulates. The instruments are designed to be field portable so that studies in environmental effects can be executed. Field portability includes their use in underwater studies of minute marine organisms and their behavior under pollution stress. The research consists of laboratory proof-in-principle experiments, development of holocameras, including time lapse and motion picture, and development of automated image analysis methods to process the vast amount of data recorded by the cameras.
Keywords: HOLOGRAPHY; USES; AEROSOLS; AIR POLLUTION MONITORS; PARTICLE SIZE; PARTICLES; VELOC-

ITY; LABORATORY EQUIPMENT; AQUATIC ORGANISMS; BEHAVIOR; BIOASSAY.

98135 Atmospheric Sciences: Potential of Energy Extraction Processes in the Northern Great Plains for Heavy Metals Contamination and Consequent Uptake and Turnover in a Range Ecosystem Model. O'Toole, J.J. (Ames Laboratory Reactor, Ames, IA, 50011). ***Project number:*** 4135. ***Supported by:*** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$390,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The objectives of this study are to evaluate the rate of generation and atmospheric release of elemental pollutants at the new Colstrip, Montana power station, to describe their chemical transformations, and to measure the dispersion and subsequent accumulation and impacts on components of the ecosystems they invade. This will be accomplished by: (1) qualitative description and quantitative measurement of major and minor elements in mass balance study on Colstrip Unit 1; (2) evaluation of wet and dry deposition rates of air pollutants and characterization of chemical transformations of key pollutants after stack releases; (3) measurement of the accumulation of gaseous and particulate pollutants in terrestrial vegetation, and evaluation of their effects on plant community structure, growth, and pathogenesis; (4) determination of pollutant elements in principal animal species; (5) measurement of efficiency and rate of transport of elemental pollutants down a model watershed to its impoundment; (6) evaluation of impoundments for changes in water and sediment composition, biomass, algal succession, and bioconcentration of toxic trace elements; (7) laboratory measurements of rates of uptake and bioconcentration of key pollutant elements by dominant algae and macrophytes; and (8) evaluation of the accumulation and turnover of toxic pollutant elements in controlled studies on ruminant animals.
Keywords: FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; MONTANA; CHEMICAL REACTIONS; ENVIRONMENTAL TRANSPORT; MASS BALANCE; FLUE GAS; PARTICLES; AEROSOLS; ENVIRONMENTAL IMPACTS; WATER POLLUTION; UPTAKE; BIOLOGICAL ACCUMULATION; METALS; PLANTS; ANIMALS; ECOSYSTEMS; COAL.

98137 *Laser Pumped Luminescence and Microwave Resonance* (LPLMR) Spectroscopy and Absolute Mass Calibrations. Small. (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:** Characterization, measurement, and monitoring.

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: (A) laser pumped luminescence spectroscopy, and (B) 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.

98152 Carcinogenesis Screening--Respiratory Toxicology. Goldman. (University of California at Davis, Davis, CA). **Project number:** 004152. **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:** Health effects.

The biological effects of inhaling power plant fly ash in combination with selected sulfur compounds are studied. The main objectives and related methods include: the respiratory system of rodents and monkeys by inhalation of effluents from coal-burning power sources; evaluation of the biochemical, immunological, and cellular mechanisms responsible for the injury; determination of cellular and subcellular mechanisms of adaptation and repair; examination of the relationships between the factors involved in the balance between injury and adaptation/repair; and the assessment of their relative roles in the development of chronic bronchitis, emphysema, instertitial fibrosis, and proliferative states capable of increasing the risk of carcinogenesis. Rats were exposed to fly ash. After 90-day exposure period, one group was killed and the lungs exan ined. The remaining rats were allowed to recover in room air for a.. additional 90-day period. The results indicate that relatively large quantities of fly ash induce pulmonary changes confined to alveolar regions. Once within alveoli the material persists with only minor changes in the morphological appearance of the lung through a 90-day recovery period.
Keywords: CARCINOGENESIS; SCREENING; FLY ASH; INHALATION; SULFUR COMPOUNDS; BIOLOGICAL EFFECTS; MONKEYS; RODENTS; RESPIRATORY SYSTEM; COAL; PATHOLOGICAL CHANGES; RATS; MACROPHAGES.

98161 Transport and Dispersion of Refinery Wastes in Freshwater Coastal Regions. McCown, D.L.; Harrison, W.P. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** EPA-IAG-D5-E681. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** DOE-$41,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are to: (1) develop methods for tagging and tracing refinery wastes discharged to fresh coastal waters; (2) apply these methods to specific, contaminated coastal waters; and (3) develop and verify a numerical model which would permit prediction of the transport and dispersion of such oily wastes. Rare earth elements (REE) were employed to differentially tag the waters of the Indiana Harbor Canal (IHC) and a mixture of oily waste was poured on the IHC surface. Tagging was followed by down flow, lake-water sampling from boats and from local municipal water intakes. Quantificating of the tagging REE (Dy and Sm) was done by neutron activation analysis. The first two objectives have been accomplished. Project funding was eliminated prior to addressing the third objective.
Keywords: PETROLEUM REFINERIES; CHEMICAL EFFLUENTS; COASTAL REGIONS; WATER POLLUTION; WASTE MANAGEMENT; LIQUID WASTES; DIFFUSION; COASTAL WATERS.

98162 EPA Chemical Induction of Chromosome Aberrations. Generoso, W.M. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 004098. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$53,000.
Related energy source: oil and gas(100). **R and D categories:** Health effects.

A study on the effectiveness of Synthoil Product Oil (Syncrude) and its components (basic, acid, and neutral fractions) to induce chromosomal aberration and cytotoxic effects in mice germ cells has been underway. Three test systems are currently used: dominant lethal, heritable translocation, and total reproductive capacity tests. Results to date indicate that Syncrude induced low levels of dominant-lethal mutations in spermatozoa. We have started an experiment to see if the chromosome damage that led to dominant lethality is associated with the production of heritable translocations. A study to find out which of the three fractions contain dominant-lethal activity is also underway.
Keywords: CHROMOSOMAL ABERRATIONS; SYNTHETIC PETROLEUM; BIOLOGICAL EFFECTS; MICE; SPERMATOZOA; HEALTH HAZARDS.

98163 EPA Mutagenicity and Carcinogenicity of Energy-Related Pollutants. Hsie, A.W. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 4092. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$80,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

Our major efforts have concerned the mutagenic potential of major fossil fuel technology related environmental agents. A mammalian cell gene mutational assay, CHO/HGPRT, has been utilized to quantify the mutagenicity and cytotoxicity of polycyclic hydrocarbons, heavy metals and synthetic fuel subfractions. We found that carcinogenic hydrocarbons such as benzo(a)pyrene [B(a)P], and benz(a)anthracene require metabolic activation to be mutagenic. B(a)P-4,5-epoxide and B(a)P-7,8-diol,9,10-epoxide are mutagenic without activation. Determination of metal mutagenicity is complicated by the interactive effects among metal ions, e.g., the mutagen city of MnCl2 is dependent on the MgCl2 concentration present i the assay. Preliminary studies show that MnCl2, FeSO4, CoCl2 a mutagenic, and that NiCl2, BeSO4 and CdCl2 are weakly mutagenic. The acetone effluent, which contains heterocyclic nitrogen compounds, derived from the basic fraction of a crude fuel is most mutagenic. We expect to complete these preliminary studies and extend to other environmental chemicals and mixtures.

eywords: BENZOPYRENE; BENZANTHRACENE; GENES; ENE MUTATIONS; METALS; MANGANESE CHLORIDES; IRON SULFATES; COBALT CHLORIDES; NICKEL CHLORIDES; BERYLLIUM SULFATES; CADMIUM SULFATES; POLYCYCLIC AROMATIC HYDROCARBONS; MUTAGENESIS; CARCINOGENESIS.

98164 EPA Mutagenicity Assay of Fractionated Coal Conversion Products. Epler, J.L. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 4096. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$125,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The feasibility of using short-term mutagenicity assays to predict the potential biohazard of various crude and complex test materials has been examined in a coupled chemical and biological approach. The principal focus of the research has been preliminary chemical characterization and preparation for bioassay, followed by short-term testing. Using rapid screening mutagenicity assays, the group is attempting to identify mutagenic agents associated with coal and oil shale extraction, conversion or utilization. Primary and subfractions of products and aqueous discharges are being assayed for the ability to inactivate and/or revert histidine requiring mutants of Salmonella. Potential mutagenic fractions are identified and attempts will be made to ascertain the specific compound(s) responsible for the mutagenic action. Various fractionations have been carried out and the screening assays and validating assays (yeast, E. coli, Drosophila, and mammalian cells) are in progress. These investigations are the initial attempts to monitor environmentally important energy-related processes for genetic damage. Basic and neutral fractions possessing mutagenic potential have been identified in a number of different coal liquefaction, shale, and natural crude oils.
Keywords: COAL GAS; COAL LIQUIDS; SHALE OIL; MUTAGENESIS; MUTANTS; SALMONELLA.

98165 EPA Use of the Mouse Specific-Locus Method to Quantify the Gene Mutation Hazard from Mutagens. Russell, L.B. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 4099. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$175,000.
Related energy source: fossil fuels(100). **R and D categories:** Health effects.

The objective of this project is to determine whether potential mutagens associated with non-nuclear technologies can induce transmissible gene mutations in mice. There are two quantitative aims. First, for compounds that are clearly mutagenic, dose-response experiments are used to estimate the mutation frequency at exposure levels likely to be experienced by the human population. Second, for chemicals for which no mutagenicity is detected, the sample size is made large enough to justify a quantitative statement that the observed zero mutation rate excludes, with high confidence, the possibility that any mutagenicity of the compound could be higher than a certain low, acceptable level. Most of the testing is done by the specific-locus method, the only definitive test for point mutations in mammals. The X-chromosome-loss method is sometimes used as a supportive test for damage that would not be detected by other systems. Chemicals so far tested include sulfur dioxide administered as sodium bisulfite (negative), benzo(a)pyrene (negative in the specific-locus test, but positive for sex-chromosome loss), 7,12-dimethylbenz(a)anthracene (tests in progress), and an experimental coal liquefaction product (weakly positive).
Keywords: GENE MUTATIONS; MUTAGENS; MICE; DOSE-RESPONSE RELATIONSHIPS; MUTATION FREQUENCY; SULFUR DIOXIDE; BENZOPYRENE; BENZANTHRACENE; COAL LIQUIDS; MUTAGENESIS; COAL GAS; HEALTH HAZARDS.

98166 Development of Non-Mammalian (Fish) Model for Quantitative Evaluation of Carcinogenicity of Coal Conversion Products. Setlow, R.B. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** 4022. **Contract:** D7-E681. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$54,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

The objective is to develop a new comparative test system, ıg clones of the fish Poecilia formosa, capable of detecting the cinogenicity of chemicals by treatment of cells in vitro or by ..eatment of whole animals. The carcinogenicity of the tested chemicals will be compared with that of ultraviolet radiation of cells in vitro since in the latter case the numbers of photochemical lesions are known. We wish also to see if we can develop scaling laws that would allow us to predict the effects on whole animals from the results obtained by in vitro treatment of cells.
Keywords: COAL GAS; COAL LIQUIDS; CARCINOGENESIS; ULTRAVIOLET RADIATION; BIOLOGICAL RADIATION EFFECTS; FISHES; COMPARATIVE EVALUATIONS; MATHEMATICAL MODELS; HEALTH HAZARDS.

98167 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:** 4036. **Contract:** 78 BCG. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$140,000.
Related energy source: fossil fuels(40); nuclear fuels(general)(20); conservation(40). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

98168 EPA In Vivo Screening for Gene Mutation in Cells. Russell, L.B. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 004097. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** EPA-$175,000.
Related energy source: coal(100). **R and D categories:** Health effects.

There is increasing evidence that tests with lower organisms are not necessarily predictive of mutagenicity of chemicals in the whole mammal. We are therefore using an in vivo mouse system to screen for possible mutagenic effects of compounds and mixtures associated with coal technologies. A somatic mutation test (spot test) was developed by us and is being perfected with regard to a number of experimental parameters, such as mouse strain, direction of cross, optimum embryonic stage, etc. In tests with seven compounds, the method has been validated as a useful prescreen for induced germline mutations. Following these spot-test-germline comparisons, the somatic-mutation method was used to test for the mutagenic effects of benzo[a]pyrene and of an experimental coal-liquefaction products. This spot test uses relatively small numbers of animals and can be completed in five weeks. It detects various chromosomal damages in addition to point mutations, and therefore needs in-depth follow-up after the prescreen, preferably by the specific-locus method, which detects transmitted gene mutations and small deficiencies. In addition to providing a mutagenesis prescreen, the spot test yields incidental information on cell killing, embryo toxicity, and major teratogenic effects.
Keywords: GENE MUTATIONS; GENES; SOMATIC CELLS; MICE; SCREENING; BENZOPYRENE; COAL LIQUIDS; MUTAGENESIS; IN VIVO.

100025 Application of Ohio State Implementation Plan Methodology to the EPA Section 4, ESECA Review. Bartosh, C.P. (Radian Corporation, 8500 Shoal Creek Boulevard, P.O. Box 9948, Austin, TX, 78766). **Contract:** CO-05-60569-01. **Supported by:** Department of Energy, Washington, DC (USA). Office of Resource Applications. **Funding:** DOE-$20,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Integrated assessment.

Under Section 4 of ESECA, EPA was tasked with reviewing all State Implementation Plans (SIP) for potential overkill and with advising states of its results. The EPA summary released in July 1975 is inadequate because it fails to address those air quality control regions which had insufficient data or which were rated marginal or poor. In addition, on August 27, EPA promulgated SIP's for Ohio employing new methods for SIP development. Since these methods were not applied to the incomplete ESECA Reviews, FEA finds this exercise necessary in order to encourage coal utilization in the ESECA Program. Contractor shall become familiar with the ESECA Section 4 Reviews for each state and the Summary Report and shall evaluate the methodology and results. Those states which were rated poor, NA, or marginal in the Reviews, but appear to have revision potential on the basis of the Ohio methodology, shall be identified. To the extent that a quantification of the impact of SIP revision on allowable coal sulfur is possible, that value shall be listed along with the identification of State SIP revision potential. In addition, contractor will develop instructions for applying the Ohio methodology to existing State SIP's in order that FEA can give guidance to states in effecting SIP revisions.
Keywords: OHIO; SULFUR DIOXIDE; IMPLEMENTATION; AIR QUALITY; STANDARDS; AIR POLLUTION ABATE-

MENT; POLLUTION REGULATIONS; COAL; AEROSOLS; COMBUSTION PRODUCTS; METEOROLOGY.

100026 Five Tasks Related to Air and Water Quality Impacts from Energy Resource Development. Burd, R.M. (NUS Corp., Manor Oak Two, 1910 Cochran Road, Pittsburgh, PA, 15220). **Contract:** CO-05-60574-00. **Supported by:** Department of Energy, Washington, DC (USA). Office of Resource Applications. **Funding:** DOE-$169,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

Five studies are conducted on the subjects of: (1) technologies available for control of emissions of fugitive dust from surface mining operations; (2) technical analysis of Court of Appeals decision in Appalachian power Co. vs. Train re the Federal Water Pollution Control Act; (3) water resource requirements of air pollution control technologies; (4) technical analyses of proposed amendments to the Federal Water Pollution Control Act; and (5) technical analysis of available technologies for air and water pollution controls on petroleum facilities.
Keywords: AIR POLLUTION; DUSTS; LEGAL ASPECTS; FEDERAL WATER POLLUTION CONTROL ACT; WATER REQUIREMENTS; WATER POLLUTION; REGULATIONS; SURFACE MINING; IMPLEMENTATION; PETROLEUM; ENERGY SOURCE DEVELOPMENT; AIR POLLUTION CONTROL; COAL MINING; PETROLEUM INDUSTRY; WATER POLLUTION CONTROL; TECHNOLOGY ASSESSMENT.

100027 Analysis of Energy Resource Development Impacts of Clean Air Act. Murphy, B.L. (Environmental Research and Technology, Inc., 696 Virginia Road, Concord, MA, 01742). **Contract:** CR-05-70028. **Supported by:** Department of Energy, Washington, DC (USA). Office of Resource Applications. **Funding:** DOE-$49,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The contractor shall, in collaboration with, and under the guidance of, the GTR, perform technical analyses of the implications for energy resource development, in terms of balancing energy and economic considerations with environmental objectives, of the following EPA emerging policies and regulatory directives: (1) Significant Deterioration; (2) Compliance Data Extensions; and (3) Proposed Guideline on Air Quality Models. Some of the other issues include regulatory and administrative delays, choice of atmospheric dispersion models, allocation/partitioning of the increments, natural violations, and other pollutants. Methods of enforcing prevention of significant deterioration is of particular concern. The concept itself is new and innovative enforcement techniques will be necessary. it is important that we examine these techniques to ensure that they do not exacerbate a concept already thought to be restrictive of economic growth.
Keywords: CLEAN AIR ACT; IMPLEMENTATION; ENERGY SOURCE DEVELOPMENT; AIR QUALITY; ECONOMIC IMPACT; ENVIRONMENTAL IMPACTS; MATHEMATICAL MODELS; AIR POLLUTION; MONITORING; LEGAL ASPECTS; AIR POLLUTION ABATEMENT.

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110002 Nature and Role of Polymetallic Clusters in Oxidation Catalysis. Carberry, J.J. (University of Notre Dame, Department of Chemical Engineering, Notre Dame, IN, 46556). **Project number:** ENG76-00699.A01. **Contract:** ENG76-00699.A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$100,000.
Related energy source: fossil fuels(20); coal(20); oil and gas(20); oil shales and tar sands(20); biomass(20). **R and D categories:** Characterization, measurement, and monitoring.

It is planned to study the important oxidation of CO and olefins as catalyzed by Pt and Ag, each alloyed (clustered) with cometallics such as Cu, Ir, Au, with the goal of securing effective low and high temperature activity-selectivity in the presence of poisons. Further, resistance to sintering will be systematically employed. The state nad nature of prepared clusters will be ascertained by selective chemisorption, titration, reaction, specificity, ESCA-Auger spectroscopy and both scanning electron and transmission electron microscopy.
Keywords: CARBON MONOXIDE; ALKENES; OXIDATION; PLATINUM ALLOYS; SILVER ALLOYS; COPPER ALLOYS; INDIUM ALLOYS; GOLD ALLOYS; CATALYTIC EFFECTS; CATALYSTS.

110003 Diagenesis of Pelagic Siliceous Sediments. Kastner, M (University of California at San Diego, Scripps Institution of Oceanography, La Jolla, CA, 92093). **Contract:** OCE-76-02128. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF.
Related energy source: oil and gas(100). **R and D categories:** Physical and chemical processes and effects.

This project is a two-stage experimental study examining the chemical controls on the formation of different types of siliceous rocks. These rocks, commonly called cherts or porcelanities which are rather common in deep-sea sediments and in certain continental regions, form important petroleum reservoir rocks. In the first stage of this study, the chemistry and mineralogy of siliceous organisms will be determined and low temperature hydrothermal experiments will determine the effects of carbonate and clay minerals on the crystallization process. The second stage will examine the effect of various inorganic impurities on the chemical reactions in marine and fresh water environments and extend the laboratory studies to Deep Sea Drilling Project samples.
Keywords: SEDIMENTARY ROCKS; DIAGENESIS; GEOCHEMISTRY; OCEANOGRAPHY; HYDROTHERMAL ALTERATION; SILICATES; CARBONATE ROCKS; CLAYS; CRYSTALLIZATION; MINERALOGY.

110008 Optimization of Environmental and Energy-Related Systems. Kortanek, K.O. (Carnegie Mellon University, Department of Mathematics, Pittsburgh, PA, 15213). **Contract:** ENG-76-05191. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The research is principally concerned with the continued development of models and solution techniques for use in solving problems of environmental protection and energy conservation. New control engineering models have been developed for optimizing air pollution abatement policies originally stemming from problems encountered in the Pittsburgh area. The basic control problem is to regulate the emission rate distribution of the polluting sources in order to achieve desirable air quality throughout a geographic region. The optimization may be governed by any of a number of policy goals such as seeking a feasible emission distribution which minimizes the total economic-energy impact due to its implementation. Numerical studies were made on the model in an attempt to find solutions. This led to new computational schemes and computer codes for solving extremum problems involving polynomial or orthogonal systems of functions, termed moment problems.
Keywords: ENERGY MODELS; ENERGY CONSERVATION; SIMULATION; ENVIRONMENTAL ENGINEERING; AIR POLLUTION ABATEMENT; OPTIMIZATION; AIR QUALITY; ECONOMIC IMPACT; ENERGY CONSUMPTION; COMPUTER CODES; ENVIRONMENTAL IMPACTS; MATHEMATICAL MODELS; POLLUTION CONTROL EQUIPMENT; POLLUTION CONTROL; ENVIRONMENTAL POLICY.

110009 Concentration Modulation for Remote Detection of Stack Pollutants. Barnes, F.S.; Hu, C.J. (University of Colorado, Department of Electrical Engineering, Boulder, CO, 80302). **Project number:** ENG-7705308. **Contract:** ENG-7705308. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$35,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This investigation is concerned with the development of methods for enhancing detection schemes for remote monitoring of various pollutants emitted from smoke stacks and other sources. The major technique to be investigated involves periodic modulation of the concentration of specific constituents in the sampled region by intense ultraviolet illumination combined with detection of infrared or other wavelength emissions from the modulation products. Signal to background emission noise enhancement is provided by differential detection and signal integration techniques. An electronic signal processing system has been developed that has provided laboratory demonstration of highly sensitive detection of ozone (1 part in 3 x 10/sup -9/) and nitrogen oxides (1 part in 5 x 10/sup -8/). Further improvements in sensitivity are being developed.
Keywords: AIR POLLUTION; REMOTE SENSING; FLUE GAS; MONITORING; INFRARED SPECTRA; OZONE; SENSITIVITY; TRACE AMOUNTS.

110010 Initiation and Support of a Combustion Sciences Research Program. Kruger, C.H. (Stanford University, Department of Mechanical Engineering, Stanford, CA, 93405). **Project number:** SER 77-06579. **Contract:** SER 77-06579. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Science Education Resources Improvement. **Funding:** NSF-$75,000.

Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

A research and training program in combustion science will be initiated. Particular emphasis will be placed on fundamental combustion problems related to energy utilization and pollutant emissions. The specific objectives of the project are: (1) to establish a combustion sciences laboratory to serve as a training and research facility; (2) to develop a supporting teaching and directed study program; (3) to provide new opportunities for initiation of combustion research by young scientists; and (4) to establish co-operative programs with industrial and government research laboratories for the purpose of education, technology transfer, and project evaluation. The combustion program will become an integral part of Stanford's educational and research activities in energy-related fields and will significantly strengthen the training and research program in the increasingly important area of energy science.
Keywords: COMBUSTION KINETICS; RESEARCH PROGRAMS; COMBUSTION PRODUCTS; POLLUTION CONTROL; EDUCATION; BENCH-SCALE EXPERIMENTS.

110012 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).

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.

110014 Hydrogen Sulfide and Reduced Forms of Sulfur in Air. Braman, R.S. (Florida State University, 4202 E. Fowler Avenue, Tampa, FL, 33620). **Project number:** ENV 76-09585-A02. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The proposed research is aimed at developing convenient field methods of sufficient sensitivity to permit getting quantitative values at ambient levels well above detection limits. This is necessary in order to arrive at reliable quantitative estimates of the natural biogenic contributions of hydrogen sulfide and other volatile sulfur compounds for comparison with man-made sources of atmospheric sulfur, such as combustion sources of sulfur dioxide. The ultimate goal is to provide methodology to help assess the relative contributions of natural and man-made precursors of toxic airborne sulfate particulates. This is an extension of Grant ENV-76-9585A01. Analytical techniques to be evaluated include absorption of gaseous species in metal-coated beads with subsequent high-temperature expulsion into suitable detection systems, and selective retention and expulsion of certain sulfur species in gas-chromatographic columns. For solid particulate materials, experiments will be done by heating in inert gases, by acid treatments, by solvent extraction, and by heat treatment in the presence of hydrogen gas. Water and sediment samples will be handled by comparable methods.
Keywords: AIR POLLUTION; HYDROGEN SULFIDES; SULFUR DIOXIDE; ENVIRONMENTAL TRANSPORT.

110018 Information Support Services for Chemical Threats to Man and the Environment. Ross, R.H. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** ENV-76-14776. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(40); nuclear fuels(general)(40); geothermal(10); biomass(10). **R and D categories:** Integrated assessment.

The Information Center Complex of Oak Ridge National Laboratory is providing a variety of information support services to the NSF-RANN program on Chemical Threats to Man and the Environment intended for the broad community of users of the information generated by program research. The services include: (1) the preparation of overview documents summarizing current literature on halogenated organic compounds, focusing on the organohalides of strategic environmental and human health concern; (2) the publication and distribution of a bimonthly abstract journal and newsletter covering all research results published by the Chemical Threats program grantees; (3) the annual publication of the Chemical Threats Directory of program participants; (4) the management of a technical information system file; and (5) the operation of an environmental response and referral center which provides literature searches, bibliographies, summaries of information and replies to specific questions requested by the community of researchers, governmental agencies, industrial organizations, and interested individuals concerned with the environmental and human health aspects of trace contaminants.
Keywords: AIR POLLUTION; WATER POLLUTION; HAZARDOUS MATERIALS; ORGANIC HALOGEN COMPOUNDS; MAN; HEALTH HAZARDS; INFORMATION SYSTEMS; ORNL; INFORMATION CENTERS; DATA PROCESSING; INFORMATION RETRIEVAL; BIBLIOGRAPHIES; TOXICITY; CHEMICAL EFFLUENTS; ENVIRONMENT; ECOSYSTEMS; DATA BASE MANAGEMENT.

110019 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: all(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The project is designed to improve the master's degree training program in waste management at the University of Wisconsin at Green Bay. Grant funds will be 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 from the standpoint of available and future technologies, total energy requirements, economics, resource recovery, and benefits or detriments to the environment.
Keywords: LIQUID WASTES; SOLID WASTES; WASTE PROCESSING; WASTE DISPOSAL; ENERGY DEMAND; ECONOMICS; ENVIRONMENTAL EFFECTS.

110022 Precise Experimental Determination of the Carbon Dioxide Buffer Factor in Seawater. Keeling, C.D. (University of California at San Diego, Scripps Institution of Oceanography, La Jolla, CA, 92093). **Project number:** OCE 74-21496-A02. **Contract:** OCE-74-21496. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: fossil fuels(70); hydroelectric(10); geothermal(10); solar(10). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

A series of precise measurements of K1, K2, and the buffer factor will be made by relating by direct measurement, variations in CO2 partial pressure, alkalinity, and total inorganic carbon in the range 0 to 20 degrees, at varying salinities. In the propsed study, pH measurements will be included as an adjunct to overdetermine the chemical system and ferret out and eliminate any systematic errors.
Keywords: SEAWATER; CARBON DIOXIDE; ENVIRONMENTAL TRANSPORT; PH VALUE; MATHEMATICAL MODELS; BUFFERS; FOSSIL FUELS; COMBUSTION PRODUCTS.

110025 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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

110026 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-$150,000; NOAA-$50,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

110027 Antarctic Tritium. Ostlund, H.G.; Mason, A.S. (University of Miami, 14600 Rickenbacker Causeway, Miami, FL, 33149). **Project number:** DPP76-23433. **Contract:** DPP76-23433. **Supported by:** National Science Foundation, Washington, DC (USA). Office of Polar Programs. **Funding:** NSF-$37,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The concentrations of tritium gas, tritiated water vapor, and tritiated hydrocarbons will be measured at the Clean Air Facility at South Pole Station in Antarctica during 1978 and 1979. In addition, airborne samples will be taken during the austral summers of 1977/78 and 1978/79 from one of the C-130 resupply aircraft. 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.

110030 Measurement of Sulfur Dioxide Oxidation on Particulate Surfaces. Mohnen, V.A. (State University of New York, 41 State Street, Albany, NY, 12203). **Project number:** ENV 76-81817. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of this program is to develop and evaluate procedures for investigating the mechanisms and importance of sulfur dioxide oxidation on the surface of solid particulate matter of natural and anthropogenic origin. Sulfate formation on well characterized particle and reference surfaces will be studied using molecular beams of sulfur dioxide, oxygen and water. Auger electron spectroscopy and mass spectroscopy will be used to measure the rate of product formation. It is anticipated that reaction rates and orders can be determined for a variety of surfaces during the course of this work. Surfaces to be examined include: carbon, oxides of vanadium, oxides of iron, and particulate matter collected from ambient air, power plant stacks, and laboratory flames.
Keywords: SULFUR DIOXIDE; PARTICLES; AEROSOLS; OXIDATION; EARTH ATMOSPHERE; FOSSIL-FUEL POWER PLANTS; FLUE GAS; ENVIRONMENTAL TRANSPORT; AIR POLLUTION.

110031 Sediment Dissolution Model for Fossil Fuel CO/sub 2/. Broecker, W.S. (Columbia Univ., Lamont-Doherty Geological Observatory, Palisades, NY, 10964). **Project number:** OCE76-82035. **Contract:** OCE76-82035. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$192,000.
Related energy source: fossil fuels(80); solar(10); biomass(10). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective is to provide a set of physical and chemical measurements in the world oceans to provide data for quantitative studies of ocean mixing and organic productivity. Models of CO/sub 2/ ocean uptake and calcite dissolution from baseline chemical and physical data will be developed. Initially a two-dimensional advection-diffusion model will be used to characterize thermocline mixing. Later extension of the model to the third dimension should result in important input to other areas, such as the role of the ocean in influencing climate. Preliminary models are consistent with processes of CO/sub 2/ transport out of the ocean near the equator and into the ocean at high latitudes. Lateral movement appears to be concentrated along isopycnals. Details of mixing processes inferred from collections of data during the GEOSECS (Geochemical Ocean Sections) project are given in the publications cited below.
Keywords: CARBON DIOXIDE; SEAS; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; CLIMATES; MIXING; GEOCHEMISTRY; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; CALCITE; DISSOLUTION; BASELINE ECOLOGY; DATA ACQUISITION; FOSSIL FUELS; SEAWATER.

110035 Earthquake Response and Aseismic Design of Underground Piping Systems. Ariman, T. (University of Notre Dame, Notre Dame, IN, 46556). **Project number:** 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 control technology.

The objective of this project is to investigate the earthquake response and earthquake-resistant design of underground piping systems utilized in the energy transport. The earthquake protection of utility systems has become increasingly important because of the accelerated trend of urbanization. As a result of the population growth and land development, more substructures for utilities and transportation systems are being placed underground and the need to maintain the critical services of such utility systems during and after an earthquake has become very clear. The vulnerability of such underground lifelines systems to earthquakes is well known but the current design regulations are insufficient. The reason for this is the absence of basic scientific and engineering research directed specifically to these topics. The present research is directed particularly at the study of buried gas pipelines. The research will include a comprehensive review of the current design practice of underground gas pipelines and the analysis of various pipe failure mechanisms due to seismic excitations. Special emphasis will be placed on the fracture failure of pipelines. A set of practical tools in the design of underground pipelines in a seismic environment will also be developed.
Keywords: NATURAL GAS DISTRIBUTION SYSTEMS; PIPELINES; SEISMIC EFFECTS; DESIGN; REGULATIONS; FRACTURES; SYSTEMS ANALYSIS.

110036 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.
R and D categories: Integrated assessment.

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.

110037 Quantitative Electron Microprobe Analysis of Individual Airborne Particles. Buseck, P.R. (Arizona State University, Tempe, AZ, 85281). **Project number:** 76-17130. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The goals of the proposed research are to investigate the chemical composition of individual submicron particles and to relate this composition to sources, and to investigate the chemical and physical transformation processes these particles undergo. The research program is designed to: (1) refine correction procedures developed by this research group, coupling scanning electron microscope-energy dispersive x-ray analysis with electron microprobe analysis; (2) characterize the major types of inorganic airborne particles in a desert metropolitan area (Phoenix); (3) pinpoint contributions from various area emission sources (coal burning power plants in Northeast Arizona) by comparison of individual particle analysis from ambient and source samples; and (4) investigate the nature and extent of particle coating and agglomeration.
Keywords: ARIZONA; FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; AIR POLLUTION; PARTICLES; PARTICLE SIZE; ELECTRON MICROSCOPY; ELECTRON MICROPROBE ANALYSIS; AGGLOMERATION; AEROSOLS.

110038 Field Measurements of Biogenic Sulfur Emissions. Chang, D.; Hitchcock, D.R. (Environmental Research and Technology, Inc., 696 Virginia Road, Concord, MA, 01742). **Project number:** PFR 77-20663. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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 man's 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 power plants. The research will be done by comparing the gaseous and particulate species collected on opposite sides of a large estuary where substantial biogenic emissions can be expected. The site will be distant from concentrated anthropogenic sources and adjacent to an ocean, so that clean oceanic air can be sampled before and after crossing the estuary. The total amounts and isotopic compositions of particulate sulfate and sulfur dioxide will be measured. By these and ancillary measurements of sodium and chloride, it is hoped to distinguish between airborne sulfur compounds from sea salt, from the decomposition of organic matter, and from the biological reduction of sulfate in sediments.
Keywords: SULFUR DIOXIDE; EARTH ATMOSPHERE; SULFUR OXIDES; ENVIRONMENTAL TRANSPORT; ECOLOGICAL CONCENTRATION; HEALTH HAZARDS; AEROSOLS; PARTICLES; COAL; PETROLEUM; FOSSIL-FUEL POWER PLANTS.

110039 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: all(100). **R and D categories:** Integrated assessment.

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.

110040 Sources, Transformations, and Chemical Nature of Atmospheric Pollutants. Gordon, G.E. (University of Maryland, College Park, MD, 20740). **Project number:** 77-20272. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

Research is reported on the trace elements and polycyclic aromatic hydrocarbons in size-graded particulates emitted by power plants (coal-and-oil-fired), municipal refuse and sewage-sludge incinerators, automotive traffic, airports, and the rural background. The objective is to identify sources of toxic elements and to trace the origins of ambient particulates. A second objective is to elucidate certain aspects of homogeneous gas reactions in polluted air and to determine the conditions that control ozone formation in power-plant and industrial plumes. The study extends to the combustion of refuse-derived fuel and to industrial sources represented by steelmaking, petroleum refining, cement manufacture, and nonferrous smelting. Trace elements are analyzed by neutron activation and atomic absorption. Polycyclic aromatic hydrocarbons are measured in the particulate and gas phases. Studies in the meteorological forecasting of stagnation periods will assist in evaluating the significance of the source emissions. Studies of rainfall pH will be conducted to correlate the acidity of rain with the chemistry of power plant emissions. Aircraft sampling will be continued to elucidate the factors controlling the appearance of ozone bulges in power plant and industrial plumes by coordinated measurements of ozone, hydrocarbons, nitrogen oxides, carbon monoxide, humidity, condensation nuclei, and temperature.
Keywords: FLUE GAS; TRACE AMOUNTS; ELEMENTS; POLYCYCLIC AROMATIC HYDROCARBONS; REFUSE DERIVED FUELS; COMBUSTION; OZONE; PLUMES; AIR POLLUTION; POWER PLANTS; PARTICLES; INCINERATORS; SAMPLING; PETROLEUM REFINERIES; SMELTING; INDUSTRIAL PLANTS; AEROSOL WASTES; CHEMICAL PROPERTIES; STATIONARY POLLUTANT SOURCES; MOBILE POLLUTANT SOURCES.

110047 Field Studies of Biologically Produced Atmospheric Sulfur Compounds. Bandy, A.R. (Drexel University, 32nd and Chesnut Streets, Philadelphia, PA, 19010). **Project number:** AEN 76-80322. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
R and D categories: Operational safety; Physical and chemical processes and effects.

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 and oceanic waters and the overlaying air in an urban environment (Norfolk, Virginia) and in a pristine area (Wallops Island, Virginia). Samples will be analyzed for hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl sulfide, carbon disulfide, and carbonyl sulfide. Meteorological observations will be made as aids to the identification of sources. Surface emission rates for marsh, shallow bay, and ocean will be estimated by calculations of the gas flux across a water-air interface using the method of Liss and Slater (Nature 247: 181(1974)).

Keywords: SULFUR DIOXIDE; FOSSIL-FUEL POWER PLANTS; PETROLEUM; COAL; SULFATES; ENVIRONMENTAL TRANSPORT; AQUATIC ECOSYSTEMS; OCEANOGRAPHY; SEAWATER; EARTH ATMOSPHERE; VIRGINIA; SULFIDES; ECOLOGICAL CONCENTRATION; MONITORING; SULFUR OXIDES.

110052 Pennsylvania Coal-Bearing Strata of the Narragansett Basin. Skehan, J.W. (Boston College, Weston Observatory, Weston, MA, 02193). **Project number:** AER76-02147. **Contract:** 76-02147. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Advanced Energy Research and Technology. **Funding:** NSF-$336,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The basic thrust is to determine whether reserves of coal of sufficient quantity and quality exist in the Narragansett Basin to justify development of the resource. The project has emphasized geologic exploration of the Basin and has relied on data from drill cores. Funds provided by NSF have been applied toward management utilization studies and geological research connected with the project, while costs of drilling are covered by contributions from other organizations. Among the scientific studies are: (1) detailed petrographic analysis of cores, including a study of illite crystallinity as a basis for prediction of metamorphic grade of coal; (2) lithologic analysis of cores for determination of sedimentary environment of coal deposits and prediction of stratigraphic sequence and distribution of coal beds; (3) additional fossil floral studies for stratigraphic correlation; (4) additional photogeologic study for mapping geologic structure; (5) analysis of geophysical well logs; and (6) additional gravity survey coverage of the Basin. In the nongeologic area the project emphasizes solutions for legal, economic, environmental, and societal problems associated with coal-mining development and finding ways of utilizing coal that are economically and environmentally acceptable to the region.
Keywords: COAL DEPOSITS; EXPLORATION; GEOLOGY; LITHOLOGY; DRILL CORES; PETROLOGY; STRATIGRAPHY; MAPS; WELL LOGGING; GRAVITY SURVEYS; SOCIO-ECONOMIC FACTORS.

110053 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: fossil fuels(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

This is an award for the second 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.

110054 Development and Testing of Risk-Benefit Cost Analysis for Policy Formulation. Gutmanis, I. (Sterling Hobe Corp., P.O. Box 19406, Washington, DC, 20036). **Project number:** 77-15501. **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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This is a new award focusing on the development of policy tools to provide a basis for systematic analysis and management of high consequence/low probability events. Current policy aids such as risk-benefit-cost analysis have provided primarily technical aggregate data to policy makers and little in the way of systematic information on component impacts and alternative utility functions and expectations. The result is that current analytical aids have been found deficient in their relevance to operational policy alternatives. This effort will attempt to improve the policy relevance of risk-benefit-cost analysis by developing quantitative and qualitative procedures for addressing the impacts of risks, benefits, and costs on relevant population subgroups associated with alternative policies. With the cooperation of the Department of Transportation, this improved tool will be tested on the consideration of alternative liquid natural gas policies currently under consideration. Both improvement in a policy tool and significant test of its use are expected as results of this award.
Keywords: COST BENEFIT ANALYSIS; ENERGY POLICY; LIQUEFIED NATURAL GAS; TRANSPORT; STORAGE.

110055 Chemical Lifetime of Sulfuric Acid Aerosols. Huntzicker, J.J. (Oregon Graduate Center, Beaverton, OR, 97005). **Project number:** AEN 76-16701. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

In recent years, studies by the US EPA have suggested that sulfuric acid aerosols (and perhaps other sulfates) are more damaging to human health than the common gas-phase precursor, sulfur dioxide. Sulfuric acid aerosols are damaging to vegetation and material surfaces and are probably also responsible for much of the acidic rainfall problem. Sulfuric acid aerosols are, in part, converted to less harmful sulfate salts as a result of neutralization by ammonia gas, which is also present in the atmosphere. However, present measurements of ambient levels of sulfuric acid, sulfates, and ammonia suggest that there is much less neutralization than would be expected on the basis of chemical equilibrium. It would appear that the amount of acid neutralized is limited by the rate of the process rather than its thermodynamics. In this project, controlled amounts of ammonia and sulfuric acid aerosols are allowed to react for various times under a variety of conditions in a reaction chamber. Then the products and left-over reactants are withdrawn and analyzed in order to establish the rates of neutralization under various conditions and thus determine factors that might be controlled to hasten the neutralization of sulfuric acid aerosols in ambient air.
Keywords: EARTH ATMOSPHERE; AIR POLLUTION; AEROSOLS; SULFURIC ACID; SULFUR DIOXIDE; AMMONIA; SULFATES; CHEMICAL REACTIONS; CHEMICAL REACTION KINETICS; PH VALUE; ACID RAIN.

110056 Portable Vibrating Structure for Soils Investigations. (Applied Nucleonics Co., Inc., P.O. Box 24313, Village Station, Los Angeles, CA, 90024). **Project number:** 77-19653. **Contract:** Ibanez, P. **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:** Operational safety; Characterization, measurement, and monitoring.

One of the largest sources of uncertainty in evaluating the seismic response of important structures such as nuclear power plants is the error in soil parameters used in the soil/structure interaction model. No adequate method for high strain in situ measurement of soil properties is currently available. This award is to develop such a method consisting of a portable structure excited by eccentric mass vibrators. The measured response of the structure would be coupled with theoretical models of the soil and a Bayesian parameter identification scheme to back evaluate critical soil parameters. Improved confidence in soil parameters would reduce expensive conservatism in nuclear power plants.
Keywords: NUCLEAR POWER PLANTS; REACTOR SITES; SOILS; SEISMIC EFFECTS; GEOLOGY; GEOLOGIC STRUCTURES.

110057 Response of Submerged Structures to Seismic Excitation. Ko, D.R. (Dynamics Technology, Inc., Torrance, CA, 90503). **Project number:** 78-09666. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(50); hydroelectric(50). **R and D categories:** Operational safety.

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 geome-

tries 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.

110058 Structure-Fluid Interaction Due to Earthquakes. Mei, C.C. (Massachusetts Institute of Technology, Cambridge, MA, 02139). **Project number:** 77-10236. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety.

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.

110059 Role of Primary Particulates in Urban Air Pollution. Novakov, T. (Lawrence Berkeley Laboratory, Berkeley, CA, 94720). **Project number:** 77-20076. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The first objective of the project is to assess the contribution of primary carbon (soot) emissions to the degradation of visibility through urban atmospheres. The visbility-degrading effect of primary carbon is compared with that of the secondary carbonaceous particulates formed by the oxidation of hydrocarbons in the atmosphere. A second objective is to define the roles of primary carbon in mediating the chemistry of the gaseous sulfur and nitrogen compounds in polluted air. The speed of the carbon-catalyzed oxidation of sulfur dioxide will be determined to help assess the significance of sulfate production on carbon particle surfaces and to gauge the importance of this process for the generation of hazardous airborne particulate sulfate. A parallel study is devoted to describing the surface-chemical forms of nitrogen compounds produced on carbon surfaces by reaction with atmospheric ammonia and nitrogen oxides. Polycyclic aromatic hydrocarbons associated with soot particles are investigated to determine their reactivity to nitrogen dioxide under practical conditions occurring in polluted air. This approach is designed to explore possibilities of the formation of unsuspected carcinogens in urban air. New methodology is being studied for measuring the atmospheric burden of primary carbon by applying the optical attenuation of a laser beam by a filter carrying less than a monolayer of collected airborne particles. Raman spectroscopy is applied to the measurement of graphitic soot. Techniques for probing the chemistry of surface reactions on carbon include ESCA (electron spectroscopy for chemical analysis), infrared spectroscopy, wet chemical analysis, and x-ray fluorescence.
Keywords: URBAN AREAS; EARTH ATMOSPHERE; SOOT; CARBONACEOUS MATERIALS; HYDROCARBONS; OXIDATION; SULFUR DIOXIDE; NITROGEN OXIDES; CHEMICAL REACTIONS; CHEMICAL REACTION KINETICS; POLYCYCLIC AROMATIC HYDROCARBONS; CATALYTIC EFFECTS; COMPARATIVE EVALUATIONS; AIR POLLUTION; AEROSOLS.

110060 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-$40,000.
Related energy source: solar(50); wind(50).

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 research 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.

110061 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:** Physical and chemical processes and effects.

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.

110062 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:** Operational safety; Characterization, measurement, and monitoring.

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.

110063 Systematic Approaches to Improved Policy Decision Making under Uncertainty. Raiffa, H. (Harvard University, Kennedy School of Government, Cambridge, MA, 02138). **Project number:** SOC 7716602. **Contract:** SOC 7716602. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Social Sciences. **Funding:** NSF-$71,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Operational safety; Environmental control technology; Integrated assessment; Health effects.

The study develops methods that enhance the applicability of decision-analytic techniques to public decisions. These techniques are applied to three case studies: (1) the regulation of chemical carcinogens with an emphasis on benzene pollution; (b) nuclear power plant siting; and (c) auto insurance. The methods used include: (1) evaluations of outcomes involving multiple attributes, especially human life and health; (b) assessing probabilities in the face of substantial uncertainties; and (c) designing institutional structures for decision making under uncertainty.
Keywords: NUCLEAR POWER PLANTS; SITE SELECTION; PLANNING.

110064 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: other advanced(100).

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.

110065 Development of an Integrated Laser-Low Energy Ion Accelerator Facility for the Training of Young Scientists in Energy-Related Atomic and Molecular Physics. Silverman, M.P. (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: other advanced(100).

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. The proposed project responds to an existing interest in highly excited atoms and molecules among faculty and students of the Physics Department of Wesleyan University by providing a strong, coherent, personalized program of training of young scientists in this area. Specifically, the 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.
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.

110066 World Carbon Budget: An Analysis Through Modeling. Woodwell, G.M. (Marine Biological Laboratory, Woods Hole, MA, 02543). **Project number:** DEB-7805327. **Contract:** DEB-7805327. **Supported by:** National Science Foundation, Washington, DC (USA). Dept. of Environmental Biology. **Funding:** NSF-$220,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The research will examine the importance of biota-CO2 interactions through detailed modeling. Extent of source/sink role of biota and importance of particulate organic carbon transfer to ocean depths will be studied.
Keywords: CARBON DIOXIDE; BIOLOGICAL MATERIALS; CARBON; MATHEMATICAL MODELS; PLANTS; ANIMALS; ORGANIC COMPOUNDS; SEAS; ENVIRONMENTAL TRANSPORT.

110067 Role of Terrestrial Ecosystems and Climatic Change in the Global Carbon Cycle. Harris, W.F.; Olson, J.S. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** DEB-7826722. **Supported by:** National Science Foundation, Washington, DC (USA). Dept. of Environmental Biology. **Funding:** NSF-$452,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The project will quantify the role of terrestrial ecosystems in balance and dynamics of global carbon cycle and estimate the effects of detectable climate change upon the distribution of carbon in such systems.
Keywords: TERRESTRIAL ECOSYSTEMS; CLIMATES; CARBON; ENVIRONMENTAL TRANSPORT; DISTRIBUTION.

110068 Paleolimnological Investigation of the Effects of Atmospheric Inputs of Acids and Heavy Metals on Lake Ecosystem Chemistry and Plankton. Davis, R.B.; Norton, S.A. (Univ. of Maine, Dept. of Botany and Plant Pathology, Orono, ME, 04473). **Project number:** DEB-7810641. **Contract:** DEB-7810641. **Supported by:** National Science Foundation, Washington, DC (USA). Dept. of Environmental Biology. **Funding:** NSF-$99,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The study will investigate acid precipitation and heavy metal fallout on lakes in northeastern U.S. and Scandinavia by analyzing sediment cores.
Keywords: USA; SCANDINAVIA; LAKES; ATMOSPHERIC PRECIPITATIONS; METALS; SEDIMENTS; AQUATIC ECOSYSTEMS; PLANKTON; CONTAMINATION; CHEMICAL PROPERTIES.

110069 Lichens as Ecological Indicators of Ozone Air Pollution. Nash, T.H. (Arizona State Univ., Dept. of Botany, Tempe, AZ, 85281). **Project number:** DEB-7610244. **Contract:** DEB-7610244. **Supported by:** National Science Foundation, Washington, DC (USA). Dept. of Environmental Biology. **Funding:** NSF-$3,513,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The research will analyze the distribution and abundance of lichens in mountains of southern California. The purpose is to determine how lichen communities respond to ozone stress. Laboratory studies will determine change in photosynthetic rates of lichens fumigated with ozone. Distribution and changes in lichen communities in the field will be related to ambient ozone stress. Lichens are a sensitive indicator of various air pollutants and this reasearch will provide data for their use as indicators of ozone pollution.
Keywords: LICHENS; BIOLOGICAL INDICATORS; DISTRIBUTION; CALIFORNIA; OZONE; MONITORING; AIR POLLUTION; PHOTOSYNTHESIS; BIOCHEMICAL REACTION KINETICS; STRESSES.

110070 Dynamic Behavior of Photochemical Aerosols. McMurray, P.H. (Univ. of Minnesota, Dept. of Chemical 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: fossil fuels(60); coal(20); oil and gas(20). **R and D categories:** Physical and chemical processes and effects.

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.

110071 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:** fossil fuels(50); coal(50). **R and D categories:** Environmental control technology.

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 efficiency 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.

110072 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(35); oil and gas(30); nuclear fission(35). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

110073 Chemical and Vibrational Kinetics of Nitric Oxide in Combustion. Hanson, R.K.; Kruger, C.H. (Stanford University, Mechanical Engineering Department, Stanford, CA, 94305). **Project number:** ENG77-20184. **Contract:** ENG77-20184. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Engineering. **Funding:** NSF-$50,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

Research deals with the conversion of fuel-bound and atmospheric nitrogen to nitrogen oxides during combustion. The research will involve three components: (1) a shock-tube study of nitric oxide (NO) kinetics in gas mixtures containing model fuel-nitrogen compounds, (2) a program to develop tunable laser spectroscopy techniques for the measurement of species concentrations in combustion gases, and (3) completion of shock-tube research on the rate of reaction which controls NO formation from atmospheric nitrogen. In the first study, mixtures of nitric oxide and a model fuel-nitrogen compound, ammonia (NH/sub 3/), will be shock-heated and spectroscopic measurements will be made of the concentration-time histories of critical species. The objective will be to develop a reaction mechanism which satisfactorily predicts the observed concentration-time histories. The research to develop tunable laser spectroscopy represents an application of recently developed tunable infrared diode lasers to measurements in combustion gases. These devices have great potential for non-perturbing in situ measurements of species concentrations, including radical species, in combustion flows. The rate of formation of NO from atmospheric nitrogen is known to be controlled by the reaction N/sub 2/ + O yields NO + N. Previously the value of the rate constant for this reaction had not been well known. As a part of this program, research will be completed to obtain accurate values of this rate constant, making use of a tunable CO laser to measure NO concentrations in shock-tube experiments.
Keywords: NITRIC OXIDE; CHEMICAL REACTION KINETICS; CHEMICAL REACTION YIELD; AMMONIA; COMBUSTION KINETICS; SHOCK TUBES.

110074 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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

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.

110075 In-Service Energy Institute for Junior and Senior High School Science and Mathematics Teachers. Metz, D.J. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** A/C 6804. **Contract:** SMI77-12827. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$15,000.
Related energy source: all(100).

The subject matter and format of the Institute is designed to acquaint the participants with fundamental concepts of energy from the perspectives of the basic sciences and engineering, and to explore the various aspects of power generation and utilization in an industrial society, including technological options, conservation measures, resources, environmental and health effects, and economic, social, and institutional factors. Approximately equal time is devoted to lectures, by Laboratory staff members, and workshop activities, guided by laboratory staff members. Participants are required to perform an active role through the preparation of written and oral reports in specific assigned areas. Tours of exprerimental areas of the Laboratory and field trips are integrated into the program.
Keywords: CURRICULUM GUIDES; EDUCATIONAL TOOLS; POWER GENERATION; ENERGY CONSERVATION; ENVIRONMENTAL IMPACTS; SOCIO-ECONOMIC FACTORS; ENERGY SOURCE DEVELOPMENT; INDUSTRY; ENERGY SOURCES; ENGINEERING.

110076 Biological Energetics of the Deep-Sea Benthic Boundary Layer. Smith, K.L. (University of California at San Diego, Scripps Institution of Oceanography, La Jolla, CA, 92037). **Project number:** OCE 7808640. **Contract:** OCE 7808640. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF-$94,000.
R and D categories: Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The goal of this study is a quantitative description of the flow of biological energy through the animal community living on and near the bottom of the deep sea. Measurements of oxygen consumption provide the basis for a comparative measure of the rate of energy utilization. Biochemical analyses of animal tissues are used to assess the storage of energy-rich material and the physiological status of the animals. The results should yield a significant increase in our understanding of the rate and direction of energy flow through the biological communities in the deep sea.
Keywords: BENTHOS; BOUNDARY LAYERS; OCEANOGRAPHY; BIOLOGICAL MODELS; COMMUNITIES; POPULATION DYNAMICS; OXYGEN; BIOCHEMICAL OXYGEN DEMAND; PHYSIOLOGY; METABOLISM; BIOLOGICAL MODELS; DYNAMIC FUNCTION STUDIES.

110077 Studies of Benthic Algal Growth and Reproduction: Life Forms and Life History Strategies. Neushul, M. (University of California at Santa Barbara, Marine Science Institute, Santa Barbara, CA, 93106). **Project number:** OCE 76 24360. **Contract:** OCE 7624360. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF.
Related energy source: biomass(100). **R and D categories:** Ecological/biological processes and effects.

The goal of this study is to learn how the marine environment influences the growth and reporduction of kelp and other benthic algae. Algae are cultured under controlled laboratory conditions, then transplanted to the field. Observations on nutrients, growth rate, and water motion are providing information on the optimum growing conditions for the plants.
Keywords: BENTHOS; ALGAE; PLANT GROWTH; REPRODUCTION; NUTRIENTS; CULTIVATION TECHNIQUES; WATER POLLUTION.

110078 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: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

110079 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: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

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.

110080 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: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

110081 *Shelf Sediment Dynamics Program.* Sternberg, R.W. (University of Washington, Department of Oceanography, Seattle, WA, 98195). **Project number:** OCE78-17089. **Contract:** OCE78-17089. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF-$150,000.
Related energy source: all(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

A program is described to evaluate existing shelf sediment transport models, site selection, and data inventory activities. The program comprises compilation and evaluation of existing information on shelf sediment dynamics to incorporate recent advances in instrumentation and theoretical models. The initial phase of the development of multidisciplinary studies of shelf sediment transport processes should be completed within the first two years. Pollutants derived from energy conversion facilities that can adsorb on particles will be distributed on the shelf by sediment transport. These studies are expected to aid understanding about the final disposition of radiochemicals and toxic materials that end up in the sediment.
Keywords: SEDIMENTS; CONTINENTAL SHELF; MOTION; KINETICS; WATER POLLUTION; ADSORPTION; SPATIAL DISTRIBUTION; RADIOACTIVE MATERIALS; TOXIC MATERIALS; ENVIRONMENTAL TRANSPORT.

110082 Large Scale Ocean Atmosphere Coupling in the North Pacific Ocean (NORPAX). Wyrtki, K. (University of Hawaii, Department of Oceanography, Honolulu, HI, 96844). **Project number:** OCE-7623173A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Ocean Sciences. **Funding:** NSF-$2,000,000; DOD-$1,200,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objective of this project is to analyze and understand the interactions between ocean and atmosphere on space scales of hundreds of kilometers and time scales of weeks to years, with the goal of learning more about the causes of the low frequency fluctuations on the ocean-atmosphere system. Emphasis is placed on the role of the upper ocean and research is conducted in the Pacific Ocean. A better understanding of the dynamics of ocean-atmosphere interactions on these scales will lead to improved long-range weather and climate predictions.
Keywords: OCEANOGRAPHY; PACIFIC OCEAN; EARTH ATMOSPHERE; MATHEMATICAL MODELS; WEATHER; CLIMATES; FORECASTING.

110083 Carbon Dioxide Interchanges Between Atmosphere and Biosphere: A Methodology Development for Application to Large Terrestrial Ecosystems. Rosenberg, N.J.; Verma, S.B. (University of Nebraska, Institute of Agriculture and Natural Resources, Lincoln, NB, 68583). **Project number:** ATM-77-27533. **Contract:** ATM-77-27533. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Atmospheric Sciences. **Funding:** NSF-$60,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives of this research are to evaluate the possible impacts of the world's agricultural lands on the global CO2 balance, to determine the influence of atmospheric and soil moisture conditions on the carbon balance of a perennial crop, and to estimate the contribution of soil, root, and crop respiration to the atmospheric CO2 balance in a typical agricultural region. Field measurements are being conducted of CO2 fluxes into and away from the earth's surface in a major agricultural region. The program is expected to yield data for evaluation of the role of agricultural lands in the global CO2 cycle.
Keywords: EARTH ATMOSPHERE; TERRESTRIAL ECOSYSTEMS; SOILS; CARBON DIOXIDE; ENVIRONMENTAL TRANSPORT; AGRICULTURE; CARBON CYCLE; GLOBAL ASPECTS; MOISTURE; CROPS; RESPIRATION; ENVIRONMENTAL EFFECTS; LAND USE; BIOMASS; CLIMATES; ECOLOGY.

110084 Gaseous Emissions from Natural Wetlands. Gillette, D.A.; Heidt, L.E. (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-$30,000.
R and D categories: Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are to measure fluxes of naturally emitted gases in a wetlands environment and to attempt to establish a global budget for wetlands sources of these gases. Micrometeorological and box methods will be used to measure fluxes of gases. Other environmental measurements include: Ph, Eh, conductivity of water, NO3/sup -/, NO2/sup -/, NH4/sup +/, and SO4/sup --/ content of water measured. Estimates will be made of world-wide production of gases

from a study of environmental conditions related to gaseous emissions.
Keywords: AQUATIC ECOSYSTEMS; GASEOUS WASTES; GLOBAL ASPECTS; AIR POLLUTION; NITROGEN DIOXIDE; AMMONIUM COMPOUNDS; SULFATES; NITROGEN COMPOUNDS; ECOLOGICAL CONCENTRATION.

110085 Acid Precipitation Experiment (APEX). (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.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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 specific meteorological conditions, and to explore several chemical conversion processes capable of producing acids. Atmospheric measurements of H2SO4, SO2, HNO3, NOx, NO3/sup -/, HCl, Cl/sup -/, NH3, NH4/sup +/, O3, elemental aerosol composition, and size distribution of aerosol are conducted. Measurements of dissolved analogs of those atmospheric constituents are made on samples of cloud water and precipitation water collected while the air measurements are made. Measurements of the surface, below cloud altitude, cloud base altitude, and above the boundary layer are made between Colorado and the New England Coast.
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.

110086 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: biomass(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

110087 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 fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The project objective is to contribute to an assessment of the atmospheric and health effects of airborne 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 are being investigated by standard tests of sex-linked recessive lethal mutations induced in Drosophila exposed to natural and elevated levels of alpha radioactivity in the culture media. 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.
Keywords: RADIOACTIVE AEROSOLS; RADON; DAUGHTER PRODUCTS; HEALTH HAZARDS; LEAD 210; POLONIUM 210; MORTALITY; ALPHA PARTICLES; DROSOPHILA; RADIOSENSITIVITY; RADIONUCLIDE KINETICS; MUTAGENESIS; CARCINOGENESIS; NEOPLASMS; RADIOINDUCTION.

110088 Atmospheric Transformation and Mutagenic Activity of Primary and Secondary Air Pollutants. Pitts, J.N. (University of California at Riverside, Statewide Air Pollution Research Center, Riverside, CA, 92521). **Project number:** AEN 78-01004. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(75); all(25). **R and D categories:** Operational safety; Physical and chemical processes and effects; Health effects.

Polluted urban air is the product of a diverse mixture of man-made contaminants that react chemically with one another and with naturally occurring atmospheric constituents to form a new class of secondary contaminants that include visibility-degrading aerosols, gaseous bioirritants, and various substances having unspecified effects on human health. These smog-forming chemical processes have a definite time-course that determines air quality at locations remote from the sources where a given parcel of air acquired its primary pollutants. The diversity of chemical species emitted by multifarious sources and the complexity of the chemical and photochemical processes involved, complicate the work of pollution control authorities, who cannot defend regulatory decisions without credible scientific evidence connecting demonstrable effects with identified sources subject to regulation. Following an earlier NSF/RANN project (73-02904-A04) to develop a kinetic computer model of smog photochemistry, this project undertakes to clarify the roles of certain highly active minor chemical species in smog formation (nitrous acid, pernitric acid, the hydroperoxyl radical). It seeks to elucidate the formation and roles of particulates in photochemical air pollution and to determine the chemical transformations of amines and nitrosamines in simulated polluted air. This includes the isolation of mutagenic fractions from ambient air and the identification of their chemical nature and origins. Finally, the research will investigate the chemical nature and possible mutagenic properties of airborne pollutants from agricultural burning. Experimental techniques include simulated photochemical smog formation, infrared spectroscopy, chemical analysis, gas and liquid chromatography, mass spectroscopy, and bacterial assays for mutagenesis.
Keywords: AIR POLLUTION; URBAN AREAS; EARTH ATMOSPHERE; CHEMICAL REACTIONS; PHOTOCHEMICAL REACTIONS; SMOG; PHOTOCHEMISTRY; AEROSOLS; NITROUS ACID; NITRIC ACID; HYDROPEROXY RADICALS; HYDROCARBONS; MATHEMATICAL MODELS; MUTAGEN SCREENING; PARTICLES; OZONE; SULFUR OXIDES; OXIDATION.

110089 Application of Computer Graphics to Air Quality Data Analysis. Vanderpol, A.H. (Meteorology Research, Inc., 464 West Woodbury Road, Altadena, CA, 91001). **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Integrated assessment.

This research proposal is aimed at developing statistical procedures which will enable researchers to probe large air quality data bases in a cost-effective manner. The research will lead to techniques by which scientists, unfamiliar with statistical procedures, can ask specific questions of large data bases of varying quality and expect to obtain useful information or insight. These procedures will be developed and tested using two existing European data bases which have not yet been analyzed in detail. These two data sets, from the European Air Chemistry Network (ECAN) and the Long Range Transport of Air Pollutants (LRTAP) study, will be probed to determine whether they will yield useful information on the relationship of SO2 emissions, air mass transport, and sulfate concentrations in Europe. The results of these studies will be directly applicable to several ongoing or planned U.S. regional scale studies of sulfur transport and conversion. The procedures to be developed will utilize powerful, but little known, existing statistical techniques which are especially suited for analysis of real data bases. These techniques are relatively insensitive to the occasional stray data points common in air pollution data.
Keywords: SULFUR DIOXIDE; EUROPE; SULFATES; AIR POLLUTION; AIR QUALITY; DATA ANALYSIS; DATA COMPILATION; COMPUTER GRAPHICS.

110090 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. **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:** Characterization, measurement, and monitoring; Physical and chemical

processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

110091 Chemical and Physical Characterization of Submicron Aerosols. Seinfeld, J.H. (California Institute of Technology, Pasadena, CA, 91125). **Project number:** ENV-76-04179. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.

Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The object of this research program is to develop a fundamental understanding of the formation and growth of submicron aerosol particles of importance in air pollution. The research program consists of theoretical and experimental studies aimed at elucidating the processes affecting the distribution of chemical species with respect to particle size for submicron aerosols. Major objectives of the program are: (1) to determine the processes which govern the emissions of submicron particles from combustion sources; (2) to develop a comprehensive mathematical model capable of simulating the dynamics of the size and composition distribution of air pollution aerosols; and (3) to develop a low-pressure impactor capable of fractionating particles below 0.5 micrometer diameter and use this impactor in conjunction with the combustion studies and in measurements of trace-metal concentrations in ambient air and in the vicinity of power plant plumes.

Keywords: FOSSIL FUELS; COMBUSTION PRODUCTS; PARTICLES; AEROSOLS; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; FOSSIL-FUEL POWER PLANTS; PARTICLE SIZE; COMBUSTION KINETICS; MATHEMATICAL MODELS; FRACTIONATION; PLUMES; AIR POLLUTION.

110092 Development of Multilayer Monochromators and Polarizers for Neutron Scattering. Schoenborn, B.P. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C 06919. **Contract:** 77-01133. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$65,000.

R and D categories: Characterization, measurement, and monitoring.

The goal of this project is to make highly efficient neutron polarizers and monochromators for use in a variety of scientific investigations in material science and molecular biology. Apart from the use of such devices at Brookhaven, a number of multilayer monochromators will be made available to other institutions. The initial investments and cost per device is much smaller than for other neutron monochromators (e.g., graphite). A system consisting of layers with contrasting scattering density with a large repeat period will be a very efficient monochromator. Such artificial monochromators, named multilayer monochromators, are made of alternate layers of different scattering material with widely differing scattering factors, e.g., Mn and Ge with scattering factors of -2.8 and .37 Fermis. Such multilayers offer a number of advantages over conventional monochromators. The reflectivities of these multilayers are very good; by depositing enough layers one can make a multilayer with approximately 90% reflectivity.

Keywords: NEUTRON SPECTROSCOPY; MANGANESE; GERMANIUM; MOLECULAR STRUCTURE; MONOCHROMATORS.

110093 Neutron Scattering Analysis of Biological Structures: An External Users Program. Schoenborn, B.P. (Brookhaven National Laboratory, Biology Department, Upton, NY, 11973). **Project number:** A/C 06911. **Contract:** PCM-16763. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$135,000.

R and D categories: Characterization, measurement, and monitoring; Health effects.

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. This difference makes it possible to distinguish the atomic constituents of proteins and the location of lipids, proteins and nucleic acids in large biological complexes such as cell membranes and ribosomes. Specific deuteration of a protein can be used to distinguish the labeled unit from its environment without affecting its chemical properties. 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.

Keywords: NEUTRON SPECTROSCOPY; MOLECULAR STRUCTURE; LIPIDS; PROTEINS; NUCLEIC ACIDS; CELL MEMBRANES; RIBOSOMES; LABELLING; NEUTRON BEAMS; BIOASSAY.

110094 Miniaturized Rapid Response Infrared Sensor for Low Carbon Dioxide Concentration. Bingham, G.E. (Lawrence Livermore Laboratory, P.O. Box 5507, L-524, Livermore, CA, 94550). **Project number:** DEB-77-16327. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$116,000.

Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is for developing a miniature CO/sub 2/ sensor that will accurately detect fluctuations of 0.1 ppM in the ambient CO/sub 2/ concentration. This sensor has a full-scale response of 10 Hz and an input power drain of 3 watts; is not sensitive to vibration or random accelerations; is designed to operate in noncondensing environments from -20 to +40 degrees C; weighs less than 0.5 kg; and can be be held in the palm of the hand. The principle of measurement is the differential absorption of CO/sub 2/ at 385 and 4.27 mu m. The instrument uses a CMOS microprocessor to correct for water vapor effects and density changes in the measurement path, and to output concentration directly. The microprocessor also allows accurate calibration using a single gas; other design factors should eliminate the need for repeated calibrations at intervals less than several months. Initial prototypes of this instrument will be available for optimization and field testing during the summer and fall of 1978.

Keywords: CARBON DIOXIDE; ECOLOGICAL CONCENTRATION; AIR POLLUTION MONITORS; INFRARED SPECTRA; EARTH ATMOSPHERE.

110095 Phytotoxic Organic Chemical Compounds. Ross, R.H. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** IA 40-413-73. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Advanced Energy Research and Technology. **Funding:** NSF-$150,000.

Related energy source: fossil fuels(100). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

Organic chemical compounds are known to be potentially phytotoxic. The primary objective of this project is to catalog many of these organic chemical compounds which have proven to be phytotoxic. A broad-scaled literature information search and retrieval process for the years 1920 to present was initiated and completed and appropriate papers selected and data extracted. The finished product will be a catalog containing approximately 5000 entries.

Keywords: ORGANIC COMPOUNDS; TOXINS; PLANTS; INFORMATION SYSTEMS; CLASSIFICATION.

110096 Mercury in the Environment at Almaden, Spain. Huckabee, J.W. (Oak Ridge National Laboratory, Environmental Sciences Division, Building 1505, Oak Ridge, TN, 37830). **Project number:** OIP75-01775-A01. **Contract:** OIP-01775-A01. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of International Programs. **Funding:** NSF-$166,000.

Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The program objective is to determine concentration and form of mercurials in selected ecosystem compartments near the Almaden mine. Seasonal (2/yr) collections and analyses of the selected environmental media will be made. Results will be published in open literature. Results should indicate the extent and location of Hg in the environment under conditions of high atmospheric and aquatic effluents.

Keywords: MERCURY; SPAIN; MINERAL CYCLING; ECOSYSTEMS; MINES; CHEMICAL STATE.

110097 Material Spiraling in Stream Ecosystems. Brocksen, R.W. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** 40-689-78. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$325,000.

R and D categories: Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives of this project are to (1) elucidate the pathways of nitrogen and phosphorus through a stream ecosystem, (2) develop a model for describing the dynamics of N and P transfer in streams, (3) examine the role of various physical, chemical and biological variables on N and P retention and transport in streams, and (4) determine the relationship between the spiralling length, defined as the length of stream required for complete turnover of the downstream flux of a nutrient by the biotic components, of N and P and stability properties of stream ecosystems subjected to perturbations. Radioactive and stable isotopes are being used to determine the dynamics of N and P in natural and artificial streams. Physical, chemical and biological variables such as gradient, flow, and community structure will be manipulated to examine their effects on N and P retention and transport in artificial stream systems. The spiralling lengths of N, P, and C will be altered in natural streams by experimental perturbations such as fertilization, starvation, scouring, and poisoning in order to determine the relationships between spiralling length and stability properties of stream ecosystems. A preliminary estimate of the spiralling length of phosphorus in Walker Branch, Tennessee, has been obtained. These results are being analyzed for publication. Experiments to test the hypothesis of phosphorus limitation on decomposition rates and primary production rates in Walker Branch have been completed and data are being analyzed for open literature publication. These experiments demonstrated P limitation but also indicated that N may be partially limiting.
Keywords: AQUATIC ECOSYSTEMS; NITROGEN; PHOSPHORUS; ENVIRONMENTAL TRANSPORT; ECOLOGICAL CONCENTRATION; MINERAL CYCLING.

110098 Extending Systems Analysis in Ecology. Shugart, H.H.; Gardner, R.H. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** DEB-77-25781. **Supported by:** National Science Foundation, Washington, DC (USA). **Funding:** NSF-$395,000.
R and D categories: Ecological/biological processes and effects.

The objectives of this work include: (1) exploration of areas of topical importance in ecology in which systems--ecological applications could aid in the development of the field; (2) determination of solutions to certain problems that have emerged in the subdiscipline of systems ecology; and (3) identification of applications in ecology of systems--theoretic techniques from other sciences. The project extends work that began during the NSF-funded IBP Program and is dedicated to the development of systems ecology as a vigorous subdiscipline in the field of ecology. The project is strongly oriented toward basic research and in spinning-off models and mathematical methods to other ecological research programs.
Keywords: ECOLOGY; BIOLOGICAL MODELS; POPULATION DYNAMICS; MATHEMATICAL MODELS; TERRESTRIAL ECOSYSTEMS.

111022 Remote Measurement of Air Pollutants. Murray, R.E.; Byer, R.I. (Stanford Research Institute and Stanford University, Menlo Park, CA, 94025). **Project number:** 77-10198. **Supported by:** National Science Foundation, Washington, DC (USA). Div. of Problem Focused Research. **Funding:** NSF.
R and D categories: Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The present grant is a continuation of work done under Grants GI-38986 and AEN75-14997 A02. The objective is the development of laser methods for remote measurement of atmospheric levels of gases such as sulfur dioxide (SO2), nitrogen dioxide (NO2), ozone (O3), ethylene (C2H4), and ammonia. These techniques are needed for monitoring ambient levels of gases in polluted air and for obtaining average concentrations integrated over kilometer (or longer) pathlengths to provide data for testing pollutant dispersion models. The work employs the differential absorption laser-radar (DIAL) technique whereby light transmitted from a laser source is back-scattered from atmospheric particles or from topographic targets (like a hillside). The light beam is tuned to a wavelength strongly absorbed by a molecule of interest. From the time delay between the sending and the receipt of the returned back-scattered signal pulses, one can determine gas concentrations at various distances along the path. The concept has been tested for measurement of SO2 and O3 in the ultraviolet and of NO2 in the visible spectrum. Under the present grant the investigators will demonstrate the performance of the system under different pollutant-gas levels and variable meteorological conditions. The technique will be extended to the infrared to explore the advantages of this spectral region for detecting a wider variety of gases and for potentially greater detection sensitivity. Special attention will be given to ammonia and ozone in the infrared.
Keywords: AIR POLLUTION; REMOTE SENSING; LASERS; SULFUR DIOXIDE; NITROGEN DIOXIDE; OZONE; ETHYLENE; AMMONIA; ECOLOGICAL CONCENTRATION.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

120005 Solar UV-B Damage to Skin. Grube, D.D. (Argonne National Lab., Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** T3568E. **Supported by:** National Aeronautics and Space Administration, Washington, DC (USA). **Funding:** NASA-$30,000.
Related energy source: fossil fuels(5); solar(95). **R and D categories:** Health effects.

The long term objective of the project is to establish a quantitative measure of solar UV-B damage to skin. The studies are concerned with: (1) establishing dose-response characterizations on the photomediated-induction of molecular lesions in the epidermal DNA of hairless mice following exposure to different spectra of ultraviolet light; (2) identifying induced molecular lesions which result in initiation of skin tumorigenesis; (3) determining the role of repair mechanisms in tumorigenesis; and (4) characterizing the molecular lesion and systemic factors which influence the expression of uv-induced skin tumors. Two strains of hairless mice that differ markedly in susceptibility to the induction of skin carcinomas are exposed to different fluence and spectra of ultraviolet light, alone or in combination with other carcinogenic treatments. Using varying exposure regimens, the following biological endpoints have been determined: (1) the deposition and fate of uv-induced molecular lesions in epidermal DNA; (2) dose-response relationships for skin tumor induction; and (3) modulating factors influencing initiation as compared to the expression of uv-induced tumorigenesis. Preliminary results implicate specific photoadducts in carcinogenesis and illustrate the importance of promotional influences on strain differences in susceptibility. The ongoing studies will establish the dose requirements for initiation as compared to the expression of tumorigenesis in the two strains of hairless mice.
Keywords: SOLAR RADIATION; ULTRAVIOLET RADIATION; IRRADIATION; MICE; BIOLOGICAL RADIATION EFFECTS; SKIN; NEOPLASMS; DNA; STRAND BREAKS; BIOLOGICAL REPAIR; CARCINOGENESIS; MOLECULAR BIOLOGY; DOSE-RESPONSE RELATIONSHIPS; CARCINOGENS; SYNERGISM; RADIOINDUCTION.

120007 NASA Skin Cancer and Solar UV-B Damage to Skin. Fry, R.J.M. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 40-681-78. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** NASA-$35,000.
R and D categories: Health effects.

The objective is to determine the dose response relationships for ultraviolet radiation (uvr)-induced tumorigenesis. Hairless mice are exposed to various regimes of uvr. In the first experiment, the fluence per fraction is constant at 1.5 x 10-cubed J/m-sq and the number of fractions varies from 3 to 36. Phorbol ester treatment is used after the uvr in order to maximize the initiation events and thus tumor responses can be obtained after relatively few exposures to uvr. In the second experiment the dose per fraction is variable, but the number of fractions is constant at 36. These experiments are complementary to ones carried out by us at ANL under DOE funding. The salient features important to risk assessment are (1) the tumorigenic effect of uvr plus chemical photosensitization is influenced by the fractionation regime, (2) strain-dependent differences lie mainly in the expression rather than the initiation of tumorigenesis, and (3) uvb is a potent promoter indicating the importance of the risk of combined exposures to chemicals and uvr.
Keywords: ULTRAVIOLET RADIATION; MICE; SKIN; NEOPLASMS; DOSE-RESPONSE RELATIONSHIPS; RADIOINDUCTION.

120008 NASA uv-Induced DNA Damage and Repair in Cultured Human Cells. Regan, J.D. (Oak Ridge National Laboratory, Biology Division, P.O. Box Y, Oak Ridge, TN, 37830). **Project number:** 40-565-76. **Supported by:** Department of Energy, Washington, DC (USA). Office of Health and Environmental Research. **Funding:** NASA-$37,000.
R and D categories: Health effects.

There is concern that depletion of the stratospheric ozone layer will allow an increase in the amount of biologically harmful ultraviolet radiation (290 to 320 nm = uv-B) penetrating to the Earth's surface. One of the possible consequences of such an increase in uv-B is an increase in human skin cancer, especially among light skinned populations. This study is based on the concept that skin cancer is induced in part by unrepaired pyrimidine dimers (uv-light induced) in the DNA of basal or squamous cells. The three most likely major factors involved in skin cancer induction by uv are: (1) dose (exposure x intensity), (2) penetration through the stratum corneum and pigment layers, and (3) capacity of cellular repair mechanisms to remove dimers. The loss of dimers in the DNA of cells grown in culture is a measure of enzymatic repair capacity. If

biopsy material from skin cancer patients shows more dimers/unit dose and/or less repair capacity than that from control, an extremely valuable tool will be available for assessing the skin cancer problem. Normal human skin cells grown in culture can excise about one million uv-light induced pyrimidine dimers from their DNA during a 24 hour period. This is the amount of dimers produced by 5J/m-sq of 254 nm light or approximately 30,000 J/m-sq of 313 nm light.
Keywords: MAN; SKIN; NEOPLASMS; RADIOINDUCTION; ULTRAVIOLET RADIATION; BIOLOGICAL REPAIR; PYRIMIDINES; DIMERS; DNA; RADIATION DOSES.

TENNESSEE VALLEY AUTHORITY

130001 Atmospheric Transformation of Emissions from Coal-Fired Power Plants: (a) Full-Scale Field Studies. Meagher, J.F. (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-$179,000; TVA-$150,000.
Related energy source: coal(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to identify the mechanisms responsible for chemical transformations in coal-fired power plant plumes. Emphasis will be placed on the SO2-sulfate and NO-NO2-nitrate conversion. Crosswind profiles and average concentrations of the various plume constituents are obtained by traversing the plume with an instrumented aircraft. Measurements are made at different altitudes for each of several locations downwind of a power plant. Additional gaseous and particulate samples are collected and returned to the laboratory for detailed analysis. Data will be collected under various meteorological conditions. The data obtained will be used to calculate conversion rates for primary effluents. These rates will be correlated with changes in temperature, relative humidity, solar intensity, and plume constituent concentrations. A mechanism will be postulated to explain the observations.
Keywords: FOSSIL-FUEL POWER PLANTS; AIR POLLUTION; FIELD TESTS; PLUMES; SULFUR DIOXIDE; SULFATES; NITRIC OXIDE; NITROGEN DIOXIDE; NITRATES; CHEMICAL EFFLUENTS; CHEMICAL REACTION KINETICS.

130002 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:** Physical and chemical processes and effects.

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.

130003 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:** Ecological/biological processes and effects.

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.

130004 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:** Ecological/biological processes and effects.

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.

130005 Characterize and Quantify the Transfer, Rate, and Effects of SOx, NOx and Acid Precipitation in the 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: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

130006 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:** 80BDO. **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:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

130007 Fate and Effects of Atmospheric Emissions from Cooling Systems on Terrestrial Habitats. Noggle, J.C. (TVA, Air Quality Research Section, E and D Building, Muscle Shoals, AL, 35660). **Project number:** 80BDP. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$10,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to evaluate the impact of moisture, salts, and toxic trace metals released from cooling towers on the terrestrial environment. Study plots located in areas of maximum and minimum deposition are utilized to evaluate the effect of increased moisture levels, salt deposition, and toxic heavy metals on growth and vigor of selected species. Accumulation of heavy metals on and in vegetation, as well as nutrient loss and accumulation in the soil, are evaluated. Wet-dry collectors are installed at the near and remote sites to assess the rate of mineral deposition. Estimates of plant uptake and/or foliar contamination will be obtained. Laboratory analysis of mineral deposition on soybean and mustard leaves and in the wet-dry collector at the site nearest the cooling towers (1 km) revealed no significant differences from those at the most distant site (9 km). There were no significant differences in either grain yield of soybeans or vegetative growth of mustard between the sites.
Keywords: COOLING TOWERS; ENVIRONMENTAL IMPACTS; MOISTURE; TERRESTRIAL ECOSYSTEMS; METALS; PLANTS; METABOLISM; SOYBEANS; BRASSICA; NUTRIENTS; SOIL CHEMISTRY.

130008 Remote Sensing of SO2 Effects on Vegetation. Sapp, C.D. (TVA, Air Quality Research Section, E and D Building, Muscle Shoals, AL, 35660). **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/biological processes and effects.

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.

130009 Strip Mine Drainage Water Quality with Emphasis on Toxic Substances. Ruane, R.J. (TVA, 246 401 Building, Chattanooga, TN, 37401). **Project number:** 79BDS. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$189,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The goal of this project is to demonstrate methodologies for predicting the impact on downstream biotic communities, based upon characterisitcs of the site to be mined. The approach will be to: (1) identify the occurrence and significance of trace metals in a strip mined area; (2) calibrate existing regionalized hydrologic models using data from surface mined watersheds; (3) develop or extend nonpoint source water quality models so that the natural-area environmental loadings of important water quality constituents can be predicted; (4) relate the transport of significant trace metals and other important water quality constituents to the hydrology of small strip mined watersheds; (5) develop relationships between the chemical composition of strip mine overburden and the downstream transport of important constituents over and above the natural-area environmental levels; and (6) relate the transport of important constituents to the structure and function of biological communities.
Keywords: SURFACE MINING; ACID MINE DRAINAGE; TOXICITY; WATER QUALITY; ENVIRONMENTAL IMPACTS; AQUATIC ECOSYSTEMS; METALS; TRACE AMOUNTS; HYDROLOGY; MATHEMATICAL MODELS; ENVIRONMENTAL TRANSPORT; FORECASTING; WATERSHEDS; WATER POLLUTION; SEDIMENTS; SURFACE WATERS.

130010 Evaluation and Improvement of Models Used for Radiological Impact Assessment of Gaseous Releases from Nuclear Power Plants. Doty, R.L. (Tennessee Valley Authority, River Oaks Building, Muscle Shoals, AL, 35660). **Project number:** 80BDM. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$44,000.
Related energy source: coal(40); nuclear fission(60). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives are to obtain data useable in the evaluation and refinement of analytical models used for radiological impact assessment of nuclear power plants (emphasis to be placed on components of direct radiation), and to develop meteorological data analysis procedures that help refine intermediate and long-range transport models (results to be applicable to both nuclear and coal-fired power plants). Using pressurized ionization chambers, external gamma radiation exposure rates were measured in the vicinity of a riverside nuclear power reactor. These rates were correlated with effluent and meteorological characteristics. Data analysis procedures will be developed using statistical techniques and large-scale computer systems. Background and operational radiation levels around Browns Ferry Nuclear Plant were determined. Analyses of exposure rates and meteorological and plant operational data were performed. Development of data analysis procedures has just begun.
Keywords: NUCLEAR POWER PLANTS; RISK ASSESSMENT; METEOROLOGY; RADIONUCLIDE MIGRATION; RADIOACTIVITY; MATHEMATICAL MODELS; GAMMA RADIATION; BROWNS FERRY-1 REACTOR; BROWNS FERRY-2 REACTOR; BROWNS FERRY-3 REACTOR; RADIOACTIVE EFFLUENTS; RADIATION MONITORING; DATA ACQUISITION.

130011 Development and Evaluation of an Integrated Approach to the Optimization of Nuclear Power Plant Radiological Surveillance Programs. Kanipe, L.G. (TVA, River Oaks Building, Muscle Shoals, AL, 35660). **Project number:** 80BDI. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$50,000.
Related energy source: nuclear fission(90); nuclear fusion(10). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of the project are to: (1) develop and maintain a model quality assurance program for radiological surveillance; (2) develop improved radiological monitoring techniques; and (3) develop information applicable to optimizing an environmental radiological monitoring program. The emphasis in this task is to be on development of a multiple-laboratory program. The methods employed are to: (1) produce an analytical quality control document which can be used by radiological laboratories for quality control monitoring of procedures, counting equipment, and data handling; (2) develop a program of interlaboratory studies, standards, and analytical and counting procedures to use as standard methods in multiple laboratories; (3) provide guidelines for gamma counting and data reduction techniques; and (4) develop information on a cost-effective radiological surveillance program through the use of statistical methodologies, parametric studies and analysis of sampling procedures. An interlaboratory standards and cross-check program has been established. Necessary evaluation of available surveillance data and existing surveillance programs is complete, as is a preliminary critical pathway analysis. Three reports have been published.
Keywords: NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; RADIATION MONITORING; FISSION PRODUCTS; FISSION PRODUCT RELEASE; AIR POLLUTION MONITORS; QUALITY ASSURANCE.

130012 Effects of High Intensity Electric Fields. Barnett, J.H. (TVA, 350 Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: all(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

There is much national concern about the effects on people exposed to electric fields from EHV and UHV power lines and equipment. The solution of problems associated with exposure to these fields involves the identification of biological effects and biomedical problems and the advancement of technology to minimize electric fields in the vicinity of transmission lines and equipment. This project will consist of an ongoing review of research being conducted nationally, investigations of specific problems and

solutions related to electric fields on the TVA power system, and investigation of ways to apply the results of the national effort to the TVA power system.
Keywords: TENNESSEE VALLEY AUTHORITY; EHV AC SYSTEMS; UHV AC SYSTEMS; POWER TRANSMISSION LINES; ELECTRIC FIELDS; BIOLOGICAL EFFECTS; HEALTH HAZARDS.

130013 Develop Comparative Economics of NOx Emission Control Processes. Faucett, H.L. (Tennessee Valley Authority, Office of Agricultural and Chemical Development, Emission Control Development Projects, Muscle Shoals, AL, 35660). **Project number:** 80BFU. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$100,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The primary objective of this project is to perform technical assessments, preliminary economic evaluations, and detailed cost analyses of selected NOx abatement processes. The project will be conducted in three phases. Phase I will include a technical feasibility evaluation of all candidate NOx control processes. The main task of Phase II will be to perform preliminary economics for selected NOx removal processes identified in Phase I. Based on the results of Phase II, a more detailed engineering study of selected NOx removal processes will be performed in Phase III. In addition, an NH3 availability and cost projection study to the year 2000 has been done. TVA will also participate in the pilot plant proposal evaluation which is a part of EPA's program on NOx removal technology. The Phase II NOx report has been drafted. Following completion of typing, the report will be transmitted to EPA for review. The NH3 availability and cost projection study has been transmitted to EPA for review.
Keywords: NITROGEN OXIDES; AIR POLLUTION ABATEMENT; ECONOMICS; CONTROL; REMOVAL; AMMONIA; COAL; COMBUSTION; FOSSIL-FUEL POWER PLANTS; CHEMICAL EFFLUENTS; FEASIBILITY STUDIES.

130014 NOx Technology. Wells, W.L. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Oak Ridge (USA). **Funding:** TVA-$25,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130016 Particulate Technology. Huang, C.M.; Frank, R.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130017 Lime/Limestone Advanced Concepts--TVA's 1-MW Pilot Plant (Colbert) for EPA. Hollinden, G.A.; Robards, R.F. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; OTHER.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130019 ASTM Air Quality Evaluation Methods. Robards, R.F.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$1,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

This project is designed to determine how reliable the standard methods are for measuring the major pollutants in ambient air and in emissions from principal sources, based on accuracy, reproducibility, and repeatability. The American Society for Testing and Materials (ASTM) has initiated a project to determine the reliability, accuracy, and reproducibility of standard methods for measuring the major pollutants in ambient air. TVA is a cosponsor of the project and the Power Research Staff keeps abreast of their accomplishments.
Keywords: AIR QUALITY; EVALUATION; AIR POLLUTION MONITORS; STANDARDS; POLLUTION REGULATIONS.

130020 Sludge Disposal from Sulfur Dioxide and Particulate Removal Processes. Crowe, J.L. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objective of the program is to evaluate data which is 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. Approaches utilized will be 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. Acceptable methods for disposal of these sludges have not been established, and new data are being generated on the subject. In order to solve the problem of sludge disposal, this data must be collected, summarized, and evaluated.
Keywords: SLUDGES; WASTE DISPOSAL; SULFUR DIOXIDE; PARTICLES; FLY ASH; FOSSIL-FUEL POWER PLANTS; WASTE MANAGEMENT; SOLID WASTES.

130022 Processing Sludges from Lime/Limestone Wet Scrubbing Processes for Disposal on Recycle for EPA-FBC Waste Task. Crowe, J.L. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; OTHER-$15,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives of this task are to chemically and physically characterize waste products from fluidized bed combustion processes and to determine disposal methods for this material. The scope of this task consists of characterizing waste material produced by fluidized bed combustion of coal using scanning electron microscopic investigation, infrared analysis, x-ray crystallography and analytical procedures, summarizing and evaluating methods of disposal for these waste products, and recommending future testing as required. All monies to carry out this project will be EPA pass-through funds. Characterization of bed materials from fluidized bed combustors operated by various research facilities has been completed. Potential methods for disposal have been identified. Preparation of a final report is in progress.
Keywords: LIME-LIMESTONE WET SCRUBBING PROCESSES; WASTE PROCESSING; SLUDGES; WASTE DISPOSAL; RECYCLING; FLUIDIZED-BED COMBUSTION; WASTE MANAGEMENT; COAL; SOLID WASTES; CHEMICAL PROPERTIES; FOSSIL-FUEL POWER PLANTS.

130023 TVA's Program to Test a Fish Pump to Reduce Fish Impingement at Brown's Ferry Nuclear Plant. Ray, S.S. (TVA, 1320

Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The Water Research Program has an Intake Structures Subprogram with the objective, among others, of determining whether a fish pump can be effectively utilized to reduce fish impingement at Browns Ferry Nuclear Plant. The specific objectives of this project are to determine the performance of the pump and maintenance and operational problems in an on-site demonstration. The scope of the project includes the purchase and installation of a fish pump, operation of the pump, data acquisition through identification and enumeration of fish impinged on the screens and of those transported by the pump, data evaluation, and reporting.
Keywords: BROWNS FERRY-1 REACTOR; BROWNS FERRY-2 REACTOR; BROWNS FERRY-3 REACTOR; PUMPS; INTAKE STRUCTURES; FISHES; IMPINGEMENT.

130024 Trace Element Study. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130025 Beneficial Uses of Waste Heat: General. Snipes, R.L.; Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: coal(50); nuclear fission(50).

The Biological Research Program is a Waste Heat Utilization Subprogram 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 including an interface with the cogeneration projects.
Keywords: WASTE HEAT UTILIZATION; RESEARCH PROGRAMS; DEMONSTRATION PROGRAMS; CO-GENERATION; THERMAL POWER PLANTS; TENNESSEE VALLEY AUTHORITY; THERMAL EFFLUENTS.

130027 Alleviation of Power Plant Condenser and Raw Water System Fouling by Corbicula. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$175,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50).

The Biological Research Program has a Control of Nuisance Organism Subprogram designed to develop equipment and techniques to minimize adverse biological impacts on power facilities. This project is designed to develop methods to alleviate Corbicula fouling at TVA steam-electric generating facilities. Mechanical systems, chlorination, molluscicides, controlled release paints, ozonation, heat treatment, closed-loop designs and other methods which appear feasible will be evaluated. A state-of-the-art review and evaluation of potential for application in terms of environmental, technical, and operational feasibility for each of the defined methodologies will be produced. Phase I will consist of laboratory testing and evaluation of chemical, mechanical, and thermal control systems for the control of Corbicula. Phase II will consist of the development of conceptual designs and cost estimates for both totally integrated closed-loop and individual closed-loop raw water systems. The information obtained in Phases I and II will be applied to an operating facility in Phase III.
Keywords: FEASIBILITY STUDIES; ANTIFOULANTS; BIOLOGICAL FOULING; THERMAL POWER PLANTS; CONDENSERS; COOLING SYSTEMS.

130029 Study of Methods to Prevent Saturation of Closed Loop Ash Ponds Systems. Flora, H.B. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$2,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The Water Research Program has an Effluent Control Subprogram which has the objective of evaluation and development of methods to control the chemical composition of effluent discharges. The primary objective of this project is to study methods which have potential application for desaturating liquor loops of closed loop recirculation systems at ash ponds. The scope of the project includes summarizing and evaluating data and reviewing application concepts. Funds are not provided for an extensive experimental program.
Keywords: FLY ASH; PONDS; CLOSED-LOOP CONTROL; WASTE MANAGEMENT; SATURATION; ASHES; WATER QUALITY; FOSSIL-FUEL POWER PLANTS; COAL.

130030 Protection of Aquatic Life at Power Plant Cooling Water Intakes. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$20,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Ecological/biological processes and effects.

The Water Research Program has an Intake Structure Subprogram which has, among others, an objective to evaluate, investigate, and develop various mechanisms to divert and/or protect aquatic life in power plant cooling water. The specific objectives are: to review the operation and kinematics of the vertical traveling screen, to determine future potential test needs and development needs, to develop the use of wedge-wire screens, to initiate and/or continue test programs to develop these two technologies, and to review reports relating to the development of the technologies presently being tested by TVA. The scope of the program consists of compiling detailed information on the mechanics, operation, and kinematics of vertical traveling screens; reviewing this information to determine which technology or portion of a technology has the best potential use and/or need for development, following wedge-wire screen research and developing related manufacturing specifications; participating in TVA's wedge-wire research as project manager initiating test programs for vertical traveling and wedge-wire screens by informing TVA of the potential ability of these technologies to provide adequate protection to aquatic life; and reviewing reports that evaluate the applicability of fine mesh vertical traveling screens and wedge-wire screens to power plant intakes. A report of the wedge-wire screen in-river testing will be published.
Keywords: POWER PLANTS; COOLING SYSTEMS; INTAKE STRUCTURES; AQUATIC ECOSYSTEMS; TEMPERATURE EFFECTS; THERMAL POLLUTION; THERMAL EFFLUENTS; WATER POLLUTION; WATER POLLUTION ABATEMENT; BIOLOGICAL EFFECTS; SCREENS.

130031 Heat Dissipation Technology. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$20,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The Water Research Program has a Thermal Control Subprogram which has the objective of continuously evaluating the state-of-the-art of cooling technology. The technologies to be monitored include cooling towers, spray systems, cooling ponds, and advanced systems. The project may be expanded to include the construction and testing of prototype facilities if necessary to meet TVA requirements. The project objectives will be accomplished by literature reviews and studies to ensure the accurate evaluation of cooling systems. Economic analyses will be conducted to establish the feasibility of the various systems. If the construction and testing of experimental facilities is necessary, additional funds will be required.
Keywords: POWER PLANTS; THERMAL EFFLUENTS; COOLING SYSTEMS; COOLING TOWERS; COOLING PONDS; EVAPORATIVE COOLING; DATA ACQUISITION; DATA ANALYSIS; ECONOMICS; THERMAL POLLUTION; WATER POLLUTION; WATER POLLUTION ABATEMENT; DIFFUSION; FEASIBILITY STUDIES.

130032 Thermal Effects from Steam-Electric Generating Facilities. Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$25,000.

Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

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. The main objectives of the project are to (1) become familiar with the different aspects of thermal effects; (2) determine whether there is a potential for predicting thermal effects from TVA power plants; and (3) develop competence in evaluating systems to minimize thermal effects. The scope of the project will consist mainly of an in depth literature search to determine the state-of-the-art of thermal effects from steam-electric generating facility. Techniques to predict thermal effects on aquatic biota will be investigated.

Keywords: POWER PLANTS; THERMAL EFFLUENTS; THERMAL POLLUTION; WATER POLLUTION; TEMPERATURE EFFECTS; AQUATIC ECOSYSTEMS; BIOLOGICAL STRESS; WATER POLLUTION ABATEMENT; BIOLOGICAL EFFECTS; FISHES.

130033 Membrane Processes for Refurbishing Power Plant Water Supply. Flora, H.B.; Boroughs, R.D. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.

Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology.

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.

130034 Use of Waste Heat in Sewage Sludge Disposal. Snipes, R.L.; Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.

Related energy source: coal(50); nuclear fission(50). **R and D categories:** Environmental control technology.

The Biological Research Program has a Waste Heat Utilization Subprogram designed to evaluate and develop waste heat utilization technology. This project is designed to review and evaluate existing technology on the use of waste heat from steam-electric generating facilities for sewage and sludge treatment. The major objectives will be to define the state-of-the-art in this particular area and determine whether TVA should initiate a development program at any of its generating facilities. The scope of the project includes reviewing and evaluating existing technology, summarizing results of the review, and concluding whether or not there is justified potential for successfully integrating a sewage or sludge treatment facility with a TVA power plant. Funds are not provided for an extensive research or development program.

Keywords: WASTE HEAT; SEWAGE SLUDGE; WASTE DISPOSAL; WASTE PRODUCT UTILIZATION; TECHNOLOGY ASSESSMENT; POWER PLANTS; THERMAL EFFLUENTS; THERMAL POLLUTION; WATER POLLUTION; WATER POLLUTION ABATEMENT.

130035 Fly Ash Characterization and Disposal. Flora, H.B. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA; OTHER-$155,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130036 Refuse Burning at Allen Steam Plant. Parker, F. (TVA, 410 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$12,000.

Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objective is to review and comment on proposals and reports concerned with supplying refuse-derived fuel to TVA's Allen Steam Plant for use as a supplemental fuel. This will be accomplished by working with the city of Memphis to build a demonstration facility.

Keywords: FOSSIL-FUEL POWER PLANTS; BOILER FUEL; REFUSE DERIVED FUELS; COMBUSTION; DEMONSTRATION PROGRAMS; MUNICIPAL WASTES.

130037 Widows Creek Unit 8--Limestone Wet Scrubber. Wells, W.L. (TVA, 470 Commerce Union Bank Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$100,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130038 SOx Technology. Wells, W.L.; Hollinden G.A. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

130039 Study of Methods to Reduce Chlorine Discharges. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$25,000.

Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology.

The Water Research Program has an Effluent Control Subprogram which has, among others, an objective to develop, through research, methods to assess the quality of chlorinated effluents and to reduce the magnitudes of chlorinated discharges either through reduction in the use of chlorine or the use of an alternative biocide to comply with discharge regulations under the NPDES permits. The primary objective of this project is to evaluate and assess processes that can accomplish this goal in an environmentally compatible manner. The scope of this project is to study and summarize the methods by which chlorine discharges from once-through cooling systems and cooling tower blowdown may be reduced and to review and comment on other studies being conducted. Also, alternative mechanisms to treat biofouling will be studied. Funds are not provided for extensive experimentation.

Keywords: COOLING SYSTEMS; COOLING TOWERS; FEASIBILITY STUDIES; BIOLOGICAL FOULING; ANTIFOULANTS; CHLORINE; RESEARCH PROGRAMS; THERMAL POWER PLANTS.

130040 Characterization of Effluents from Caol-Fired Utility Boilers for EPA--Assessment of Gaseous Emissions from Different Boilers Task. Crooks, J.R. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 017-15-4008.6. **Contract:** TV-41967A.

Supported by: Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; OTHER-$300,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130041 Advanced Waste Heat Control for EPA. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; OTHER-$1,020,000.
Related energy source: coal(50); nuclear fission(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130043 Information--Technology Transfer--Computer Economics. Torstrick, R.L. (TVA, Office of Agricultural and Chemical Development, Emission Control Development Projects, Muscle Shoals, AL, 35660). **Project number:** 80 BBH. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Utilities and Industrial Power Div. **Funding:** EPA.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The objective is to develop computer economics based on Shawnee lime-limestone program, a users manual, and computer applications for production and marketing of abatement byproducts. Results of the computer program will be made available to prospective users by preparing specific computer runs or by providing users with copies of program and assisting with its use. A computer program will be documented and a users manual will be prepared including procedures for assessing the system developed during Phase II of the sulfuric acid marketing studies. The result will be tape copies of the Shawnee Lime-Limestone Computer Program along with accompanying documentation which have been sent to the following companies: Argonne National Laboratory; Exxon; PEDCo; UOP; City of New York, Environmental Protection Administration; Carnegie-Mellon University; Gibbs and Hill, Inc.; Burns and Roe, Inc.; and Michael Baker, Jr., Inc.
Keywords: LIME-LIMESTONE WET SCRUBBING PROCESSES; INFORMATION SYSTEMS; TECHNOLOGY TRANSFER; COMPUTER CODES; AVAILABILITY; WASTE PRODUCT UTILIZATION; SULFURIC ACID; MARKET; ECONOMICS.

130044 Develop Comparative Economics of SOx Control Processes. McGlamery, G.G. (TVA, Office of Agricultural and Chemical Development, Emission Control Development Projects, Muscle Shoals, AL, 35660). **Project number:** 80 BBI. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Utilities and Industrial Power Div. **Funding:** EPA-$250,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The purposes and objectives of this project include the economic evaluation and review of potentially attractive SO2 removal processes and assessment of their technical development. The methods employed are: (1) selecting of processes for evaluation (by TVA and EPA); (2) defining study objectives and economic premises; (3) contacting sources of technology; (4) preparing flowsheets, material balances, and layouts; (5) estimating equipment costs; (6) preparing capital investments and operating costs; (7) evaluating costs sensitivities; and (8) preparing report draft. The Sludge I report has been published and distributed by EPA. The Sludge II report has been completed and the draft is being reviewed by EPA. The Phase III sludge work has just begun with three processes being evaluated at this time. Flowsheets, process and equipment features of the three physical coal-cleaning processes have been reviewed with vendors and material balances have been upgraded. Three chemical coal-cleaning processes are also being evaluated. Several FGD processes have been evaluated and a draft report covering three of them is being prepared.
Keywords: SULFUR OXIDES; AIR POLLUTION CONTROL; COMPARATIVE EVALUATIONS; ECONOMICS; FLUE GAS; DESULFURIZATION; TECHNOLOGY ASSESSMENT; COST; POLLUTION CONTROL EQUIPMENT; REMOVAL; COMPUTERS; SCRUBBERS.

130045 Byproduct Marketing. O'Brien, W.E. (TVA, Office of Agricultural and Chemical Development, Emission Control Development Projects, Muscle Shoals, AL, 35660). **Project number:** 80 BBJ. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Utilities and Industrial Power Div. **Funding:** EPA-$300,000.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology; Integrated assessment.

The objectives are to (1) screen potential uses of abatement sulfur byproducts in the fertilizer industry, and (2) evaluate best alternatives for economic gain to power and fertilizer by incorporating potential fertilizer supply and demand into the marketing model. Potential marketing of byproduct gypsum, sulfur, and sulfuric acid from power plants in the U.S. will be assessed through use of systems analysis of SOx abatement processes. The Phase I sulfuric acid marketing report has been published and released. The Phase II sulfuric acid marketing report has been completed and a draft has been released to EPA for review. The Phase II gypsum report has been sent to the publisher.
Keywords: DESULFURIZATION; SULFUR; SULFURIC ACID; GYPSUM; MARKET; FERTILIZER INDUSTRY; ECONOMICS; ELECTRIC UTILITIES; MATHEMATICAL MODELS; FOSSIL-FUEL POWER PLANTS; SULFUR OXIDES; AIR POLLUTION CONTROL; INFORMATION SYSTEMS; EMISSION; GASEOUS WASTES; CHEMICAL EFFLUENTS; TRANSPORT; COMPUTERS; FLUE GAS; WASTE PRODUCT UTILIZATION; BY-PRODUCTS.

130046 Development of Flue Gas Desulfurization Technology: Shawnee Lime/Limestone Scrubbing Program TVA/EPA. Crowe, J.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 017-15-4026. **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA; OTHER-$1,350,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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 TVA 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, and 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 maintenance of the test facility; engineering, procurement, and construction for modification; field testing of sludge disposal techniques; and expansion of computer program for projecting the design and economics of full-scale lime and limestone FGD system.
Keywords: FLUE GAS; DESULFURIZATION; LIME-LIMESTONE WET SCRUBBING PROCESSES; DEMONSTRATION PROGRAMS; RELIABILITY; EFFICIENCY; ECONOMICS; SULFUR DIOXIDE; REMOVAL; AIR POLLUTION CONTROL; FOSSIL-FUEL POWER PLANTS; SCRUBBERS.

130048 Advanced Concepts SO2 Removal Processes Improvements. Potts, J.M. (TVA, Office of Agricultural and Chemical Development, Applied Research Branch, Muscle Shoals, AL, 35660). **Project number:** 79 BBM. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Utilities and Industrial Power Div. **Funding:** EPA.
Related energy source: fossil fuels(50); coal(50). **R and D categories:** Environmental control technology; Integrated assessment.

The project involves bench-scale level laboratory investigation of promising concepts for improving SO2 removal and recovery processes. Scrubbing systems using ammonia, potassium, calcium, and zinc salts in solutions and slurries will receive attention. Studies will be made of the absorption and regeneration steps including solubility of absorbents and reaction products in scrubbing liquors; oxidation, precipitation, decomposition, and reduction steps for applicable systems; and gas-liquid contacting devices. A final report on the work is being completed at this time.
Keywords: SULFUR DIOXIDE; REMOVAL; RECOVERY; BENCH-SCALE EXPERIMENTS; SCRUBBERS; REGENERATION; CHEMISORPTION; AMMONIA; POTASSIUM COMPOUNDS; CALCIUM COMPOUNDS; ZINC COMPOUNDS; AQUEOUS SOLUTIONS; SLURRIES; FOSSIL-FUEL POWER PLANTS; FLUE GAS; SAMPLING; AIR POLLUTION CONTROL; FLUE GAS; SORPTIVE PROPERTIES.

130049 Home Insulation Research and Demonstration Program. Whisenant, W.C. (TVA, DB PSC 3, Chattanooga, TN, 37401). **Project number:** 782-51-524. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$108,000.
Related energy source: conservation(100).

The objective of the program was to identify and develop the most economic means of applying insulation and reducing heat loss from existing homes heated electrically, especially those owned by people with low incomes; and to demonstrate to such homeowners the potential energy and cost savings for these improvements. The approach was to select a limited number (80) of low-income homes with electric heat and high energy use; to determine and implement measures needed to reduce heat losses substantially (add insulation, weatherstripping, etc.) and work with homeowners to better manage heat energy and appliances; and to work with local community service agencies to assist in adding ceiling insulation in up to 300 homes of low income owners as needed. The average home consisted of about 1,000 square feet. Winterizing costs averaged $440.10 per home. The cost of insulating attics averaged 15.2 cents to bring up to R-19 level. The average cost for floor insulation was 21.3 cents per square foot for R-11. Savings during the 1976--1977 heating season averaged 3,895 kWhs. Current savings for 1977--1978 will be available by September 1978.
Keywords: LOW INCOME GROUPS; RESIDENTIAL BUILDINGS; ENERGY CONSERVATION; THERMAL INSULATION; DEMONSTRATION PROGRAMS; WEATHERSTRIPPING; ELECTRIC APPLIANCES; ECONOMICS.

130050 Load Metering Program. Eskander, S.S. (TVA, 712 Power Board Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$225,000.
Related energy source: conservation(100).

The Load Metering Program involves the installation of special metering facilities to determine the time integrated load characteristics for sample groups of retail customers. One purpose of the program will be to evaluate metering techniques, sampling theory, and data processing requirements for future load research activities. However, the main purpose of the program will be to yield information that is urgently needed for current cost-of-service, rate design, forecasting, and load management research assignments, and the scope of this initial research has been developed accordingly. A stratified sample of 600 retail customers of the Electric Power Board of Chattanooga, Tennessee, was selected and assigned to six residential intervals, 11 commercial-industrial (no demand) intervals, and 7 commercial industrial (with demand) classes of customers. These customers were next interviewed using questionnaires to obtain pertinent demographic, appliance data, construction characteristic, etc., which may impact energy use patterns on customers. TVA purchased and retains title to all metering equipment, and the distributor (Electric Power Board of Chattanooga) will be reimbursed for the cost of installing and removing the equipment and for obtaining customer questionnaire responses for the test customers. The distributor will be responsible for installation and removal of meter tapes at selected intervals. TVA will provide for the translation of meter tapes and such computer programming as may be required to analyze the data. The electricity demand for the sample customers will be recorded for up to a 3-year period. These data will provide information that is urgently needed to help facilitate current cost of service, rate design, forecasting, and load management research. In addition, this pilot program will help evaluate metering techniques and equipment that will be utilized in later projects to test specific rate designs.
Keywords: TENNESSEE VALLEY AUTHORITY; POWER SYSTEMS; LOAD MANAGEMENT; ELECTRIC POWER; RATE STRUCTURE; POWER DEMAND; POWER METERS; ENERGY CONSUMPTION; FORECASTING; COST.

130051 Beneficial Uses of Waste Heat: Greenhouses. Snipes, R.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring.

The project is designed to evaluate the feasibility of utilizing power plant heated water discharges for heating and cooling greenhouses. TVA is using a prototype greenhouse at Muscle Shoals, Alabama, to develop present technology for application in a demonstration scale facility at TVA's Browns Ferry Nuclear Plant in Decatur, Alabama.
Keywords: BROWNS FERRY-1 REACTOR; BROWNS FERRY-2 REACTOR; BROWNS FERRY-3 REACTOR; WASTE HEAT UTILIZATION; GREENHOUSES; AGRICULTURE.

130053 Fine Mesh Screening Alternatives for Power Plant Intakes. Tomljanovich, D.A. (TVA, Forestry Building, Ridgeway Road, Norris, TN, 37828). **Supported by:** Tennessee Valley Authority, Norris (USA). **Funding:** EPA-$60,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

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.

130056 Ecological Recovery after Reclamation of Toxic Spoils Left by Coal Surface Mining. Zarger, T.G. (TVA, Division of Forestry, Fisheries, and Wildlife Development, Norris, TN, 37828). **Project number:** EPA ID No. 80 BDQ. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Resource Extraction and Handling Div. **Funding:** EPA-$67,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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 distrubed 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.

130058 Long Pit Strip Mining Reclamation Demonstration Project. Allen, N. Jr. (TVA, 503 Power Building, Chattanooga, TN, 37401). **Project number:** K-1-988-90-990.6006. **Contract:** TVA-71P-98-E4. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$6,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring.

The long pit mine mining operation is continuing, but the status of the project is no longer experimental. Costs for monitoring of past project work only are being incurred in the experimental areas.
Keywords: COAL MINING; SURFACE MINING; LAND RECLAMATION; DEMONSTRATION PROGRAMS; COST; MONITORING.

130059 Response of Freshwater Systems to Electric Power Production. Isom, B.G.; Murray, S.A.; Tennessen, K.J.; Dycus, D.L. (TVA, Water Quality and 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:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

130060 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. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$31,000.
Related energy source: coal(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

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.

130061 Reoxygenation of Reservoirs and Hydroelectric Turbine Releases. Ruane, R.J. (TVA, 246 401 Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Muscle Shoals, AL (USA). **Funding:** TVA-$26,000.
Related energy source: hydroelectric(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The objectives of the project are to: (1) evaluate alternative methods of aerating reservoirs and reservoir research; (2) develop design criteria, cost estimates, and methods of operation for small bubble oxygen injection diffusers; and (3) quantify the aquatic impacts and benefits of aeration to various minimum dissolved oxygen levels. The work involves: (1) feasibility studies of alternative aeration techniques and their application; (2) laboratory experiments to test techniques (e.g., small bubble oxygen diffusers tested in 40' by 7' diameter tank); (3) field tests to develop design criteria, cost data, and operating procedures; and (4) full scale field operations to examine aquatic effects.
Keywords: HYDROELECTRIC POWER PLANTS; WATER RESERVOIRS; AERATION; MIXING; OXYGEN; HYDRAULIC TURBINES; DESIGN; FEASIBILITY STUDIES; COST; DIFFUSERS; OPERATION; AQUATIC ECOSYSTEMS.

130062 Thermal Effluent Computer Modeling Research. Waldrop, W.R. (TVA, Engineering Laboratory, P.O. Drawer E, Norris, TN, 37828). **Supported by:** Tennessee Valley Authority, Norris (USA). **Funding:** EPA-$27,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Environmental control technology; Integrated 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.

130063 Develop Economic Projection Modeling Capability Necessary to Drive Modular Energy and Environmental Planning Models at a Multicounty Level. Hinote, H. (TVA, 270 Liberty Building, Knoxville, TN, 37902). **Project number:** 79 BDU. **Supported by:** Tennessee Valley Authority, Knoxville (USA). **Funding:** EPA-$74,000.
R and D categories: Integrated 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 macroenomic data base at a multicounty level that is necessary for rigorous site specific analyses. Much of the conceptual work has been done, but a significant effort is required to make the model an operational tool for driving energy and environmental planning models. A demonstration of the two sector model (population--labor force and employment sectors) for a multicounty area will be completed by June 1979.
Keywords: TENNESSEE VALLEY REGION; ENERGY MODELS; REGIONAL ANALYSIS; ECONOMIC ANALYSIS; SOCIO-ECONOMIC FACTORS; SOCIAL IMPACT; ECONOMIC IMPACT; NUCLEAR POWER PLANTS; THERMAL POWER PLANTS; EMPLOYMENT; MATHEMATICAL MODELS.

130064 Electric Power System Operation and Expansion Environmental Residual Model. Evans, B.D. (TVA Power Resource Planning, 216 Power Building, Chattanooga, TN, 37401). **Project number:** E-AP-77-BDV. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The model was developed in conjunction with and in parallel to the development of the TVA Power System Integrated Planning Model. The model has the capability of predicting the residual output of a power system on a plant-by-plant basis and of evaluating expansion policies. The model is based on the power system simulation model developed by TVA.
Keywords: MATHEMATICAL MODELS; TENNESSEE VALLEY AUTHORITY; PLANNING; AC SYSTEMS; OPERATION; COMPUTERS.

130065 Develop and Demonstrate Application of Computer Graphics to Energy System Environmental Impact Assessment. Babb, M.C. (TVA, 264 401 Building, Chattanooga, TN, 37401). **Project number:** 80BDW. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$164,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Integrated assessment.

The objective of this project is to demonstrate ways in which computer graphics can be used to enhance or otherwise hasten environmental analysis through innovative displays and interactive analysis with the computer. Demonstrations will be developed which utilize the range of graphic hardware and software currently available to highlight ways for producing: (1) suitable figures for reports and publication; (2) innovative displays describing complex relationships or voluminous sets of data; and (3) displays that are rapid, reliable, require minimal development effort, and produce high quality graphics. Publications and reports outlining experiences, benefits, and limitations of using computer graphic techniques will be issued.
Keywords: NUCLEAR POWER PLANTS; FOSSIL-FUEL POWER PLANTS; HYDROELECTRIC POWER PLANTS; ENVIRONMENTAL IMPACTS; REGIONAL ANALYSIS; MATHEMATICAL MODELS; COMPUTER GRAPHICS; INTERACTIVE DISPLAY DEVICES; SOCIO-ECONOMIC FACTORS.

130070 Waste Heat Utilization: Biological Recycling. Bond, B.J. (TVA, Division of Agricultural Development, T218 NFDC, Muscle Shoals, AL, 35660). **Project number:** 80BBF. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$57,000.
Related energy source: conservation(100). **R and D categories:** Operational safety; Environmental control technology; Characterization,

measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objectives of this study are to (1) develop a method that could use waste heat from power plant condenser discharge water to achieve nutrient recycling and use livestock manures from confined livestock facilities to grow aquatic and/or terrestrial plants, and (2) develop the cultural requirements to grow selected aquatic organisms (e.g., fish, clams, and other herbivorous filter-feeding organisms) to consume plants grown from livestock manure and enhance this production with waste heat. Selected aquatic organisms will be screened and evaluated for their potential response to simulated waste heat water temperatures such as algae, filter feeding finfish (ilapia, silver carp, bighead carp, and freshwater invertebrates (asiatic clams) when grown in livestock manure enriched water. A small scale system will be designed, constructed, and tested for integrated aquatic plant and aquatic animal production using livestock manure and simulated waste heat water temperatures. Silver carp, bighead carp, and tilapia grown in polyculture in swine waste enriched water during the summer have produced the equivalent of 1412 kg/ha in 52 days. Silver carp and tilapia have shown excellent growth. Algae growth has been limited to naturally occurring species with high growth rates. Warm water grown algae has less crude protein on a dry weight basis and changes the dominant species in a culture. Chinese water chestnuts yield was 22.4 to 26.9 metric tons/ha using swine manures in a no-heat study. A replicated study is being designed for a winter-time study to demonstrate the potential for warm water to produce fish, treat waste, and overwinter tilapia.
Keywords: WASTE HEAT UTILIZATION; RECYCLING; THERMAL POWER PLANTS; NUTRIENTS; FISHES; PROTEINS; MANURES; ALGAE; DOMESTIC ANIMALS; PRODUCTION; AQUACULTURE; DEMONSTRATION PROGRAMS; PRODUCTION.

130071 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. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$44,000.
Related energy source: fossil fuels(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Laboratory studies are planned to improve analytical procedures and provide acceptable alternate analytical methods for several pollutants from energy-critical areas in the Ohio and Tennessee River Valleys. Specific tasks involve the development and/or verification of quantitative methods including: acrolein by voltammetry at positive potentials; total arsenic by voltammetry for comparison with atomic absorption and colorimetry; cadmium, lead, copper, zinc simultaneously by voltammetry; digestion techniques for suspended and dissolved metals by atomic emission plasma and referenced to atomic absorption; chromium (hexavalent and trivalent) simulataneously by voltammetry or ion chromatography; extractable organic pollutants in sediments; and metals in fish tissue.
Keywords: FOSSIL-FUEL POWER PLANTS; OHIO VALLEY REGION; TENNESSEE RIVER; WASTE WATER; GASEOUS WASTES; QUANTITATIVE CHEMICAL ANALYSIS; VOLTAMETRY; ABSORPTION SPECTROSCOPY; CHROMATOGRAPHY; METALS; FISHES; WATER POLLUTION; LIQUID WASTES.

130072 Processing Sludges from Lime/Limestone Wet Scrubbing Processes for Disposal or Recycle for EPA: Sludge to Fertilizer Task. Duggan, J.C. (Tennessee Valley Authority, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 017-15-4007.1. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$195,000.
Related energy source: coal(100). **R and D categories:** Environmental control tcchnology.

The objective is to obtain data on the variables in bench scale and pilot plant production of fertilizer from scrubber by-product sludges, on compatibility factors involved in granulation, drying, storage, and mixing with conventional fertilizers, and on the trace elements in fertilizer mixture. These data are considered in determining the marketability of fertilizer produced from these materials. Through the use of the cross pipe reactor, small bench scale and pilot plant investigations will be made to determine optimum mixture between sludge, air, ammonia, and acid to achieve desired melt conditions. In addition to a product marketing evaluation support, activities will include granulation, drying, and storage studies and plot and field scale investigations. Initial pilot plant studies using the preneutralizer have been made with oxidized sludge with positive results. Studies with unoxidized sludge have been less encouraging due to evolution of SO2 and foaming during the preneutralization step.
Keywords: BENCH-SCALE EXPERIMENTS; PILOT PLANTS; FLUE GAS; SCRUBBING; SLUDGES; DRYING; STORAGE; AIR; MIXTURES; AMMONIA; INORGANIC ACIDS; MARKET; OXIDATION; FERTILIZERS; PRODUCTION; FOSSIL-FUEL POWER PLANTS; WASTE PROCESSING; RECYCLING.

130073 Processing Sludges from Lime/Limestone Wet Scrubbing Processes for Disposal or Recycle for EPA-Scrubber-Sludge Correlation Task. Crowe, J.L.; Wells, W.L. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 017-15-4007.2. **Contract:** TV-41967A. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** TVA-$20,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

Results are presented of a study to define the range of variability of solids characteristics produced by the Shawnee 10-Mw prototype scrubbers and to correlate. Through scanning electron microscopic investigation, infrared analysis, x-ray crystallographic and analytical procedures, the range of variability of sludge solids produced by two 10-Mw prototype scrubbers located at the Shawnee facility was determined and correlated with operational parameters. Characterization studies from the Shawnee scrubbing facility have been made and correlations of these characterizations to scrubber operation have been completed. A final report is in preparation.
Keywords: SLUDGES; LIMESTONE; FLUE GAS; SCRUBBING; TENNESSEE VALLEY AUTHORITY; WASTE PROCESSING; CORRELATIONS; FOSSIL-FUEL POWER PLANTS.

130074 Processing Sludges from Lime/Limestone Wet Scrubbing Processes for Disposal or Recycle for EPA: Revegetation of SO2 Waste Disposal Ponds Task. Duggan, J.C. (Tennessee Valley Authority, 440 Commerce Union Bank, 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: fossil fuels(100). **R and D categories:** Environmental control technology.

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.

130075 Characterization of Effluents from Coal-Fired Utility Boilers. Flora, H.B. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Contract:** TV-41967A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA-$604,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130076 Morphological Deformities in Procladius from Coal Strip Mine Ponds. Tennessen, K.J. (TVA, E and D Building, Muscle Shoals, AL, 35660). **Project number:** EPA-IAG D8-E721-D5. **Supported by:** Environmental Protection Agency, Washington, DC (USA). **Funding:** EPA-$66,000.
Related energy source: coal(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The purpose of this study is to investigate the factor(s) causing lingual deformities in Procladius larvae by: (1) characterizing the water and sediments found in coal strip mine ponds located near Brilliant, Alabama, in order to identify any possible causitive factors; (2) searching for nematode parasites in the larvae; (3) determining larval population densities in the strip mine ponds; and (4) analyzing the gut content of normal and aberrant larvae for an indication of diet as a possible factor. Laboratory rearing of nonaber-

rant larvae at various population densities and in the presence of various levels of possible causitive factors will be performed in order to induce lingual aberrations. Six months worth of data has been collected on pond water characteristics and population densities. Culturing methods for our bioassay study is currently under development.
Keywords: SURFACE MINING; PONDS; MORPHOLOGICAL CHANGES; POPULATION DENSITY; INSECTS; LARVAE; CHEMICAL EFFLUENTS; BIOLOGICAL EFFECTS; WATER POLLUTION.

130077 Waste Heat Utilization: Soil Heating. Bond, B.J. (TVA, Division of Agricultural Development, T218NFDC, Muscle Shoals, AL, 35660). **Project number:** 80BBF. **Supported by:** Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry. **Funding:** EPA-$37,000.
Related energy source: conservation(100).

The objectives of this program are to (1) evaluate the use of heated water for warming soil to enhance crop growth and increase yields, and (2) determine the optimum lateral spacing and burial depth for water distribution lines. Water heated to temperatures which simulate the condenser discharge from a nuclear power plant is circulated through buried polyethylene pipes to the soil. Various vegetable crops, including sweet corn, squash, and bush beans, among others, are grown. Data are collected on soil temperature distribution and heat effects on crop yield. With 43 degrees C water temperatures in April and May, soil temperatures over the water pipes were increased an average of 6 degrees C at the 3-inch depth, 9 degrees C at the 6-inch depth, and 14 degrees C at the 12-inch depth when pipes were spaced 18 or 36 inches apart. A 9-inch line spacing resulted in slightly greater temperature increases. The positive plant growth responses to soil heating occur primarily in April and May with a tendency toward negative responses in mid-summer when ambient soil temperatures are near optimum for plant growth. During the 1978 growing season, yield increases due to soil heating with pipes placed 18 inches deep and 36 inches apart were 76% for Silver Queen sweet corn, 20% for Golden Security sweet corn, 44% for crook-neck squash, and 34% for bush beans. Soil heating with pipes spaced 9 or 18 inches apart resulted in significantly smaller yield increases apparently because above-optimum soil temperatures occurred in the later part of the growth cycle.
Keywords: NUCLEAR POWER PLANTS; WASTE HEAT UTILIZATION; CROPS; PRODUCTION; VEGETABLES; SOILS; AGRICULTURE; MAIZE; BEANS; FEASIBILITY STUDIES; DEMONSTRATION PROGRAMS; HEATING.

130078 Commuting by Van Pooling. Barnett, J.H. (TVA, 350 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-993.024. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.
Related energy source: conservation(100).

The objective of this program is to assess the potential of van pooling to reduce petroleum consumption and to evaluate internal combustion engine vans as to their appropriateness in van pooling for intra-city applications. Data obtained from TVA van pools to determine economic and resource savings resulting from van pooling will be evaluated. TVA will work with regional transit authorities and industrial facilities to determine management, dispatch, and routing. Pilot demonstrations in local industries and communities will be instituted.
Keywords: TENNESSEE VALLEY AUTHORITY; VANPOOLING; INTERNAL COMBUSTION ENGINES; FEASIBILITY STUDIES; MANAGEMENT; INDUSTRIAL PLANTS; FUEL CONSUMPTION; ENERGY CONSERVATION.

130079 Advanced Combustion Technology, General. Mayfield, M.J. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990-1035. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: fossil fuels(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

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 development related to advanced combustion and assessing the potential for application to the TVA power system are on-going continuous functions of the Power Research 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 furnaces with flue gas scrubbing.
Keywords: FLUIDIZED-BED COMBUSTION; RESEARCH PROGRAMS; TECHNOLOGY ASSESSMENT; COMBUSTION; FLUE GAS; SCRUBBING.

130080 Assessment of Chemical Discharge Effects on the Aquatic Environment. Goss, L.B.; Johnson, J.T. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6034. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Ecological/biological processes and effects.

Programs are reported that are 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 state-of-the-art of chemical discharges effects on aquatic biota, determine the needs for specific research on specific chemicals, and develop detailed plans for warranted research. Detailed state-of-the-art reviews and assessments of informational needs will be made on the various chemicals discharged from power facilities. As warranted from these reviews and assessments, detailed research project plans will be developed for determining acceptable levels of chemical discharges and studies will be carried out. A preliminary state-of-the-art review has been conducted on chlorine.
Keywords: FOSSIL-FUEL POWER PLANTS; LIQUID WASTES; ENVIRONMENTAL EFFECTS; MAXIMUM PERMISSIBLE CONCENTRATION; TOXIC MATERIALS; RESEARCH PROGRAMS; PLANNING.

130081 Fluidized Bed Waste Utilization Project. Duggan, J.C. (Tennessee Valley Authority, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1066. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

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.

130082 Study of Magnetite Recovery from Fly Ash. Parker, F.G.; Wilson, R.D. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1067. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$34,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

A program is reported that is designed to determine the amount of ash derived magnitite that can be economically removed and collected; to determine if ash derived magnitite can be used in heavy media coal cleaning facilities; to compare cost and efficiencies of using ash derived magnetite versus commercial grade magnetite; and to develop a process flow diagram for removal of magnetite from fly ash. The approach to be used for this project will include: (1) obtaining samples of Paradise Steam Plant's fly ash and contracting with appropriate organizations to define whether magnetite can be recovered economically and efficiently from fly ash; (2) contracting with appropriate organizations to perform demonstration plant studies to determine the useability of derived magnetite in a heavy media coal cleaning process; (3) conducting an assessment to define the potential of locating a magnetite recovery plant at Paradise Steam Plant; and (4) if other results are positive, designing a plant to recover magnetite from fly ash.
Keywords: FOSSIL-FUEL POWER PLANTS; TENNESSEE VALLEY AUTHORITY; FLUE GAS; FLY ASH; MAGNETITE; ECONOMICS; REMOVAL; BUILDUP; RECOVERY; USES; COAL PREPARATION PLANTS; SEPARATION PROCESSES.

130083 Thermogravimetric Analysis (TGA) for Coal Combustion. Badin, E.J. (Tennessee Valley Authority, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1076.

Supported by: Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$19,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

130084 Feasibility of Using Pyrolysis Byproduct Char as Power Plant Fuel. Williams, G.C. (Tennessee Valley Authority, 1360 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1036. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$165,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

A program is reported that is designed to evaluate the commercial potential of utilizing char produced from the Occidental Research pyrolysis process as a boiler fuel. Occidental Research Corporation and the State of Kentucky plan a 250 ton/day coal pyrolysis plant. TVA will evaluate the possibility of providing space for this plant at an existing TVA power plant in Kentucky. Suitability of the char as a boiler fuel will be determined by conducting laboratory tests on fuel and ash properties. In addition small-scale test burns will be conducted to evaluate combustion characteristics. If the tests indicate feasibility, a full-scale test program for a TVA power plant will be recommended. An economic assessment of char utilization will also be performed. By early 1978 sufficient quantities of representative char samples from eastern bituminous coals are expected to become available from Occidental's pilot pyrolysis plant to permit detailed testing of the char characteristics (burnability, ash products, etc.).
Keywords: OCCIDENTAL FLASH PYROLYSIS PROCESS; CHARS; BOILER FUEL; COAL GASIFICATION PLANTS; PILOT PLANTS; PLANNING; PROCESS DEVELOPMENT UNITS; EVALUATION; COMMERCIALIZATION.

130085 Mineral Recovery from Coal Ash. Parker, F.G.; Jarrett, M.V. (Tennessee Valley Authority, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1039. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

A program is reported that is designed to investigate a process utilizing fly ash as a source of minerals, to assess the potential for collecting aluminum and iron in a marketable form, and to study the possibilities of recovering trace metals from fly ash. TVA will analyze information provided by MGC and provide samples for analysis by MGC. If the process indicates promise, a one ton/day pilot plant will be designed and operated at a TVA site to demonstrate extraction of aluminum and iron from fly ash. Concurrently, the engineering design for a 10 ton/hour pilot plant will be developed. Bench-scale tests have been conducted by MGC on the extraction of metals from fly ash. Preliminary results indicate the feasibility of the process. Additional results and test data are expected from MGC for analysis by TVA before project committal. Midwest Research Institute (MRI) is presently evaluating the process.
Keywords: FLY ASH; DEMETALLIZATION; ALUMINIUM; IRON; TRACE AMOUNTS; ELEMENTS; PILOT PLANTS; DESIGN; RECOVERY; METALS.

130086 Recovery of Nitrogenous Byproducts from Flue Gas. Wells, W.L. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1050. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

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.

130087 Study of Mineral Wool Fabrication from Wet Bottom Ash. Parker, F.G.; Wilson, R.D. (Tennessee Valley Authority, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1053. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$205,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

A program is reported that is designed to develop uses of ash and slag which are byproducts from large coal-fired electrical generating facilities. The project is being conducted to determine if the molten slag produced in TVA's wet bottom boilers is suitable for use in the manufacture of mineral wool while still molten; to perform assessments, technical and economic, defining the potential of locating mineral wool producing plants at TVA power plants which have wet bottom boilers and the use of the resulting mineral wool for home insulation; to prepare a conceptual design and cost estimate for a pilot plant to demonstrate that the process is practicable and operative; and to establish a commercial production plant for mineral wool at both the Paradise and Allen Plants. The approach to be used for the project is to: (1) conduct a review of the existing literature on the subject; (2) obtain samples at TVA plants where applicable and contract with commercial organizations to determine if TVA's slag can be used to make mineral wool; (3) conduct an assessment to define the potential of locating mineral wool producing plants at TVA facilities; (4) if other results are positive and if necessary, design a pilot plant to demonstrate the process; and (5) if the assessments are positive, reach commercial productions sufficient to supply part or all of the insulation required by the TVA home insulation program.
Keywords: FOSSIL-FUEL POWER PLANTS; TENNESSEE VALLEY AUTHORITY; ASHES; SLAGS; RAW MATERIALS; MINERAL WOOL; MANUFACTURING; FEASIBILITY STUDIES; BOILERS; WASTE PRODUCT UTILIZATION.

130088 Monthly Trace Element Analyses of Coal Burned at TVA Fossil Plants. Flora, H.B.; Ogle, K.L. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1043. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$43,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

An effluent control subprogram is reported which is designed to obtain information on the chemical composition of coal burned by TVA fossil-fired power plants. This would include trace elements and other major elements. Such information would be valuable in terms of assessing the effects of coal composition on precipitator performance, effects of coal composition on slagging properties, effects of coal composition on reliability, and effects of coal composition on plant gas emissions and plant ash pond effluents. Also, these data would allow TVA to pick the most feasible site for a metal recovery process should such an effort ever be undertaken. The scope of the project consists of collecting composite monthly coal samples for one year from all TVA coal-fired power plants and having these samples analyzed for approximately 25 chemical species.
Keywords: TENNESSEE VALLEY AUTHORITY; FOSSIL-FUEL POWER PLANTS; COAL; CHEMICAL COMPOSITION; TRACE AMOUNTS; ELEMENTS; ELECTROSTATIC PRECIPITATORS; PERFORMANCE; FLUE GAS; LIQUID WASTES; PONDS; FUELS.

130089 SULF-X Simultaneous SO2--NOx Removal Process. Robards, R.F.; Wells, W.L. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1077. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The SULF-X process is a regenerable process producing elemental sulfur using mine waste products containing iron oxides and coal as the absorbent (FeO) with coal producing the heat required for regeneration of the absorbent and evolution of vaporized sulfur. Absorption of NOx has also been claimed to occur. The objective is to extend development of this process beyond that of the

inventors, PENSYS (Pittsburgh Environmental and Energy Systems, Inc.), such that its applicability to utility conditions can be fully evaluated. Data from PENSYS will be evaluated and TVA's laboratory testing of the chemistry of the SULF-X process will be performed to assess the claims of PENSYS and also expand on SO2 and NOx absorption capabilities. Modifications of the Colbert pilot plant will be made to accommodate the SULF-X system. Preliminary pilot plant testing will determine the effect of variables (liquid rate, gas rate, solids content, stoichiometry, pH, and nozzle pressure drop) on SO2 and NOx removal. Optimum operating conditions can therefore be selected and a long-term run performed to evaluate system reliability, load following, and simulated upset conditions.
Keywords: COAL MINING; COAL MINES; WASTE PROCESSING; MINERAL WASTES; DESULFURIZATION; NITROGEN OXIDES; PILOT PLANTS; ADSORPTION; SULFUR DIOXIDE; REMOVAL.

130091 Synthetic Fuels--General. Siegel, G.R. (Tennessee Valley Authority, 1360 Commerce Union Bank , Chattanooga, TN, 37401). **Project number:** 988-15-990.1075. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: biomass(50); other advanced(50). **R and D categories:** Environmental control technology.

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.

130092 Study of Methods to Control Corrosion. Flora, H.B.; Moss, R.P. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1064. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology.

The Water Research Program has an Effluent Control Subprogram which has, among others, an objective to develop methods to control scaling and corrosion for semi-closed loop systems. The primary objective of this project is to evaluate and assess processes that will accomplish this goal in an environmentally compatible manner. The scope of this project is to study and summarize the methods by which the control of scaling and corrosion in a semi-closed loop system may be attained. This will include the study of the mechanisms of corrosion and developing methods of controlling corrosion and, in addition, biofouling in semi-closed loop systems. The mechanisms of corrosion are being reviewed.
Keywords: BIOLOGICAL FOULING; CORROSION PROTECTION; CLOSED-CYCLE COOLING SYSTEMS; SCALING; THERMAL POWER PLANTS.

130093 Economic Comparison of the DOWA and Thoroughbred 121 SO2 Removal Processes. Wells, W.L. (Tennessee Valley Authority, 470 Commerce Union Bank, 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:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130094 Evaluation of the DOWA SO2 Scrubbing System. Robards, R.F.; Wells, W.L. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1059. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$150,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130095 1-Mw Magnesium Oxide Scrubber Project: Colbert. Crowe, J.L.; Wells, W.L. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1055. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

A project is reported that is designed to develop, through research, a sulfur dioxide removal process, using MgO as the alkali, for use on full-size electric generating facilities to meet standards and/or regulations. A second objective is to evaluate SO2 and particulate removal efficiencies at the 1-Mw level while evaluating various types of process equipment and certain process control parameters. 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. The magnesium oxide scrubbing-regenerative process has been tested on several Japanese and U.S. installations. Although good SO2 removals can be obtained, there are significant process problems that must be resolved before full scale construction of such a process on TVA boilers can be undertaken.
Keywords: FOSSIL-FUEL POWER PLANTS; FLUE GAS; DESULFURIZATION; SCRUBBING; MAGNESIUM OXIDES; POLLUTION CONTROL EQUIPMENT; EVALUATION; REGENERATION; SCRUBBERS; TENNESSEE VALLEY AUTHORITY; MAGNESIUM SLURRY SCRUBBING PROCESS; PERFORMANCE TESTING.

130096 Electrostatic Precipitator Efficiency: Water Soluble Elements in Coal. Huang, C.M. (Tennessee Valley Authority, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1045. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objective is to determine the cause for lower efficiency of electrostatic precipitators when using weathered low-sulfur coal as compared with using the same coal directly from the railroad car. The project scope will be to determine the water soluble elements in the coal as received and after weathering and to establish any correlation of these data with electrostatic precipitator operation. This project will be primarily a survey type of investigation. Limited field studies may be conducted to obtain required missing information when deemed necessary. A review of the chemical analysis of coal being supplied to TVA power plants indicates that the coal normally has K2O concentrations of approximately 3 percent. If this

constituent is being leached by rainwater, it could have an adverse effect on the ESP operating efficiency.
Keywords: COAL; WEATHERING; CORRELATIONS; ELECTROSTATIC PRECIPITATORS; EFFICIENCY; POTASSIUM OXIDES; QUANTITY RATIO; LEACHING; TENNESSEE VALLEY AUTHORITY; CHEMICAL COMPOSITION.

130097 Technical and Economic Evaluation of TVA Purchasing Energy from Memphis Municipal Refuse and Sewage Sludge Incineration Plant. Parker, F.G. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6051. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$21,000.
Related energy source: other advanced(100). **R and D categories:** Environmental control technology.

The objective is to investigate the technical and economic aspects of TVA buying either steam or electrical energy produced by the City of Memphis through coincineration of municipal refuse and sewage sludge. The Memphis Department of Public Works proposes to coincinerate municipal refuse and sewage sludge to produce steam or steam and electrical energy. They have requested that TVA buy any steam produced for use at Allen Steam Plant or that TVA serve as a customer for electrical energy if a cogeneration system is selected. TVA is evaluating various uses for steam and hot water at Allen and its economic value. The value of the electrical energy will be evaluated if a cogeneration system is selected. A report will be sent to Memphis in the near future. The City of Memphis has applied for an EPA grant for the incineration project under public law 92-500. EPA is presently reviewing the application. Leonard S. Wegman Co., Inc., a New York based engineering firm, has completed a preliminary engineering report on the incineration project. The report is available from the City of Memphis.
Keywords: WASTE PROCESSING PLANTS; POWER GENERATION; STEAM GENERATION; MARKET; MUNICIPAL WASTES; SEWAGE SLUDGE; COMBUSTION; SOLID WASTES; ECONOMICS; CO-GENERATION; WASTE PRODUCT UTILIZATION; FOSSIL-FUEL POWER PLANTS; TENNESSEE VALLEY AUTHORITY.

130098 Advanced Heat Pump/Thermal Storage Systems. Barnett, J.H. (Tennessee Valley Authority, 350 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-993.016. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: fossil fuels(34); nuclear fuels(general)(33); conservation(33).

The objectives of this program are to review and follow the progress of developing technology in advanced heat pump systems and select and demonstrate systems that have the potential for conserving energy and reducing peak demands. Computer programs will be modified and simulation studies of selected advanced heat pump systems will be performed to determine their applicability to the TVA area. An appropriate type for demonstration will be selected. The size of heat pump unit and storage bin will be determined and installed at the appropriate site. Operating data will be collected and performance studies carried out. Design of the ice-maker heat pump system (daily cycle energy system) is now being performed.
Keywords: HEAT PUMPS; ICE; TECHNOLOGY ASSESSMENT; DEMONSTRATION PROGRAMS; ENERGY CONSERVATION; PERFORMANCE; DESIGN; HEAT STORAGE.

130099 Assessment of the Load Management Potential: Control of Residential Water Heating and Space Conditioning on the TVA System. Barnett, J.H. (Tennessee Valley Authority, 350 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-993.010. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$800,000.
Related energy source: fossil fuels(34); nuclear fission(33); conservation(33).

The objectives of this program are to evaluate the potential costs and benefits and the technological feasibility of control of existing water heating and space conditioning loads and the possibility of greater benefits associated with larger size water heaters. The high saturation of electric space and water heating on the TVA system will provide useful information for most U.S. activities as their saturation of these electric loads increase to replace relatively scarce oil and natural gas. Analysis of 15-minute load data will be performed by the Rate Branch to develop load profiles of both uncontrolled and controlled water heaters and space conditioners as well as payback periods for input into the Power Supply Planning models of Power Resource Planning. Analysis will include the development of hourly load profiles by climatic zones, by accounting for the time zone diversity and for daily and seasonal variation. This information will be used to evaluate the costs and benefits of load management on generation, transmission, and distribution components of the system. In addition, the data will be incorporated into ongoing load research programs to improve the quality of hourly load information for rate and load forecasting purposes.
Keywords: TENNESSEE VALLEY AUTHORITY; ELECTRIC UTILITIES; SPACE HEATING; AIR CONDITIONING; WATER HEATERS; LOAD MANAGEMENT; FEASIBILITY STUDIES; COST BENEFIT ANALYSIS.

130100 Beneficial Uses of Waste Heat: Industrial and Residential Uses. Snipes, R.L.; Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6053. **Contract:** TVA-39614A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$35,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and monitoring.

The Biological Research Program has a Waste Heat Utilization Subprogram 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. The TV-36914A contract was amended to allow Battelle Columbus Laboratory to conduct the initial technical assessment of industrial and residential uses of power plant waste heat.
Keywords: WASTE HEAT UTILIZATION; TECHNOLOGY ASSESSMENT; RESIDENTIAL BUILDINGS; INDUSTRIAL PLANTS; THERMAL POWER PLANTS; REVIEWS; EVALUATION; WASTE HEAT.

130101 EPA/TRW Gravichem Tests with TVA Coal. Cole, R.M. (Tennessee Valley Authority, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1054. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$12,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives are: to determine the physical and chemical properties of the treated coal, and to determine the effects of coal treatments on boiler operation, including SO2 and particulate emissions. TVA will provide 300 tons of West Kentucky No. 9 coal for testing at EPA/TRW coal prep pilot plant located near Los Angeles, California. The product coal will be returned to TVA for a test burn. The results of the Gravichem process bench scale tests with a TVA coal were encouraging. The EPA/TRW pilot plant will resume operation January 1978 to further evaluate the process.
Keywords: COAL; TRW PROCESS; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; SULFUR DIOXIDE; PARTICLES; EMISSION; TENNESSEE VALLEY AUTHORITY; TESTING; COMBUSTION PROPERTIES; US EPA.

130102 Physical and Chemical Coal Cleaning: General. Cole, R.M. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1041. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$45,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130103 Solar Assisted Heat Pump Demonstrations. Phillips, J.J (TVA, 350 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-993.018. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: solar(50); conservation(50).

The project objectives are to determine the economic feasibility of using solar energy to supplement electrical heat pumps for

esidential space heating and domestic water heating on the TVA ystem, and to evaluate systems for demonstrations which may have potential for reducing system peak demands and conserving energy including commercial-sized systems. The approach is to: evaluate existing state-of-the-art and equipment design to accommodate different system approaches; evaluate on-going demonstrations being conducted nationally by various vendors in cooperation with utilities or other concerns; select appropriate systems for demonstrations on the TVA system; and analyze performance of demonstration units to determine impact on the utility system. Individual projects will be initiated to demonstrate specific configurations. Solar assisted heat pump systems to be encouraged under the Presidential energy initiative program will be identified. Ongoing DOE, EPRI, and TVA projects are being evaluated.
Keywords: SOLAR-ASSISTED HEAT PUMPS; DEMONSTRATION PROGRAMS; FEASIBILITY STUDIES; RESIDENTIAL BUILDINGS; SOLAR SPACE HEATING; SOLAR WATER HEATING; EVALUATION; PERFORMANCE; ELECTRIC UTILITIES.

130104 LMFBR Safety, Licensing, Environmental, and Public Issues. Adams, H.B. (TVA, 1300 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.3004.5. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The project has the following objectives: (1) review and evaluate the licensing experience with nuclear plants as it relates to LMFBR's; (2) identify and evaluate areas such as proliferation, safety, and health hazards where concern has been expressed over the LMFBR; and (3) examine the safety technology of LMFBR's and identify, evaluate, and plan projects which will increase the attractiveness of LMFBR's.
Keywords: LMFBR TYPE REACTORS; REACTOR LICENSING; REACTOR SAFETY; PUBLIC RELATIONS.

130105 LMFBR Fuel Cycle. Adams, H.B. (TVA, 1300 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.3004.6. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The program objectives are (1) to identify and evaluate the major parameters that affect LMFBR fuel cycle costs; and (2) to assess the fuel fabrication, reprocessing, disposal and storage, safeguards, and transportation requirements and developments for the LMFBR.
Keywords: LMFBR TYPE REACTORS; FUEL CYCLE; ECONOMICS.

130106 Thorium Utilization. Kamal, A. (TVA, 1300 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.B019. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

The program objectives are (1) to identify methods of economically using thorium in present day LWR's and in advanced reactors; (2) to investigate the use of thorium in alternate fuel cycles; and (3) to determine the unique requirements (enrichment, fabrication, conversion, reprocessing, etc.) associated with these fuel cycles. The program will review and assess the on-going R and D efforts to utilize thorium in present and advanced nuclear power systems; carry out computer studies of different thorium fuel utilization schemes in various nuclear power systems; and evaluate the safety consequences, operational characteristics, and economic potential of thorium utilization in these nuclear power systems.
Keywords: POWER REACTORS; FUEL CYCLE; THORIUM CYCLE; PLANNING; ECONOMICS.

130107 Light Water Reactor Safety. Williams, J.H. (TVA, 1300 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.3020. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The project objectives are (1) to assess the experience and technology of nuclear safety, plant behavior, safeguards, and environmental impact of LWR's; (2) to identify problems associated with LWR's in these areas; and (3) to plan and conduct projects which can contribute to acceptable solutions to these problems.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR SAFETY; RESEARCH PROGRAMS.

130108 Chemical Interaction in the Plume from a Wet-Limestone Scrubber (Task 3). Meagher, J.F. (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-$174,000.
Related energy source: fossil fuels(100). **R and D categories:** Physical and chemical processes and effects.

The objective is to determine the effect of a wet-limestone scrubber on plume chemistry. Emphasis will be placed on a situation where a scrubbed plume is mixing with an unscrubbed plume. An instrumented aircraft study will be conducted at a steam plant with a generating capacity of 1850 Mw of which 550 Mw are scrubbed. Sulfur dioxide, O3, and NOx will be monitored continuously. Particle instrumentation includes a condensation nuclei counter, integrating nephelometer, and continuous particle sizing by two instruments. SO4/SO2 ratio will be determined. Temperature, dew point, altitude, and position (VOR-DME) data will be collected also. Concurrent ground-based sampling will be performed. The result expected is an evaluation of the effect of mixing of moist plume from wet SO2 scrubbed with unscrubbed plumes on the rate of oxidation of SO2 to sulfate.
Keywords: FOSSIL-FUEL POWER PLANTS; LIME-LIMESTONE WET SCRUBBING PROCESSES; PLUMES; CHEMISTRY; SULFUR DIOXIDE; OZONE; NITROGEN OXIDES; MONITORING; METEOROLOGY; OXIDATION; AIR POLLUTION.

130109 Knoxville Time-of-Day Rate Test. Eskander, S.S. (TVA, 712 Power Board Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$144,000.
Related energy source: conservation(100).

The Knoxville time-of-day rate test is a demonstration project to determine consumer acceptance to time-of-day rates and to obtain information on the effect of time-of-day rates upon electricity consumption patterns. It is expected that the initial test will provide the following information: consumer acceptance of time-of-day rates; effect of time-of-day rates upon monthly consumption of electricity and upon power bills; and effect of time-of-day rates upon consumption of electricity during onpeak and offpeak periods. The test involves the voluntary participation of 220 residential consumers who were randomly chosen on the basis of annual electricity consumption. One-half of these consumers are being billed on a time-of-day rate consisting of a customer charge, an onpeak period energy charge, and an offpeak energy charge. Both small and large consumers are included in the test. Consumers selected for the test were paid an initial participation incentive of $25 in order to reduce the high rejection rate of potential participants that other tests with voluntary participation had experienced. Consumers selected for the experimental rate group signed an agreement to participate in the test for a 1-year period to ensure continuity of test data and to provide information during the four seasons. The Knoxville Utilities Board has cooperated in conducting the test. KUB participated in the selection of the test participants; surveyed the test participants; installed, read, and repaired meters; installed alert-signal lights inside the homes of the experimental rate group participants; and developed billing computer programs for time-of-day rate. Results show that the group of customers on the experimental preliminary rate are saving an average of 3 to 5% on their electric bills when compared with the control group on the standard schedule. The experimental rate group is using approximately 30% of their energy onpeak and 70% offpeak. Corresponding numbers for the control group are 34% and 66%, respectively.
Keywords: TENNESSEE VALLEY AUTHORITY; ELECTRIC POWER; RATE STRUCTURE; DEMONSTRATION PROGRAMS; POWER DEMAND; RESIDENTIAL BUILDINGS; FORECASTING; POWER SYSTEMS; LOAD MANAGEMENT.

130110 Electric Thermal Storage. Eskander, S.S. (TVA, 712 Power Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: conservation(100).

The objective of this study is to assess or evaluate the storage of heat energy derived from electricity during offpeak periods for transfer and use during onpeak periods. Such a study will yield valuable information on the effect energy transfer will have on peak demand and the ability to improve the load factor of the system and delay capacity construction. We have the opportunity to evaluate a unique storage system and its ability to meet our customers' requirements and demands for space heating. Two new homes will be built in the Lenior City, Tennessee, area to incorporate a heat storage system containing refractory bricks. These bricks will be heated to 1400 degrees F during an eight-hour offpeak period and will store the energy for heating the home over a sixteen-hour onpeak period. This test will be completed after two years of operation after which a heat pump will replace the storage unit for space heating. Additionally, a 120-gallon water heater will be installed in each of the two homes to study storage characteristics and energy consumption. All major heating units, space or water, will be monitored by

magnetic tape metering equipment and operated or charged primarily during offpeak periods. TVA will retain title to the metering and brick storage system. Each brick heat storage units costs $1,100 installed and each resident will be placed on a T-O-D experimental rate. Kilowatt demand information for energy storage devices, currently commercially available, and the result of the application of these devices on the TVA generating system are the desired results of this project.
Keywords: RESIDENTIAL BUILDINGS; HEAT STORAGE; POWER DEMAND; OFF-PEAK ENERGY STORAGE; SPACE HEATING; BRICKS; THERMAL ENERGY STORAGE EQUIPMENT; LOAD MANAGEMENT; POWER SYSTEMS; TENNESSEE VALLEY AUTHORITY.

130111 Energy Utilization System Metering Study. Eskander, S.S. (TVA, 712 Power Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: conservation(100).

The objective of this study is to assess or evaluate the storage of heat energy derived from electricity during offpeak periods for transfer and use during onpeak periods. Such a study will yield valuable information on the effect energy transfer will have on peak demand and the ability to improve the load factor of the system and delay capacity construction. We have the opportunity to evaluate a unique storage system and its ability to meet our customers' requirements and demand for space heating. Two new or existing homes in Murfreesboro, Tennessee, a part of the Middle Tennessee Electric Membership Corporation, will have a heat storage system containing water as the storage medium and a heat pump as the charging and discharging unit incorporated into each. The system is an Annual Energy Utilization System (AEUS) providing both heating in winter and cooling in summer by freezing the water in storage during offpeak periods for use during onpeak periods. Likewise, the charging for heating will occur during offpeak for onpeak period usage. The system is provided by EUS, Inc. of Pittsburgh, Pennsylvania. All expenses associated with the project that do not include metering and monitoring will be borne by EUS, Inc., Middle Tennessee Electric Membership Corporation, and the National Rural Electric Cooperative Association. TVA estimates capital costs for equipment purchase at $11,981. The resident will be placed on a T-O-D experimental rate. Kilowatt demand information for energy storage devices, currently commercially available, and the result of the application of these devices on the TVA generating system are the desired results of this project.
Keywords: RESIDENTIAL BUILDINGS; POWER DEMAND; HEAT STORAGE; OFF-PEAK ENERGY STORAGE; SPACE HEATING; HEAT PUMPS; TENNESSEE VALLEY AUTHORITY; POWER SYSTEMS; LOAD MANAGEMENT.

130112 Assessment of the Load Management Potential: Control of Residential Water Heating and Space Conditioning on the TVA System. Eskander, S.S. (TVA, 712 Power Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$605,000.
Related energy source: conservation(100).

The principal objective of the study is to determine the potential costs and benefit of end-use control of certain residential electric loads. Data obtained from the study will also be integrated with data from other studies to form a broader base for cost-of-service, rate design, and forecasting activities. Other valuable information resulting from the study will include operational characteristics of load management equipment and consumer acceptance of end-use control. A stratified sample of 125 residential customers in each of four distributor's service areas within the TVA system will be randomly selected. These customers will be interviewed to determine their suitability and willingness to participate, as well as relevant demographic, appliance mix, and energy use characteristics. Special metering, recording, control, and other associated equipment will be installed in each participant's residence. The distributors--Jackson, Tennessee Utility Division; Cleveland, Tennessee Electric System; City of Huntsville, Alabama Utilities; and Tri-County Electric Membership Cooperative, Lafayette, TN--will be responsible for interviewing customers and obtaining their agreement to participate, and installing, maintaining, and removing magnetic tape cartridges and all other equipment. The distributors will be reimbursed by TVA for all of their expenses associated with the project. Additionally, TVA will provide funds to compensate participants for any energy the test equipment may consume and their time and inconvenience associated with the test. TVA will purchase and retain title to all equipment involved with the test with the exception of special energy storage water heaters and special smart thermostats installed in some locations. In these instances TVA will purchase the heaters and thermostats and participants will receive title to the items, after the two-year test period, as compensation. TVA will be responsible for tape translation and data analysis. Upon request, any information resulting from such analysis will be transmitted to the distributors involved without charge. Anticipated results of the project are costs and savings associated with end-use control of domestic water heating and space conditioning.
Keywords: LOAD MANAGEMENT; COST BENEFIT ANALYSIS; RESIDENTIAL BUILDINGS; ELECTRIC POWER POWER SYSTEMS; RATE STRUCTURE; POWER DEMAND; ECONOMICS; WATER HEATERS; AIR CONDITIONING; TENNESSEE VALLEY AUTHORITY; POWER METERS.

130113 Super Solar Home Metering Program. Eskander, S.S. (TVA, 712 Power Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA.
Related energy source: solar(100).

The project objective is to evaluate the feasibility of solar energy in the TVA service area, particularly the Chattanooga EPB service area. This study will allow us to determine the contribution that the sun's energy can make toward supplying an expected 80% of the total energy requirements for residential space and water heating. Ten new homes incorporating solar heating devices will be metered and monitored for a two-year period. Insulation standards will be high so as to minimize the heating requirements. Various passive solar features will be designed into the home construction to give an added dimension to the solar contribution. The estimated cost for monitoring equipment is approximately $16,000 with an additional $1,500 estimated for operating costs. Kilowatt demand information for residences equipped with the above space conditioning and water heating equipment and construction characteristics is the desired result of the project. This information will be used to determine the effect of such installation on the TVA, and specifically the Chattanooga EPB, service area.
Keywords: HOUSES; SOLAR HEATING SYSTEMS; MONITORING; PASSIVE SOLAR HEATING SYSTEMS; THERMAL INSULATION; COST; FEASIBILITY STUDIES; SOLAR SPACE HEATING; SOLAR WATER HEATING.

130114 Super Saver Home Metering Project. Eskander, S.S. (TVA, 712 Power Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$127,000.
Related energy source: conservation(100).

The Super Saver Home Metering Project involves the installation of special metering equipment to determine the time integrated load characteristics of sample residential customers. The main purpose is to obtain data on these specially constructed homes, and compare this data to that from conventional homes. This comparison will be the basis for studies concerning rate design, forecasting, load management, and cost-of-service as applied to the effects of energy efficient residential construction standards. From a surveyed sample of 50 Super Saver homes located in the TVA service area, 25 homes were chosen that presented a good cross-section of demographic and home construction characteristics from five different geographic areas of TVA System. Each house will be equipped with meters and metering and recording equipment to monitor electric loads and ambient temperatures. Data will be collected every 15 minutes, and analysis of data will be on an hourly basis. In all, 36 months of load data will be obtained and analyzed. TVA will be responsible for such analyses. The distributor will install and maintain the metering equipment, and will be reimbursed for all work and services performed. Anticipated results of the project are load curves for this type of residence from which customer savings and the effect on the TVA generating system can be determined.
Keywords: RESIDENTIAL BUILDINGS; ELECTRIC POWER; POWER DEMAND; POWER METERS; FORECASTING; LOAD MANAGEMENT; COST; RATE STRUCTURE; DATA ACQUISITION; TENNESSEE VALLEY AUTHORITY; POWER SYSTEMS.

130115 Development of FGD Technology: Pilot-Plant Studies of MgO Scrubbing and Regeneration. Schuppert, K.M. (TVA, Office of Agricultural and Chemical Development, Emission Control Development Projects, Muscle Shoals, AL, 35660). **Project number:** 79 BBK. **Supported by:** Environmental Protection Agency, Research Triangle Park, NC (USA). Utilities and Industrial Power Div. **Funding:** EPA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

Economic evaluations have shown that production of by-product sulfuric acid by regenerable magnesium oxide scrubbing is potentially the least cost method in many situations for control of sulfur oxide emissions from power plants. A pilot-plant facility may be useful in providing information in support of operating, or planned, full-scale systems. TVA will build a 600-Mw installation. Tests of process steps and of the integrated process will be conducted to provide design information and to define operating procedures for magnesium oxide scrubbing and regeneration. The pilot plant at Colbert Steam Plant will be operated to study MgO scrubbing for SO2 removal and generation of useful byproducts. The tests for this project will not begin until CY 1980.
Keywords: FOSSIL-FUEL POWER PLANTS; FLUE GAS; DESULFURIZATION; MAGNESIUM OXIDES; SULFURIC ACID; SCRUBBERS; PILOT PLANTS; REGENERATION;

SULFUR DIOXIDE; REMOVAL; EQUIPMENT; SAMPLING; STATISTICS; MAGNESIUM SLURRY SCRUBBING PROCESS; EVALUATION; OPTIMIZATION.

130116 Environmental Studies of Coal Cleaning Processes. Cole, R.M. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 017-15-4021. **Contract:** TV-41967A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; OTHER-$79,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

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.

130117 Control of Fine Particulate by Ionization Methods: TVA/EPRI/APS Ionizer Project. Huang, C.L.; Frank, R.L. (TVA, Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1038. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$900,000; OTHER-$50,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130118 Waste Heat Utilization Workshop. Goss, L.B.; Snipes, R.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6033. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$20,000; EPRI-$50,000.
Related energy source: all(100).

The Biological Research Program has a Waste Heat Utilization Subprogram designed to evaluate and develop waste heat utilization technology. This project is designed to comprehensively evaluate the various factors the power industry must consider in developing waste heat utilization technologies and projects. A workshop will be conducted assessing such factors associated with waste heat utilization such as interphase criteria, environmental constraints, non-environmental legal constraints, etc.
Keywords: WASTE HEAT UTILIZATION; TECHNOLOGY ASSESSMENT; THERMAL POWER PLANTS; EVALUATION; ENVIRONMENTAL IMPACTS; LEGAL ASPECTS; MEETINGS; EDUCATION.

130119 EPRI-AEIC Electric Water Heating Study. Fox, H.B. (TVA, 210 Power Board Building, Chattanooga, TN, 37401). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** EPRI; TVA.
Related energy source: conservation(100).

The research objectives of this study are threefold: (1) to evelop basic climatological water heating data representative of ulfferent 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 (10) 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.

130120 Economic Study of Dry NOx Removal Processes. Wells, W.L.; Robards, R.F. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 130013. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA; OTHER-.$175,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

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.

130121 Development of Improved Lime/Limestone Scrubbing Technology at the TVA Colbert Pilot Plant for EPRI: Horizontal Scrubber Task. Robards, R.F.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 011-15-4011.2. **Contract:** TV-42660-A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objective of this task is to evaluate a horizontal scrubber system at the 1-Mw level using the Colbert pilot plant. Upon completion of preliminary testing, the horizontal scrubber will be operated for a long-term run under the conditions found most promising. This study will also concentrate on (1) improving mist eliminator operation; (2) improving systems component (L/C, gas velocity, solids, pH) for maximum SO2 control; (3) load following; and (4) others as necessary. Preliminary testing is completed and the final report is being prepared.
Keywords: FOSSIL-FUEL POWER PLANTS; LIME-LIMESTONE WET SCRUBBING PROCESSES; OPTIMIZATION; EVALUATION; MIST EXTRACTORS; SULFUR DIOXIDE; REMOVAL; DESULFURIZATION; FLUE GAS.

130122 Development of Improved Lime/Limestone Scrubbing Technology at the TVA Colbert Pilot Plant. Robards, R.F.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 130018. **Contract:** TV-42660-A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA; OTHER-$200,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of this task are to make heat balances for several reheat schemes; to evaluate materials of construction along with system operability; and to evaluate the erosion and corrosion of various materials used in the construction of scrubber systems. The methods employed are: (1) design, construct, and use several reheat schemes in the operation of lime/limestone pilot plant scrubbers; (2) test the corrosion and erosion resistivity of various materials; and (3)

evaluate the reheaters after they have been exposed to pilot plant operation. Two reheat schemes have operated and the data have been analyzed. Assorted materials have undergone corrosion/erosion testing and have been analyzed. The final draft report has been prepared by ECDP.
Keywords: FOSSIL-FUEL POWER PLANTS; LIME-LIMESTONE WET SCRUBBING PROCESSES; BUILDING MATERIALS; HEATING SYSTEMS; CORROSION; EROSION; SLUDGES; SYSTEMS ANALYSIS; RELIABILITY; COMBUSTION; FLUE GAS; DESULFURIZATION.

130123 TVA/EPRI Cocurrent Scrubber at Shawnee. Robards, R.F.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 011-15-4020.1. **Contract:** TV-46803-A. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; OTHER-$40,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130124 Economic Study of NOx Removal Processes. Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 011-15-4023. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA; OTHER-$80,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

The objectives of this project are: (1) to review the technical status of nitrogen oxide emission control processes; (2) to select and recommend for further evaluation promising candidate NOx abatement processes applicable to coal-fired power plants; (3) to perform preliminary economic assessments of these latter processes; (4) to identify further process research and development required for commercial application; and (5) to suggest specifications for future detailed engineering analysis of NOx abatement systems. During Phase I, the NOx abatement processes for which sufficient data can be obtained will be examined for technical feasibility and commercial potential as applicable to coal-fired power plant installations. During Phase II, a preliminary economic evaluation will be made of the processes which show promising application to coal-fired power plants. This study is directed to evaluating potentially attractive NOx control methods. Phase I of this project, funded by EPA, has been completed. An economic study of dry NOx removal processes was recently funded by EPRI.
Keywords: NITROGEN OXIDES; REMOVAL; ECONOMICS; FOSSIL-FUEL POWER PLANTS; FLUE GAS; DENITRIFICATION; AIR POLLUTION ABATEMENT; TECHNOLOGY ASSESSMENT; AIR POLLUTION CONTROL.

130125 Electric Field Data for 500-kV Transmission Lines. Walker, T.R. (TVA, 350 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-991.06. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$53,000.
Related energy source: all(100). **R and D categories:** Characterization, measurement, and 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. Energy Research will provide overall project management. The Division of Power Systems Operations' central laboratory will collect the data. Discussions have been held with DOE and work statements and interagency agreements are being prepared.
Keywords: EHV AC SYSTEMS; NOISE; ELECTRIC FIELDS; BEHAVIOR; BIOLOGY; POWER TRANSMISSION LINES.

130126 Coal-Oil Slurry for Boiler Ignition. Cole, R.M. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1052. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000; OTHER-$25,000.
Related energy source: fossil fuels(50); conservation(50). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The Coal Cleaning Subprogram has a Coal-Oil Slurry Firing Project which has among others an objective 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 boilers. The objective of this project is to review the present technology and perform preliminary design and 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 slurries for boiler ignition. A conceptual design and cost estimate on the best system(s) will then be made for a pilot plant and a full scale plant. 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. Potential fuel oil saving, operating data, and recommendations will be included in the final report. Some work has been performed by GM for EPRI and ERDA is believed to be considering programs in this area. Foster-Wheeler Energy Corporation has a substantial background in this area.
Keywords: COAL; FUEL OILS; FUEL SLURRIES; IGNITION; FOSSIL-FUEL POWER PLANTS; STEAM GENERATORS; TECHNOLOGY ASSESSMENT; DESIGN; COST; PILOT PLANTS; BOILERS; ENERGY CONSERVATION; FUEL SUBSTITUTION; BOILER FUEL.

130127 Control of NOx Formation in Wall, Coal-Fired Utility Boilers. Hollinden, G.A.; Zielke, R.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1021. **Contract:** EPA-IAG-137(b). **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology.

This study will ultimately result in an operational guidance manual that will outline step-wise procedures for application of the control technology for minimizing NOx and related emissions. The manual will additionally provide engineering design guidance and description of the effects that combustion modifications have on steam generator performance. A section of this manual will include description of the necessary equipment modifications and estimated costs for applying this control technology. TVA will provide the equipment and personnel to study the effects that specific combustion modifications have on formation of NOx and related pollutants and assess their effects on corrosion, flame stability, slagging, and general boiler performance. The experimental and analytical studies associated with this project are complete and the final report is being prepared.
Keywords: FOSSIL-FUEL POWER PLANTS; FLUE GAS; DENITRIFICATION; AIR POLLUTION CONTROL; AIR POLLUTION ABATEMENT; NITROGEN OXIDES; MANUALS; COMBUSTION CONTROL; STEAM GENERATORS; CORROSION; FLAMES; COST; EQUIPMENT.

130128 Advanced Regenerable Scrubbing Systems: 1 Mw Colbert Plant. Robards, R.F.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1060. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$20,000; OTHER-$800,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and 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.

130129 Radioactive Waste Disposal. Williams, J.H. (TVA, 1300 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.3025. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology.

The objective is to assist in solving TVA's radioactive waste disposal and spent fuel storage problems. The approaches taken are to: review and assess the technology of radioactive waste disposal and spent fuel storage; evaluate plans for radwaste disposal and spent fuel storage; identify problems which TVA faces and define the research and development needed in reaching solutions to those problems; and develop plans and projects for those problems amendable to research solutions.

Keywords: RADIOACTIVE WASTE DISPOSAL; SPENT FUEL STORAGE; TECHNOLOGY ASSESSMENT; TENNESSEE VALLEY AUTHORITY.

130130 Radiation Exposure Control. Williams, J.H. (TVA, 1300 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.3026. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objectives of the project are to examine plant experience dealing with personnel exposures to ionizing radiation and to investigate means for reducing radiation sources, manpower requirements, and radiation exposures by the following methods: (1) studying LWR operations experience as it relates to personnel exposures; (2) examining plant designs and operating procedures to identify ways for reducing radioactive sources, personnel exposures, and manpower requirements; and (3) developing plans and projects providing for improved personnel safety and/or reduced manpower needs.

Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; PERSONNEL; RADIATION PROTECTION; RADIATION DOSES.

130131 Development of Improved Lime/Limestone Scrubber Technology at the TVA Colbert Pilot Plant for EPRI: Sludge Characterization Task. Crowe, J.L.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 011-15-4011.3. **Contract:** TV-42660A. **Supported by:** Electric Power Research Inst., Palo Alto, CA (USA). **Funding:** TVA; OTHER-$22,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objectives of this task are to determine the range of variability of the solids in sludges produced from full-scale scrubber installations operated by various electric utilities and to correlate the variability with plant operating conditions. The approach is to obtain samples from scrubbers operated by various utilities and the operating conditions under which these samples were produced. These samples will be analyzed by various instrumental and chemical techniques and the results correlated to the operating conditions that produced the sludge. Five utilities participated in the program. Characterization studies of the sludge samples received have been made and correlation of these characterizations to scrubber operation have been completed. A final report is in preparation. Monthly progress reports to EPA by TVA are available.

Keywords: FOSSIL-FUEL POWER PLANTS; LIME-LIMESTONE WET SCRUBBING PROCESSES; SLUDGES; CHEMICAL COMPOSITION; COAL; SCRUBBERS; WASTE MANAGEMENT; FLUE GAS; DESULFURIZATION.

130132 Electric and Hybrid Vehicle Studies. Barnett, J.H. (TVA, 350 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 88-15-993.014. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$401,000.

Related energy source: conservation(100).

The work involves the performance of technical assessments and testing of electric and hybrid vehicles and associated technologies including, but not limited to, improved batteries and battery systems, transmissions, control systems, and hybrid propulsion units. The future impact of significant numbers of electric vehicles on the TVA generation system will be evaluated in order to provide for the long range planning of the power system. The possibility of cooperation with EPRI and other organizations in electric and hybrid vehicle research and demonstration will be investigated. The performance of electric and hybrid vehicles will be investigated from reports of various national R and D projects and from data obtained from tests performed by TVA. Developments in related technology will be evaluated by participation in battery system testing and assessment of developments in transmissions and control systems and hybrid propulsion units. Metering, rate structures, and load pattern studies and computer modeling will be used to project the future effect of electric vehicles on the power system. TVA will cooperate as appropriate with any federal R and D efforts, and will work with electric and hybrid vehicle manufacturers in improving the changing characteristics of the vehicles to improve efficiencies. An informational and promotional program will be provided when competitive vehicles are commercially available. Six electric vehicles have been purchased and metered to provide operational data. Vehicle evaluations will be performed at regular intervals to determine the reliability of the vehicle under commuter type use.

Keywords: ELECTRIC-POWERED VEHICLES; HYBRID ELECTRIC-POWERED VEHICLES; PERFORMANCE; TECHNOLOGY ASSESSMENT; ELECTRIC BATTERIES; CONTROL SYSTEMS; POWER SYSTEMS; DEMONSTRATION PROGRAMS; RELIABILITY; TENNESSEE VALLEY AUTHORITY.

130133 Assessment of Terrestrial Impacts Associated with Power Operations. Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6032. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.

Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

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.

130134 Characterization of Organic Priority Pollutants from Coal Pile Drainage. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1063. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130135 Chemical Equivalence of Boiler Cleaning Waste in Ash Pond Effluent. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1062. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.

Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The Water Research Program has an Effluent Control Subprogram which has among others an objective to obtain information on 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 will be to perform field studies to verify that various chemical components of boiler cleaning wastes will be removed in an alkaline or acid ash pond. The scope of this project will include sampling the discharges of an alkaline and acid ash pond during the release of boiler cleaning wastes to the pond. These samples will be analyzed for priority pollutants. Laboratory work was performed by TVA to demonstrate that copper and iron could be removed by alkaline ash ponds and by neutral ash ponds after the wastes have been treated (precipitation). EPA has required that we perform a field demonstration to prove copper and iron are removed. It is not known how priority pollutant legislation will impact the use of the ash pond as a chemical treatment pond. Data on priority pollutants is needed to assess the impact of this treatment scheme.

Keywords: FOSSIL-FUEL POWER PLANTS; BOILERS; CLEANING; WATER POLLUTION CONTROL; PONDS;

SAMPLING; ASHES; COPPER; IRON; REMOVAL; POLLUTION REGULATIONS; COMPLIANCE; WATER TREATMENT.

130136 Softening of Highly Concentrated Waters. Ogle, K.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1056. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$15,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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 assess the potential of lime-soda ash softening at high total dissolved solids as a process to enable a greater degree of recycle in ash sluice and cooling water systems. The scope of this project will include a series of tests to determine the efficiency of lime-soda softening on waters with high total dissolved solids and other compositions that make softening difficult. A summary of experiences western utilities have had on highly concentrated waters will be documented. Data will be input to computer models of chemical equilibria to correlate laboratory results with pertinent parameters such as ionic strength and relative saturation. A preliminary review has indicated the need for such work. Chemical equilibrium models are available. A report on the experiences of other users of this process will be prepared.
Keywords: WATER TREATMENT; ADDITIVES; CALCIUM HYDROXIDES; CALCIUM OXIDES; SODIUM CARBONATES; MATHEMATICAL MODELS; EQUILIBRIUM; SATURATION; IONS; FOSSIL-FUEL POWER PLANTS; LIQUID WASTES; ASHES; WATER CHEMISTRY; COOLING; PONDS; WATER POLLUTION.

130137 Prediction of Scale Formation in Recirculating Cooling Systems. Boroughs, R.D. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1058. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$65,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

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.

130138 Development of Model to Predict Scale Formation in Closed Cycle Water Systems. Boroughs, R.D.; Tielke, R.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1048. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$20,000.
Related energy source: fossil fuels(100). **R and D categories:** Environmental control technology.

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 Character ization and Disposal (task-water reuse) and Prediction of Scal 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.

130139 Study of Methods for Monitoring Chlorinated Discharges. Flora, H.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1057. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$40,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and 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.

130140 TVA Cocurrent Scrubber Project. Robards, R.F.; Wells, W.L. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1049. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: coal(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The Air Research Program has an SOx Technology Subprogram 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 primary objective of the lime/limestone cocurrent scrubber project which is a part of the SOx Technology Subprogram is to further evaluate SO2 and particulate removal efficiencies at the 1 and 10-Mw level which are logical steps leading to development of full scale systems. A second objective of this project is to evaluate advantages of the lime/limestone cocurrent scrubber process such as economics, physical size, equipment configuration, etc., while conducting the 1-Mw and 10-Mw testing. TVA's 1-Mw lime/limestone pilot plant at the Colbert Steam Plant has been converted to the cocurrent configuration as part of an EPRI project. Results obtained from previous 1-Mw testing were very encouraging. The results from the proposed 1-Mw testing and the previous 1-Mw testing will be used in designing and operating a 10-Mw cocurrent scrubber at the Shawnee test facility. The results from the 1- and 10-Mw testing will be used in evaluating the lime/limestone cocurrent scrubber process as an alternate process for meeting standards and/or regulations at full-scale electric generating facilities.
Keywords: FOSSIL-FUEL POWER PLANTS; SULFUR OXIDES; SCRUBBERS; REMOVAL; AIR POLLUTION CONTROL; LIME-LIMESTONE WET SCRUBBING PROCESSES; CONTROL.

130141 TVA Widows Creek Unit 8 Wet Limestone Scrubber Research Project. Wells, W.L. (TVA, 470 Commerce Union Bank, 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:** Environmental control technology; Characterization, measurement, and 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) Pro ess Evaluation; (4) Process Improvement and Optimization; (Sludge Treatment Demonstration and Evaluation; (6) E15 Enviro mental 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.

130142 Wood Waste as an Energy Source. Parker, F.G. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6038. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$25,000.
Related energy source: coal(50); biomass(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objectives of this research project are: (1) to determine if wood waste can be used as a supplemental fuel in a power boiler; (2) to assess the economic feasibility of wood waste as a fuel to coal in power boiler; and (3) to determine the effect the wood waste would have on existing pollution control equipment. The approach to be used in this project will be: (1) review the existing subject literature; (2) design, construct, and conduct a test firing; (3) evaluate pollution control equipment during wood combustion in the boiler; and (4) modify one or more boilers at Widows Creek Steam Plant to burn wood waste from Mead Paper Company. Several paper studies have indicated that wood waste can be used as a source of energy. However, these studies have not demonstrated the use of wood as a fuel in a utility boiler.
Keywords: WOOD WASTES; COMBUSTION; FOSSIL-FUEL POWER PLANTS; BOILER FUEL; POLLUTION CONTROL EQUIPMENT; DEMONSTRATION PROGRAMS; FEASIBILITY STUDIES.

130143 Waste Burning. Parker, F.G. (TVA, 440 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6017. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.
Related energy source: fossil fuels(50); biomass(50). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objectives are to make technical and economic feasibility studies for utilizing municipal and industrial solid waste in TVA power plant boilers and to assist communities in the TVA power service area in the evaluation of municipal solid waste programs as they relate to TVA power programs. An updated evaluation of technical and economic potential of processes for burning waste to produce energy will be maintained. The activities of Energy Research will be coordinated with the Office of Tributary Area Development, Division of Engineering Design, Division of Environmental Planning, and state and local governments. A feasibility study is presently being planned for burning wood waste from Mead Paper Company at Widows Creek. A technical and economic study is also being assessed for an incineration system at Gallatin, Tennessee. Two reports, IEA(m)-75-6 and PRS-8, have been published.
Keywords: MUNICIPAL WASTES; INDUSTRIAL WASTES; SOLID WASTES; COMBUSTION; FOSSIL-FUEL POWER PLANTS; BOILER FUEL; TECHNOLOGY ASSESSMENT; ECONOMICS; WOOD WASTES; WASTE PRODUCT UTILIZATION.

130144 Calcium Carbonate Scale Kinetics. Boroughs, R.D. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1065. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$8,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology.

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 non-thermal effluents, respectively. The objective of this project is to provide information on the kinetics of $CaCO_3$ scale formation. This will aid in assessing recycle options for both thermal and non-thermal water systems. The scope of this task will include planning and implementing laboratory study to measure the rate of $CaCO_3$ precipitation under various conditions. Different measures of supersaturation will be compared to determine which is best correlated to the precipitation rate. An extensive review of the literature in this area has identified deficiencies in the existing work and has suggested needed improvements.
Keywords: THERMAL EFFLUENTS; CALCIUM CARBONATES; DEPOSITION; SCALE CONTROL; SCALING; TECHNOLOGY ASSESSMENT; THERMAL POWER PLANTS; COOLING SYSTEMS; CHEMICAL REACTION KINETICS.

130145 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: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Environmental control technology; Integrated assessment.

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.

130146 Preliminary Investigation of PCB Contaminated Solids Disposal by Incineration. Evers, R.W. (TVA, 1320 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-993.019. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$5,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Environmental control technology.

This project will evaluate the feasibility of establishing a demonstration effort designed to show the destruction by incineration of PCB's contained in power factor correction capacitors and other PCB contaminated solid material contained in drums. Preparation of this waste material for incineration to assure thermal destruction of the PCB material is an important part of this evaluation. Activities required to meet the above objectives will include travel to the incineration facilities of waste processors to determine their possible use in a demonstration of this kind. Research work plans will be developed should a suitable incineration facility be identified. These efforts will be coordinated with EPRI.
Keywords: INCINERATORS; COMBUSTION; SOLID WASTES; FEASIBILITY STUDIES; WASTE PROCESSING PLANTS; CAPACITORS; INDUSTRIAL WASTES; AROMATICS; ORGANIC CHLORINE COMPOUNDS; WASTE DISPOSAL.

130147 Monitoring and Control of Chemical Conditions at Steam Power Plants. Anson, D. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.1070. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$50,000.
Related energy source: coal(50); nuclear fuels(general)(50). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this program are to establish target levels and allowable levels of chemical impurities in water, steam, lubricants, and coolants used in steam power plants, and to establish guidelines for the attainment and control of these levels as a means of improving plant reliability. The approach is to examine present practices in TVA and compare with known practices used or recommended elsewhere, and to review data relating chemical conditions to corrosion, wear, etc. as a guide to possible revision of standards. Factors such as analytical capability which limit control of chemistry and develop means of removing limitations will be determined and guidelines for chemical control during operation and outage periods will be established.
Keywords: STANDARDS; WATER; STEAM; LUBRICANTS; COOLANTS; THERMAL POWER PLANTS; RELIABILITY; CORROSION; WEAR; WATER CHEMISTRY; IMPURITIES; MONITORING; CONTROL.

130148 Biomass Production for Energy Source. Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6029. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$30,000.
Related energy source: fossil fuels(100).

The Biological Research Program has a Development of Biological Production Processes Subprogram which is designed to utilize byproducts of power generation to enhance biological production processes and to utilize biological products for energy sources. This project is designed to assess the potential for biomass production for use as an energy source. A state-of-the-art review will be conducted on biomass production for use as an energy source. A detailed assessment will be made on the amounts and types of crops which could be produced in the Tennessee Valley region for use as an energy source.
Keywords: BIOMASS; PRODUCTION; TENNESSEE VALLEY REGION; RESOURCE POTENTIAL; ENERGY SOURCES; THERMAL POWER PLANTS.

130149 Control of Nuisance Organisms. Goss, L.B. (TVA, 470 Commerce Union Bank, Chattanooga, TN, 37401). **Project number:** 988-15-990.6048. **Supported by:** Tennessee Valley Authority, Chattanooga (USA). **Funding:** TVA-$10,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50).

The Biological Research Program has a Control of Nuisance Organisms Subprogram designed to develop equipment and techniques to minimize adverse biological impacts on power facilities. This project is designed to identify any such impacts and develop control studies to alleviate them. A continuing review of operational facilities will be made and when impacts are found, studies will be developed to alleviate them.
Keywords: THERMAL POWER PLANTS; ENVIRONMENTAL IMPACTS; BIOLOGICAL FOULING; CONTROL.

U. S. COAST GUARD

140001 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: fossil fuels(50); conservation(50). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

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.

140002 Diesel Diagnostics: Develop Diesel Performance Monitor. Walter, R.A. (Department of Transportation, 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: fossil fuels(50); conservation(50). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

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.

140003 Vapor Cloud Explosion Study. Lind, D. (Naval Weapons Center, Attention Code 3362, China Lake, CA, 93555). **Project number:** 3302.03.01.3. **Contract:** MIPR-34095. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** USCG-$85,000; AGA-$300,000; DOE-$65,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

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.
Keywords: LIQUEFIED NATURAL GAS; LIQUEFIED PETROLEUM GASES; COMBUSTION PROPERTIES; VAPORS; GASES; WATER; DIFFUSION; AIR POLLUTION; DETONATIONS; HYDROCARBONS; SAFETY; RISK ASSESSMENT.

140004 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. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** USCG-$400,000.
Related energy source: oil and gas(100). **R and D categories:** Environmental control technology.

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.

140005 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-C6-70363-A. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** USCG-$200,000.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

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.

140006 Natural Energy Sources--Aids to Navigation. Nelson, H.D. (U.S. Coast Guard, (G-DOE-4), Washington, DC, 20590). **Project number:** 2705. **Supported by:** Coast Guard, Washington, DC (USA); Department of Transportation, Washington, DC (USA). **Funding:** USCG-$50,000.
Related energy source: solar(100). **R and D categories:** Environmental control technology.

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 object 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: SOLAR CELL ARRAYS; NAVIGATIONAL INSTRUMENTS; SHIPS; POWER SUPPLIES; PERFORMANCE TESTING; USES.

140007 Deep Water Ports (DWP): DWP Cargo Transfer System Analysis. Laaksonan, D.E. (United States Coast Guard, Office of Research and Development, G-DSA-1/TP44, Washington, DC, 20590). **Project number:** 4710. **Contract:** 64,503;62,451;64,157;82,827;60,670. **Supported by:** Coast Guard, Washington, DC (USA). Office of Research and Development. **Funding:** DOT.
Related energy source: oil and gas(100). **R and D categories:** Operational safety; Environmental control technology.

Research is proposed to assess and analyze risks associate with a deepwater port cargo transfer system. Risks are ranked and evaluated with the objective of identifying inspection and monitoring techniques that would minimize risks involved. Additionally, the output of the research will be used in the regulation of deepwater ports.

Keywords: DEEP WATER OIL TERMINALS; RISK ASSESSMENT; TANKER SHIPS; EVALUATION; INSPECTION; MONITORING; REGULATIONS.

NUCLEAR REGULATORY COMMISSION

150001 Aerosol Release and Transport from LMFBR Fuel. Fontana, M.H. (Oak Ridge National Laboratory, Building 9201-3, Oak Ridge, TN, 37830). **Project number:** B0121. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,490,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of this program is to provide the experimental data and analytical techniques necessary to make conservative and realistic assessments of the quantities, characteristics, and transient behavior of radionuclides that may be released into an LMFBR secondary containment as a result of a range of accident conditions up to and including severe core disruptive accidents.
Keywords: LMFBR TYPE REACTORS; REACTOR SAFETY; REACTOR ACCIDENTS; FUEL ELEMENT FAILURE; RADIOACTIVE AEROSOLS; FISSION PRODUCT RELEASE; CONTAINMENT SYSTEMS.

150005 Aerosol Measurements and Modeling for Fast Reactor Safety. Gieseke, J.A. (Battelle Memorial Institute, Battelle Columbus Labs., 505 King Street, Columbus, OH, 43201). **Contract:** A4063. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$360,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Improvements will be made for aerosol behavior models used to predict the leakage of radioactive materials from LMFBR containments under postulated accident conditions. These improvements will be concerned with better representations for aerosol agglomerate properties such as shape factors, effective volumes, effective densities, and particle-particle collision efficiencies. In addition, improved size distribution representations will be used in the analyses and thermal wall deposition included in a more descriptive fashion. Experimental measurements of agglomerate properties and thermal forces will be made to provide information needed in the model improvements. Sensitivity analyses and model verification by comparison with experimental results will be used to evaluate model adequacy and the importance of assumed conditions on aerosol leakage from containments. The sensitivity and verification efforts will be kept current as new experimental data become available and as the behavior models are improved. Technical assistance to the Experimental Fast Reactor Safety Research Branch of NRC will be provided in the review and analysis of experimental and theoretical aerosol release and behavior studies. This project will ultimately provide the NRC with verified aerosol codes for conducting radiological assessments of postulated LMFBR accidents. HAARM codes developed in this project are currently used as evaluation models by NRR for current LMFBR projects such as Clinch River. A summary of expected results for current fiscal year includes: (1) letter report on BAM Code initial feasibility; (2) topical report on analysis method used in reference code; (3) HAARM-3 Users Manual; (4) topical report on characteristics of UO2 aerosols produced in argon; (5) topical report on reference code with all agglomeration rates and multiple special zone; (6) topical report on sensitivity analyses; and (7) informal summary report on resuspension evaluations.
Keywords: LMFBR TYPE REACTORS; REACTOR SAFETY; REACTOR ACCIDENTS; CONTAINMENT SYSTEMS; MATHEMATICAL MODELS; RADIOACTIVE AEROSOLS; CONTAINMENT; COMPUTER CODES; FORECASTING; PLUTONIUM.

150008 Bubble Behavior in LMFBR Accident Environment. Reynolds, A.B.; Erdman, C.A. (University of Virginia, School of Engineering and Applied Science, Charlottesville, VA, 22901). **Contract:** B5616. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$90,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The project aim is the application of analytical methods to specific problems in the release and transport of aerosols in an LMFBR core-disruptive accident, including the formation and dynamics of the HCDA bubble in the sodium pool, the sources of small particles and fuel vapor within the bubble, and heat and mass transfer at bubble surfaces. This work will be coordinated with experimental work in Aerosol Release and Transport being done at ORNL. The project consists of four subtasks: (1) Particle Size from Condensation; (2) Particle Size from Fragmentation; (3) Bubble Heat and Mass Transfer and Bubble Dynamics; and (4) Core-to-Pool Transport Phenomena. A summary of expected results for current fiscal year includes: Subtask 1--assess applicability of homogeneous nucleation and growth model to reactor accident analysis; Subtask 2--define elements of integrated hydrodynamic and flashing fragmentation model; Subtask 3--modify Grenoble bubble expansion model to assess effects of axial forces and inert gases, modify for application to ORNL under-sodium experiments, and follow the continuing experimental work at Grenoble and Cadarache, France; and Subtask 4--analyze the effect of noncondensable gas on the fuel condensation results already obtained.
Keywords: LMFBR TYPE REACTORS; REACTOR CORE DISRUPTION; RADIOACTIVE AEROSOLS; BUBBLES; RESEARCH PROGRAMS; ENVIRONMENTAL TRANSPORT; BUBBLE GROWTH.

150018 HTGR Safety Analysis and Research. Ball, S.J. (Oak Ridge National Laboratory, Building 9201-3, Oak Ridge, TN, 37830). **Project number:** B0122. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$85,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

Confirmatory research on systems and safety analysis of HTGRs includes dynamic modeling and code development, analysis of postulated accidents and other transients, and partial verification of codes via experiments. The goals are to provide an independent verification of analyses done for safety analysis reports and licensing questions, and to improve the definitions of design safety margins and overall risks. Task 1 includes development of HTGR component and system dynamic models and computer codes, and evaluations of related codes by GAC. Task 2 covers the analysis of postulated accidents for the Fort St. Vrain (FSV) reactor, and the implementation and analysis of special FSV dynamic tests.
Keywords: HTGR TYPE REACTORS; REACTOR SAFETY; REACTOR ACCIDENTS; MATHEMATICAL MODELS; COMPUTER CODES.

150022 Nuclear Safety Information Center. Cottrell, W.B. (Oak Ridge National Laboratory, Building 9764, Oak Ridge, TN, 37830). **Project number:** B0126. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$600,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The Nuclear Safety Information Center provides a focal point for the collection, evaluation, storage, and dissemination of safety information generated here and abroad on reactors and other nuclear facilities. It publishes the bimonthly journal, Nuclear Safety, and both topical reports and indexed bibliographies as appropriate. In accordance with government policy, information is provided to nonexempt customers on a cost-recovery basis. Special studies are undertaken as required by NRC. It administers the document control and translations required for the Commission's Light-Water Reactor Foreign Exchange Program. All engineering aspects of nuclear safety are covered.
Keywords: REACTOR SAFETY; RADIATION PROTECTION; INFORMATION CENTERS.

150027 Containment Analysis Development. Wells, R.A. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Contract:** A6042. **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:** Characterization, measurement, and monitoring.

The objective is the development of multidimensional transient compressible flow program based on the LASL KACHINA code, which provides general short-term code for independent evaluation of water reactor containment systems. Work is planned to simplify and extend the program to also provide long-term containment analysis capabilities. Existing KACHINA code will be modified to evaluate reactor containment systems.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; CONTAINMENT SYSTEMS; MATHEMATICAL MODELS; COMPUTER CODES; K CODES; COMPRESSIBLE FLOW.

150028 Loss of Coolant Accident Analysis. Sullivan, L.H. (EG and G Idaho, Inc., Idaho Falls, ID, 83401). **Project number:** A6052. **Contract:** A6052. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$2,005,000.

Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The basic purpose of this activity is the improvement and addition of new analytical models to the RELAP code. This includes modifying advanced model concepts and developing programming techniques so that new models can be introduced into the RELAP code structure, improving existing RELAP models, maintaining an operational code, and maintaining RELAP configuration control. Another objective is to select, from the NRC analysis development results, improved analytical models for the LOCA hydrodynamic processes and to establish, in conjunction with the RELAP Experimental Code Development effort, methods for incorporation of these models into RELAP. The improvements sought under this effort are for the purpose of establishing more accurate best-estimate models for the physical processes which occur during a LOCA and to improve the evaluation model codes.

Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; LOSS OF COOLANT; MATHEMATICAL MODELS; COMPUTER CODES; REACTOR SAFETY; HYDRODYNAMICS.

150031 PBF Experimental Engineering. MacDonald, P.E. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Contract:** A6041. **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:** Operational safety; Environmental control technology.

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 1978 are PCM-1 and PCM-5 (9-rod--1-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 initial 4-rod blowdown LOCA test (LOCA-11) is planned for FY 1978. The RIA tests will determine test fuel rod behavior and fuel failure thresholds that might result from a reactivity initiated accident. RIA ST-1, a non-programmatic test, is the only test in this series scheduled for FY 1978.

Keywords: PBF REACTOR; REACTOR OPERATION; PWR TYPE REACTORS; FUEL ELEMENTS; FUEL ELEMENT CLUSTERS; REACTOR ACCIDENTS; REACTOR SAFETY; FUEL ELEMENT FAILURE; LOSS OF COOLANT.

150034 Fission Product Transport Analysis. Gieseke, J.A. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH, 43201). **Contract:** A4078. **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:** Operational safety; Physical and chemical processes and effects.

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 is on behavior in the primary system of LWRs during controlled-LOCA and in the spent fuel cask during LOCA. The work will be 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. The analytical model as developed to date is modular and such that expressions for various deposition mechanisms can be added incrementally. The generic code, TRAP, is sufficiently general in that it is adaptable to either meltdown or LOCA situations. Expected results in the current fiscal year include: (1) available data compiled on chemical interactions, fission product deposition, reactor and cask geometries, and thermal hydraulic conditions; (2) PWR model designed and assembled; (3) BWR model designed and assembled; (4) fuel cask model designed and assembled; (5) test cases for each of the above performed to assure validity of calculational technique; (6) improvement in basic code to include the most important deposition mechanisms for LOCA conditions; (7) limited sensitivity analyses for terminated LOCA conditions; (8) specification of requirements and initial code adaptation for assumed meltdown conditions; and (9) specification of functional design requirements for fission product test facility.

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.

150035 Natural Convection in Molten Pools. Kulacki, F.A. (Ohio State University, Department of Mechanical Engineering, Columbus, OH, 43201). **Contract:** A4061. **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:** Operational safety.

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.

150037 Fission Product Release from LWR Fuel. Malinauskas, A.P. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0127. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$340,000.

Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

This program has been developed primarily with an 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). A second 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 and gap escape fraction following rod rupture.

Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; LOSS OF COOLANT; FUEL ELEMENTS; SPENT FUEL ELEMENTS; ACCIDENTS; TRANSPORT; FISSION PRODUCT RELEASE.

150038 Decay Heat Studies (Oregon State). Spinrad, B.I. (Oregon State Univ., Corvallis, OR, 97331). **Project number:** B2040. **Contract:** B2040. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$18,000.

Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of this project is to develop a scientifically defensible method of predicting decay heat and its standard deviation for thermal convertor reactors by using available experimental data and established physical laws. Calculation from listed ENDF/B-IV data is the standard method, to be analyzed according to the uncertainties of the data and validated by comparison with integral experiments at LASL and ORNL. Computation of the error caused by yield uncertainties will produce a working standard shutdown power algorithm complete with defensible standard deviation. This is to be confirmed by review of errors caused by other uncertainties, currently believed to be either small or well-defined. Since yield errors are not part of ENDF/B-IV, their documentation will be systematized. Constraints such as mass, neutron emission and charge balance in fission will be used to keep the errors consonant with physical laws. A power reactor operating history is only simulated approximately by a constant U—235 fission rate, constant flux history. An appreciable fraction of the power comes from fast fission of U—238, and at the end of life a major fraction comes from thermal fission of Pu—239. This latter is also of importance for mixed oxide fueling. The properties of shutdown heating following Pu—239 and U—238 fission will be investigated analytically by the methods already developed for U—235, and shutdown heating from realistic reactor histories incorporating these fissions will be modeled. This will improve the precision of the working standard. Pre-and post-operational analysis of the LASL and ORNL shutdown heating experiments will be performed and pre-operational analysis will be completed and reported. Emphasis will be on predicting the gamma-ray spectra from fission-product decay as escape of gamma-rays from the experiments (a spectrum-dependent escape) is a major

ource of experimental uncertainty. Liaison will be maintained with EPRI programs on gamma transport, which are related to this phenomenon.
Keywords: POWER REACTORS; AFTER-HEAT REMOVAL; URANIUM DIOXIDE; FISSION PRODUCTS; GAMMA RADIATION; MATHEMATICAL MODELS; THERMAL REACTORS; AFTER-HEAT; CALCULATION METHODS.

150039 Fission Product Beta and Gamma Energy Release. Peelle, R.W. (Oak Ridge National Laboratory, Building 6010, Oak Ridge, TN, 37830). **Project number:** B0095. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$175,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The purpose of the program is to separately measure gross fission product beta- and gamma-ray energy release rates as a function of time from approximately 2 to approximately 14000 sec after fission. Present and future efforts are on thermal-neutron fission of 235-U, 239-Pu, and 241-Pu. This project involves meticulous application of standard spectrometry techniques to reduce the present uncertainty (of 15% for one standard error) to 3 to 4% for the integral release in the measured time interval in the case of fission of 233-U and 239-Pu by thermal neutrons. The anticipated uncertainty for study of 241-Pu is < 5%. As a side benefit of the method pursued, the time-dependent spectra of beta and gamma rays will be available at modest resolution. The project includes experimental work using rabbit, beam, and laboratory facilities at the Oak Ridge Research Reactor, as well as data analysis and comparison to the results of radiochemical studies.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; AFTER-HEAT; FISSION PRODUCTS; URANIUM 235; PLUTONIUM 239.

150040 Fuel Behavior Verification. Quapp, W.J.; Bohn, M.; Dearien, J.A. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Contract:** A6046. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,825,000.
Related energy source: nuclear fission(75); nuclear fusion(25). **R and D categories:** Operational safety.

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.

150041 Fuel Behavior Model Development. Bohn, M. (Eg and G Idaho Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Contract:** A6050. **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:** Characterization, measurement, and monitoring.

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.
eywords: BWR TYPE REACTORS; PWR TYPE REACTORS; FUEL ELEMENTS; TRANSIENTS; MATHEMATICAL MODELS; P CODES; COMPUTER CODES.

150044 Multirod Burst Tests. Chapman, R.H. (Oak Ridge National Laboratory, Building 9201-3, Oak Ridge, TN, 37830). **Project number:** B0120. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,200,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the program are to characterize deformation behavior of unirradiated LWR fuel cladding under conditions predicated for loss-of-coolant accidents (LOCA); to determine rod-to-rod interaction during ballooning and burst testing of single-rod and multi-rod arrays of fuel pin simulators, using transient heating of internally pressurized assemblies in a steam environment; to develop cartridge-type electric heater suitable for heating rates up to 30 degrees C/sec; to use single-rod tests to develop and improve test equipment and to study parameters affecting deformation behavior with both heated and unheated shrouds; and to establish single-rod and multi-rod tests.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; FUEL RODS; LOSS OF COOLANT; DEFORMATION; THERMAL STRESSES; FUEL ELEMENT FAILURE; HYDRAULICS; FLOW BLOCKAGE; REACTOR SAFETY.

150045 Zircaloy Fuel Cladding Creepdown Studies. Slaughter, G.M. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0124. **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:** Operational safety.

This program is concerned with behavior of Zircaloy fuel cladding under the conditions of external pressurization, temperature, and flux found in pressurized light-water power reactors. Rates of cladding creepdown both in- and out-of-reactor are being measured.
Keywords: PWR TYPE REACTORS; FUEL CANS; ZIRCALOY; CREEP; DEFORMATION.

150046 Strength and Ductility of Irradiated Zircaloy Cladding. Bauer, A.A. (Battelle Memorial Inst., 505 King Ave., Columbus, OH, 43201). **Project number:** A4068. **Contract:** A4068. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$500,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

A mechanical property data base on irradiated cladding will be provided that can be used to predict the performance of Zircaloy cladding under various off-normal, transient, and reactor accident conditions. Data will be obtained for development of strain-to-failure correlations when burnup is high and failure is probable by mechanical interaction with fuel at relatively low temperatures. Correlations will be obtained also between pressure, heating rate and temperature of failure under transient heating conditions. A range of mechanical properties of spent fuel cladding as functions of material, reactor type, burnup, fluence, temperature and time at temperature will be determined. Evaluation of radiation-damage annealing will be completed by tensile test on Lot 3 material, by burst test on Lot 2 material, and by bend and expanding-mandrel tests on Lots 1 and 2 material. Transient heating-burst tests will be completed on Lot 1 and Lot 2 materials. Lot 3 and Lot 4 material will be procured and the characterization of Lot 3 material initiated and of Lot 2 completed. A preliminary model for the strength and ductility of irradiated Zircaloy will be developed.
Keywords: FUEL CANS; ZIRCALOY; MECHANICAL PROPERTIES; STRAINS; FAILURES; CORRELATIONS; BURNUP; PRESSURE DEPENDENCE; TEMPERATURE DEPENDENCE; TRANSIENTS; REACTOR ACCIDENTS; FUEL-CLADDING INTERACTIONS; PHYSICAL RADIATION EFFECTS; DUCTILITY.

150049 Creare Downcomer Effects Program. Rothe, P.; Crowley, C.J. (Creare, Inc., Hanover, NH, 03755). **Contract:** A4070. **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:** Operational safety.

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; (b) develop preliminary scaling hypotheses relating to transient plenum refill and phenomena affecting system behavior during the ECC injection phase; (c) provide technical assistance as required in support of WRSR's steam-water mixing and ECC bypass research programs and planning activities; and (d) develop and demonstrate an instrumentation computer system which can be used to map steam/water topographies under simulated transient LOCA conditions. 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.

150056 Steam-Water Mixing and System Hydrodynamics Program. Collier, R. (Battelle Columbus Labs., 505 King Street, Columbus, OH, 43201). **Contract:** A4048. **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:** Operational safety; Characterization, measurement, and monitoring.

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-78 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.

150063 PWR Blowdown Heat Transfer Separate Effects Program. Thomas, D.G. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0125. **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:** Operational safety.

The PWR Blowdown Heat Transfer Separate-Effects Program is an experimental study of the relationships among the principal reactor variables which can alter the rate of blowdown, the presence of flow reversal and rereversal, the time delay to critical heat flux, the rate at which dryout progresses radially and axially along the heater rods, pre- and post-CHF heat transfer coefficients and calculated local fluid conditions. Primary test results are obtained from the Thermal Hydraulic Test Facility (THTF), a large non-nuclear pressurized water loop containing a test bundle of 49 electrically heated rods with 12-ft heated length whose power profile is stepped to simulate an axial chopped cosine profile. Support is provided by the Forced Convection Test Facility (FCTF), a smaller loop containg a single rod in annular geometry.
Keywords: PWR TYPE REACTORS; REACTOR SAFETY; BLOWDOWN; HEAT TRANSFER; HYDRAULICS; TEST FACILITIES; LOSS OF COOLANT.

150065 Inspection of Nuclear Reactor Welding by Acoustic Emission. Prine, D.W. (General American Research Division, 7449 Natchez Avenue, Niles, IL, 60648). **Project number:** 150165. **Contract:** A4052. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100).

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.

150066 LOCA Analysis Assessment and Application. Dearien, J. (EG and G Idaho, Inc., Idaho Falls, ID, 83401). **Project number:** A6047. **Contract:** A6047. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$921,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The purpose of this activity is to provide verified analytical models for predicting the system response of BWR and PWR power plants to a Loss-of-Coolant Accident (LOCA). This is accomplished by establishing the requirements for analytical model development and supporting the experiments, and by comparing model predictions with data in order to assess the uncertainty bands of the model predictions. Experiments of concern are: the LOFT Program, Semiscale Program, Plenum Filling Experiment, Industrial Cooperative Programs, and other domestic or foreign programs furnishing data related to analyses of the LOCA.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; LOSS OF COOLANT; MATHEMATICAL MODELS; COMPUTER CODES; R CODES; REACTOR SAFETY; COMPARATIVE EVALUATIONS; ACCURACY; DATA.

150067 Post Accident Source Term Evaluations for Radioactive Shipping Packages. Bonzon, L.; Luna, R. (Sandia Laboratory, Albuquerque, NM, 87105). **Project number:** A1040. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$130,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The objective is to formulate through analytical and experimental efforts, a mode which will predict the escape and dispersion of radioactive material from shipping packages following impact failure coupled with other relevant accident environments (i.e., fire). Available analytical models for evaluating the extent of container damage, content escape, and near field atmospheric particulate transport, following a severe transport accident, will be compiled to scope the magnitude of airborne material release. Detectors will be located about the potential release site to determine airborne concentrations of released material. Based on the experimental results, a model will be developed for evaluating escape fractions and physical/chemical material forms as a function of accident severity. This model can be integrated with existing dispersion/health effects models to realistically evaluate the consequences of severe transportation accidents.
Keywords: CASKS; PERFORMANCE TESTING; ACCIDENTS; FAILURES; AIR POLLUTION; SAFETY; RADIOACTIVE MATERIALS; DAMAGE; ENVIRONMENTAL TRANSPORT; RADIATION HAZARDS.

150080 Part I: An Evaluation of Seismic Qualification Test for Nuclear Power Plant Equipment; Part II: Improved Guidelines for Seismic Qualification Test of Nuclear Power Plant Components. Kana, D.D. (Southwest Research Inst., P.O. Drawer 28510, San Antonio, TX, 78284). **Contract:** B6000. **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:** Operational safety; Characterization, measurement, and monitoring.

Research subjects are to be studied which will lead to new and improved guidelines for seismic qualification tests of nuclear power plant components.
Keywords: NUCLEAR POWER PLANTS; REACTOR COMPONENTS; SEISMIC EFFECTS; PERFORMANCE TESTING; RECOMMENDATIONS.

150081 Design Criteria for Piping and Nozzles. Moore, S.E. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0123. **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:** Operational safety.

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.

150082 Halden Fuel Irradiation Program. Vik, T. (Institutt for Atomenergi, P.O. Box 173, N-1751, Halden, Norway). **Contrac** B5531. **Supported by:** Nuclear Regulatory Commission, Washingtoi DC (USA). Div. of Reactor Safety Research. **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective is to obtain data on reactor fuel rod performance under normal reactor conditions and mild power transients by

placing instrumented assemblies of fuel rods in the Halden (Norway) reactor. Data will be reported on pellet-clad interaction failures, gap conductance, fission gas release during power ramps, and fuel restructuring.
Keywords: HBWR REACTOR; REACTOR OPERATION; FUEL ELEMENTS; PERFORMANCE TESTING; IRRADIATION; IRRADIATION CAPSULES; HEAT TRANSFER; FISSION PRODUCT RELEASE; FUEL-CLADDING INTERACTIONS; NUCLEAR FUELS.

150084 Crack Arrest Study. Hahn, G.T. (Battelle Memorial Institute, 505 King Avenue, Columbus, OH, 43201). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$512,000.
Related energy source: nuclear fission(100).

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.

150085 Development of High-Sensitivity Ultrasonic Techniques for In-Service Inspection of Nuclear Reactors. Linzer, M. (National Bureau of Standards, Inorganic Materials Division, Washington, DC, 20234). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$46,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives are: (1) to produce effective in-service inspection devices for early detection of flaws in nuclear reactor components; (2) to improve the sensitivity and flaw discrimination of ultrasonic pulse echoes; and (3) to conduct theoretical analyses of the interaction of ultrasonic radiation with materials as a basis for the development of novel field instruments. Signal averaging device capable of 50 mega hertz averaging and a pulse compression device capable of 30:1 have been completed. A dynamically-focused annular array has been constructed which approximates a constant f-number lens.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR COMPONENTS; INSPECTION; ULTRASONIC TESTING; EQUIPMENT; MATERIALS TESTING; SENSITIVITY.

150086 Dynamic Photoelastic Investigation of Crack Arrest. Kobayashi, T. (University of Maryland, College Park, MD, 20740). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$160,000.
Related energy source: nuclear fission(100).

The overall objective of the research program is to determine appropriate characterization methods for crack arrest in terms of a measurable physical property of the material, development of test methods and specimens for standardized crack arrest toughness measurements, and adoption by ASME Code and Regulatory authorities for design and operation of pressurized water, primary system components.
Keywords: PRESSURE VESSELS; CRACKS; TESTING; WELDED JOINTS; FRACTURE PROPERTIES; BWR TYPE REACTORS; PWR TYPE REACTORS; PHOTOELASTICITY; STRESS ANALYSIS; COATINGS.

150087 Structural Integrity of Water Reactor Pressure Boundary Components. Loss, F.J. (Naval Research Laboratory, Code 6390, Washington, DC, 20375). **Project number:** 150087. **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:** Characterization, measurement, and monitoring.

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.

150094 Consequence Modeling for Nuclear Reactor Accident. Sprung, J.L. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1042. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$281,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The project has the following objectives: (1) analyze the modeling and extend the capabilities of the consequence model incorporated in the Reactor Safety Study (WASH-1400); (2) compare the air concentrations predicted by single-station data, straight-line trajectory model (CRAC) with that predicted by multi-station data, variable trajectory model (MESODIFF); (3) further investigations into applicability of CRAC for site specific calculation; and (4) completion of sensitivity studies and documentation and rain model documentation.
Keywords: NUCLEAR POWER PLANTS; REACTOR ACCIDENTS; FISSION PRODUCT RELEASE; MATHEMATICAL MODELS; RADIATION DOSES.

150097 Reactor Safety Study Methodology Applications Program. Asselin, S.V. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1047. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$416,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

The project has the following objectives: (1) study effects of LWR plant design on public risk; (2) identify accident sequences that are major contributors to public risk for a spectrum of LWR designs; (3) apply WASH-1400 methodologies and data to study the effects of LWR plant designs on public risk; (4) develop a set of event trees for each of 4 selected LWR designs; (5) select and analyze those key accident sequences that are expected to dominate the reactor accident risk for each of the 4 LWR designs; and (6) perform systems analysis for selected systems within the key accident sequences in order to estimate system failure probability.
Keywords: SAFETY ENGINEERING; REACTOR SAFETY; BWR TYPE REACTORS; PWR TYPE REACTORS.

150104 Distribution Coefficients for Transuranic Elements in Aquatic Environments. Seymour, A.H. (University of Washington, Seattle, WA). **Project number:** B5749. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$207,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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 coeficients for water sediments; (3) release rates from sediments to overlying water; and (4) distribution coefficients for phytoplankton, water and sediments.
Keywords: TRANSURANIUM ELEMENTS; RADIONUCLIDE MIGRATION; RADIONUCLIDE KINETICS; AQUATIC ECOSYSTEMS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; DISTRIBUTION FUNCTIONS; WATER POLLUTION.

150105 Critical Pathways of the Transuranic Nuclides to Man from Agro-Ecosystems. Smith, M.H. (Savannah River Ecology Lab., Aiken, SC). **Project number:** B4124. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$96,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

The objectives are to: (1) determine whether uptake of transuranic elements increases as a function of the number of times a crop has been grown on a particular soil; and (2) determine the effects of amendments such as lime and chelating agents on long term relationships between crops and transuranium uptakes.
Keywords: MAN; BIOLOGICAL RADIATION EFFECTS; ENVIRONMENTAL EXPOSURE PATHWAY; RADIATION DOSES; TRANSURANIUM ELEMENTS; RADIONUCLIDE KINETICS; AGRICULTURE; TERRESTRIAL ECOSYSTEMS; UPTAKE; CROPS; SOILS; CONTAMINATION.

150106 Unified Transport for Power Plant Assessment (Radioisotopes). Eraslan, E.H. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** B0168. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$3,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and

chemical processes and effects; Ecological/biological processes and effects.

At present there are no acceptable, tested models for assessing the dynamic behavior and physico-chemical interactions and transport of radioisotopes in the aquatic environment, especially as related to the math models which characterize thermal plumes. More complete and timely environmental impact assessments require such models to treat radioisotopic releases. The objectives of this project are to: (1) provide tested, reliable methods (models) for predicting the radionuclide concentration of power plant discharges to rivers, estuaries, ponds, lakes, and coastal waters; (2) provide models for predicting radionuclides in sediments and transport of sediments in receiving water bodies; and (3) utilize the same mathematical and computational procedures for radioisotopic, thermal, chemical and entrainment systems, thus optimizing input and computer requirements.

Keywords: RADIONUCLIDE MIGRATION; SURFACE WATERS; MATHEMATICAL MODELS; SEDIMENTS; TRANSPORT; FORECASTING; NUCLEAR POWER PLANTS.

150108 Unified Transport Approach: Zone Matching Methods. Park, J.E. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** B0167. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$1,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

For the evaluation of the environmental impact of thermal aquatic discharges, there are presently used several discrete, mathematically noncompatible models to evaluate plume behavior in the near and far fields. This introduces considerable uncertainty in the assessment of thermal impacts in general and or reentrainment and recirculation questions specifically. The project will provide rigorous methods for integrating near-field and far-field mathematical models used to predict (analyze) aquatic thermal impacts of nuclear power plants.

Keywords: THERMAL EFFLUENTS; WATER POLLUTION; ENVIRONMENTAL IMPACTS; PLUMES; MATHEMATICAL MODELS; MONITORING.

150109 Unified Transport Approach for Power Plants Assessment (Thermal Impact). Eraslan, E.H. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** B0166. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$75,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective of this program is to provide tested, reliable methods (models) for predicting the thermal impact of power plant discharges to rivers, estuaries, ponds, lakes and coastal waters. The same mathematical models and computational procedures are to be used for thermal, chemical, radioisotopic and entrainment analyses, thus optimizing input and computer requirements.

Keywords: NUCLEAR POWER PLANTS; THERMAL EFFLUENTS; ENVIRONMENTAL IMPACTS; AQUATIC ECOSYSTEMS; COMPUTER CALCULATIONS; MATHEMATICAL MODELS.

150110 Biodosimetric Confirmation of Dose Rate Amelioration Factors. Shifrine, M.; Wilson, F.D. (University of California at Davis, Davis, CA, 95616). **Project number:** B3029. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$135,000.

Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objectives are to confirm in a relatively long-lived animal the use of hematologic and immunologic end-points as sensitive biodosimeters of radiation dose and dose-rate effects and as early predictors of the development of relative late effects including leukemia, and to provide an extrapolative quantifiable endpoint for risk assessment. The irradiation of Beagles at 0.07 and 0.33 R/day will be continued. The D37 dose will be determined on blood from these dogs irradiated in vitro. Changes on lymphocyte surfaces will be evaluated using the mixed lymphocyte culture technique. These tests will be performed every four months. Genetically unmatched pairs of irradiated dogs and unirradiated controls will be skin-grafted to determine whether the radiation has increased the duration of onset of rejection. Additional data on the various immunological parameters will be accumulated.

Keywords: IONIZING RADIATIONS; CHRONIC IRRADIATION; BEAGLES; DELAYED RADIATION EFFECTS; IMMUNE REACTIONS; BLOOD; LOW DOSE IRRADIATION; RISK ASSESSMENT; LYMPHOCYTES; BIOLOGICAL DOSEMETERS; DOSE RATES; IMMUNITY; RADIOSENSITIVITY EFFECTS; LEUKEMIA.

150111 Relative Hazard of Radioiodine as a Function of Radiation Quality and Age at Exposure. Book, S.A. (University of California at Davis. Davis, CA). **Project number:** B3028. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$57,000.

R and D categories: Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are to verify the values for the relative effectiveness of x-ray I-131, I-132, and I-133 on rodent thyroids; and to evaluate the differential sensitivity to thyroidal irradiation of immature and mature thyroid glands.

Keywords: RATS; THYROID; IODINE 133; IODINE 132; IODINE 131; RADIONUCLIDE KINETICS; RADIATION HAZARDS; RISK ASSESSMENT; AGE DEPENDENCE; RADIOSENSITIVITY.

150112 Follow-Up Study of Persons Who Had I-131 and Other Diagnostic Procedures During Childhood. Lundin, F. (Bureau of Radiological Health, Rockville, MD). **Project number:** B5771. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$1,000.

R and D categories: Operational safety; Integrated assessment; Health effects; Ecological/biological processes and effects.

The general objective is to determine the risk of thyroid neoplasm development following exposure to diagnostic levels of I-131 and the dose-response relationship.

Keywords: IODINE 131; RADIONUCLIDE KINETICS; DELAYED RADIATION EFFECTS; DIAGNOSTIC TECHNIQUES; NUCLEAR MEDICINE; THYROID; NEOPLASMS; DOSE-RESPONSE RELATIONSHIPS; RADIATION HAZARDS; X RADIATION; DATA ACQUISITION.

150113 Radiation Exposure and Risk Estimates for Inhaled Airborne Radioactive Pollutants Including Hot Particles. Mewhinney, J.A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). **Project number:** A1031. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$332,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is to conduct confirmatory research on the sources, biological fate, and predicted health consequences of airborne radioactivity which may be released in normal operations or under accident conditions in the nuclear fuel cycle.

Keywords: RADIOACTIVITY; RADIONUCLIDE MIGRATION; RADIONUCLIDE KINETICS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; AIR POLLUTION; HEALTH HAZARDS; RADIATION DOSES; HUMAN POPULATIONS.

150115 Measurements of Uranium and Radium in Uranium Mill Workers and Control Populations. Helgeson, L. (Helgeson Nuclear Services, Inc., 5587 Sunol Blvd., Pleasanton, CA, 94566). **Project number:** B5732. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective is to determine the body burdens accumulated by uranium mill workers as a result of occupational exposure to uranium ore dusts.

Keywords: FEED MATERIALS PLANTS; URANIUM; RADIUM 226; RADIATION DOSES; PERSONNEL; LUNGS; SKELETON; DAUGHTER PRODUCTS; URANIUM 235; BODY BURDEN; RADIATION HAZARDS.

150116 Disequilibrium of Uranium Daughters in Ore Dust From Milling Operations and Subsequent Lung Deposition From Inhalation. Perkins, R.W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2089. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$116,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

Objectives are to: (1) determine the amounts of uranium and thorium in uranium mill ores and ore dust particles of different sizes; (2) determine the secular equilibrium relationship between uranium and Th-230 in the ores and dust particles; and (3) with the empirical uranium-mill-ore-dust sizes and radioisotopic data obtained, estimate mill worker lung burdens and doses for Th-230.

Keywords: URANIUM; DAUGHTER PRODUCTS; LUNGS; DEPOSITION; THORIUM; URANIUM ORES; MILLING; DUSTS; THORIUM 230; EQUILIBRIUM; PARTICLE SIZE; PERSONNEL; RADIATION DOSES.

150117 Radiation Dose to Construction Workers. Endres, G.W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2073. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects.

The objective is to obtain reliable data in order to evaluate radiation doses experienced by construction workers on new plants at operating reactor sites.
Keywords: CONSTRUCTION INDUSTRY; PERSONNEL; RADIATION DOSES; DATA COMPILATION; REACTORS; HEALTH HAZARDS.

150119 Impact of Offshore Nuclear Generation on Recreational Behavior at Adjacent Coastal Sites. Baker, E.J. (Florida State University, Tallahassee, FL). **Project number:** B5745. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fuels(general)(100).

As part of a license application, the NRC is required to assess likely socio-economic impacts of construction and operation on local communities and the surrounding region. Very little information exists which can be brought to bear on these concerns. The objective of the study is to learn the manner in which the public perceives risk from offshore nuclear generating stations.
Keywords: OFFSHORE OPERATIONS; NUCLEAR POWER PLANTS; OFFSHORE SITES; RECREATIONAL AREAS; ENVIRONMENTAL IMPACTS; HUMAN POPULATIONS; BEHAVIOR; SOCIO-ECONOMIC FACTORS; PUBLIC OPINION; RADIATION HAZARDS; HEALTH HAZARDS.

150122 Asbestos in Cooling Tower Waters. Lewis, B.A.G. (Argonne National Laboratory, 9700 S. Cass Avenue (EIS-11A), Argonne, IL, 60439). **Project number:** A2031. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to prepare a generic report on the potential hazard to human health posed by asbestos fibers in discharges to air and water from cooling towers constructed of asbestos material. Samples of water from operating cooling towers were analyzed for their content and mineral type of asbestos fibers. The data obtained were interpreted in terms of known human health effects of asbestos in water as reported in the literature. Models for cooling tower drift deposition were applied to the data to estimate asbestos fiber concentrations in air at ground level due to drift. The results were compared to standards for asbestos fibers. Ambient air in the upwind vicinity of a cooling tower was sampled to allow estimation of the quantity and mineral type of asbestos contributed to cooling tower due to air washing. Chrysotile fibers were found in cooling tower water. Concentrations were on the order of 10/sup 6/ to 10/sup 8/ fibers/liter of water, with mass concentrations between less than 0.1 mu-g/liter to 37 mu-g/liter. The majority of the fibers were less than 5 mu-m in length, with aspect ratios ranging from 3.5 to 1700. The maximum concentrations of asbestos fibers in the air near ground due to drift were estimated to be on the order of asbestos concentrations reported for ambient air up to distances of 4 km downwind of the towers, with some exceptions. The remainder of the project is expected to provide quantitative information on the contribution of asbestos in ambient air to cooling tower discharges. If such contributions are on the order of quantities found in the water samples, then the type of material used to construct the towers is irrelevant in terms of asbestos discharges to surface waters.
Keywords: ASBESTOS; COOLING TOWERS; HEALTH HAZARDS; WATER POLLUTION; ENVIRONMENTAL IMPACTS; AIR POLLUTION; SAMPLING; POWER PLANTS; CHEMICAL EFFLUENTS; WASTE HEAT.

150125 PuO2 Container Certification, Phase II. Andersen, J. (Sandia Labs., Albuquerque, NM). **Project number:** A1059. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$30,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of the PuO2 Container Certification program is to design, fabricate and test a plutonium package design which can be certified for air transport.
Keywords: PLUTONIUM DIOXIDE; PACKAGING; FABRICATION; TESTING; DESIGN; RADIONUCLIDE KINETICS; RADIOACTIVE WASTE MANAGEMENT; CASKS; ENVIRONMENTAL IMPACTS.

150126 Air Qualified Plutonium Shipping Container Tests. Bonzon, L. (Sandia Labs., Albuquerque, NM). **Project number:** A1034. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology.

The objectives are to: (1) establish design margins of inservice containers beyond existing package standards; (2) determine capabilities of analytical models for container failure predictions; (3) define container failure modes and content response information for follow-on consequence evaluation program; and (4) provide information to support formulation of container certification criteria.
Keywords: PLUTONIUM; CASKS; TESTING; AIR POLLUTION ABATEMENT; STANDARDS; FAILURE MODE ANALYSIS; RADIOACTIVE WASTE MANAGEMENT.

150129 Source Term Measurements. Mandler, J. (EG and G Idaho, Inc., Idaho National Engineering Laboratory, Idaho Falls, ID). **Project number:** A6075. **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:** Operational safety; Characterization, measurement, and monitoring.

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.

150131 Chemical Effluents from Nuclear Power Stations: Copper. Harrison, F.L. (Lawrence Livermore Laboratory, Livermore, CA). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$318,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

Pollutants released into aquatic ecosystems by nuclear power stations depend on the type of cooling system used and the kinds of chemicals added to the effluent to control maintenance processes. Copper is of special interest because of its documented adverse effect on aquatic organisms. This program is designed to: (1) characterize the chemical forms and behavior of copper discharged into surface waters as effluents from nuclear power stations, (2) obtain data and information on the behavior of copper in the sediments of receiving water bodies at nuclear station sites, (3) determine the magnitude of the impact of copper on representative species, and (4) develop models suitable to NRC applications for predicting and assessing environmental impacts of copper released from nuclear power stations.
Keywords: NUCLEAR POWER PLANTS; CHEMICAL EFFLUENTS; ENVIRONMENTAL IMPACTS; COPPER; AQUATIC ECOSYSTEMS; MONITORING.

150132 Waste Management Parametric Study. Godbee, R. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** B0162. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$270,000.
Related energy source: nuclear fission(100).

The objective is to develop basic cost data for various fuel reprocessing waste treatment, storage, transportation and disposal alternatives which can be used to evaluate ALARA and proposed DOE waste management plans.
Keywords: COST; FUEL REPROCESSING PLANTS; RADIOACTIVE WASTE MANAGEMENT; RADIOACTIVE WASTE STORAGE; RADIOACTIVE WASTE DISPOSAL; TRANSPORT; RADIOACTIVE WASTE PROCESSING.

150133 Evaluation of Isotope Migration--Water Chemistry at Shallow-Land Burial Grounds. Columbo, P.; Weiss, A.J. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** A-3042. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$420,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are to define the source terms of radionuclides and other solutes in trend water from licensed low-level radionuclides disposal sites in cooperation with USGS (United States Geological Survey), and to describe the physical, chemical, and biological properties that control the movement of radionuclides along the flow paths of ground water.

Keywords: WATER CHEMISTRY; RADIONUCLIDE MIGRATION; GROUND WATER; LOW-LEVEL RADIOACTIVE WASTES; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; WATER POLLUTION.

150134 Methodology Development for Waste Disposal Options. McGrath, P. (Sandia Labs., Albuquerque, NM). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

The objective is to develop a verified methodology by which NRC decisions can be made on proposed DOE plans for the management of commercially generated waste.
Keywords: FUEL CYCLE; RADIOACTIVE WASTE MANAGEMENT; LAND RECLAMATION; DECISION MAKING; COMMERCIALIZATION; NUCLEAR ENERGY; RADIOACTIVE MATERIALS; TRANSPORT; TRANSPORTATION SYSTEMS; DECONTAMINATION; DECOMMISSIONING; SOLID WASTES; INFORMATION SYSTEMS; RADIOACTIVE WASTE DISPOSAL; GOVERNMENT POLICIES.

150136 Standardized Analysis of Fuel Shipping Containers. Whitesides, G.E. (Oak Ridge National Laboratory, Computer Sciences Division, X-10 Site, Building 6025, Oak Ridge, TN, 37830). **Project number:** B0172. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$280,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology.

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 associated with the nuclear fuel cycle. The initial version of the SCALE system 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 deliberative capability for establishing inter-modular execution paths.
Keywords: CASKS; NUCLEAR FUELS; TRANSPORT; CRITICALITY; HEAT TRANSFER; S CODES; SHIELDING; SAFETY; COMPUTER CODES.

150137 Develop and Improve Structural Analysis Methods for Shipping Containers. Larder, R. (Lawrence Livermore Laboratory, Livermore, CA, 94550). **Project number:** A0117. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$127,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective is to develop and improve methods for evaluating (1) the performance of container closures under static and dynamic loading conditions and (2) the response of the shipping containers to the puncture environment specified in 10 CFR 71. The scope of work under the task to relate flange closure forces to leak rates for different types of seals includes: (1) conducting the experimental portion of this task which involves ten seal/flange test fixtures (six seal types will be evaluated under conditions of variable bolting force, internal pressures, and number of bolts, completion, August 1978); (2) finite element analysis (e.g., NSAP-2D) of the remaining seal configurations not evaluated in FY1977 (completion, September 1978); and (3) initiate work on final report in August 1978 (completion IQ 1979).
Keywords: CASKS; PERFORMANCE TESTING; SEALS; LEAK TESTING; RADIOACTIVE WASTES; TRANSPORT.

150138 Structural Technology for Shipping Containers. (Sandia Laboratory, Albuquerque, NM, 87105). **Project number:** A1045. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$135,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objectives of the structural technology program are to: (1) provide NRC with a verified general purpose computer code modified to expeditiously perform structural analyses of shipping containers; and (2) compare the adequacy of various methods of analyzing container response to the perfomance standards as defined by 10 CFR 71.
Keywords: COMPUTER CODES; PERFORMANCE TESTING; CASKS; RADIOACTIVE WASTES; TRANSPORT.

150139 Transportation Research Program Definitional Assistance: Special Projects. Luna, R. (Sandia Labs., Albuquerque, NM). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$76,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Integrated assessment.

The objective is to provide assistance to NRC in formulating a meaningful transportation safety program and in accomplishing short term special projects.
Keywords: RADIOACTIVE MATERIALS; TRANSPORT; TRANSPORTATION SYSTEMS; RADIOACTIVE WASTE MANAGEMENT; ENVIRONMENTAL IMPACTS.

150157 Forecasting Electricity Demand by States and by Utility Service Areas. Carlsmith, R.S. (Oak Ridge National Laboratory, Building 3550, Oak Ridge, TN, 37830). **Project number:** B0190. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$190,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The proposed project is a continuation of the ongoing project Forecasting Electricity Demand by States in U.S. on an Annual Basis. While our previous and ongoing efforts have focused on the development of econometric models for forecasting electrical energy demand in kilowatt-hours (kWh), the major focus for FY 1979 will be on the development of models for forecasting peak load demand (kW) and baseload capacity. In addition, we will continue and complete the task initiated in FY 1978 in disaggregating state-level forecasts of kWh to utility service areas. Specifically, the objectives of this project are (1) to develop a computer model for projecting the need for total generating capacity based on the forecasts of demand in kWh; (2) to develop a mechanism to forecast need for baseload capacity; and (3) to improve the allocation model which disaggregates state-level forecasts of electric energy demand to electric utility service areas. The results of the proposed research activities will be used directly by the staff of NRC, ORNL, and ANL in their assessments of the environmental impacts of adding new generating facilities.
Keywords: ELECTRIC POWER; POWER DEMAND; FORECASTING; ELECTRIC UTILITIES; USA; ECONOMETRICS; MATHEMATICAL MODELS; CAPACITY; PEAK-LOAD PRICING.

150158 Social Impacts of Nuclear Power Plant Siting: A Post Licensing Case Study. Peelle, E. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$6,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this program are to investigate and assess the social and economic impacts which result from construction and operation of nuclear power plants and to develop the basis for future avoidance or mitigation.
Keywords: NUCLEAR POWER PLANTS; ENVIRONMENTAL IMPACTS; SOCIO-ECONOMIC FACTORS.

150160 Methods to Assess Impacts on Hudson River Striped Bass. Van Winkle, W. (Oak Ridge National Laboratory, P.O. Box X, Building 1505, Oak Ridge, TN, 37830). **Project number:** B0165. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$92,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Operational safety; Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

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.

150161 Assessment of Nuclear Industrial Impact on the Environment. Chapman, D.G. (University of Washington, Seattle, WA). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$421,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

A selection of plants will be made for detailed analysis, each sited on a different water body type. Problems common to the various aquatic ecosystems will be identified and related to plant design. Particular attention will be given to the level in the food chain (plankton, benthos, or fish) as well as the life history stage(s) of one or more representative species which are receiving the greatest impact. A probable causal link will be determined in each case relating to thermal exposure, cooling water volume, mixing zone, intake velocity, entrainment time, as well as other factors.
Keywords: NUCLEAR POWER PLANTS; ENVIRONMENTAL EFFECTS; AQUATIC ECOSYSTEMS; SAMPLING; MATHEMATICAL MODELS; EVALUATION; FOOD CHAINS; ENVIRONMENTAL EXPOSURE PATHWAY; THERMAL EFFLUENTS.

150162 Heavy-Section Steel Technology Program. Whitman, G.D. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0119. **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:** Operational safety.

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.

150163 Improved Ultrasonic Non-Destructive Testing of Pressure Vessels. Frederick, J. (University of Michigan, Department of Mechanical Engineering, Ann Arbor, MI, 48109). **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:** Operational safety.

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.

150168 Product Safety Testing. Case, F.N. (Oak Ridge National Laboratory, Building 3037, Oak Ridge, TN, 37830). **Project number:** B0186. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$40,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

Radionuclides are widely used in a variety of scientific, industrial and consumer product applications. These applications bring widespread distribution of radioactive materials in the public sector. Since the uses of radionuclides are valuable from both an economic and public health aspect, it is important to identify situations which may lead to unnecessary or excessive exposure of humans to ionizing radiation. Normal use and accidental conditions that lead to personnel radiation exposure or release of radionuclides into the environment should be anticipated and evaluated. Evaluations include estimations of the severity of exposure or release, determination of physicochemical nature of released material and design of remedial measures. The purpose of the program proposed here is to obtain such information for devices containing radionuclides which: (1) have wide distribution; (2) are used in unrestricted environments; and (3) are transported on common carriers.
Keywords: RADIOISOTOPES; TESTING; SAFETY; USES; RESEARCH PROGRAMS; ACCIDENTS.

150170 Source Terms for Spent Fuel Accidents (STDS). England, T. (Los Alamos Scientific Laboratory, Los Alamos, NM, 87545). **Project number:** A7037. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The objective of the program is to provide a computer program, using updated decay scheme information that allows the calculation of fission product inventories in fuel elements as a function of time.
Keywords: POWER REACTORS; SPENT FUEL ELEMENTS; ACTIVITY LEVELS; FISSION PRODUCTS; COMPUTER CODES; BURNUP; TIME DEPENDENCE.

150174 Reference Critical Experiments. McCarthy, J.D. (Atomics International Division, Golden, Co). **Project number:** A1036. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$158,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to conduct benchmark critical experiments on fuel arrangements representative of those existing in process systems for which verified data are unavailable.
Keywords: CRITICALITY; URANYL NITRATES; URANIUM OXIDES U3O8; BENCHMARKS.

150175 Revision of Nuclear Safety Guide (TID 7016). Thomas, J.T. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0163a. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$10,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective is to update Nuclear Safety Guide to reflect current technology and practices in the field of nuclear criticality safety.
Keywords: RADIATION PROTECTION; NUCLEAR ENERGY; SAFETY; FUEL PARTICLES; NEUTRON REFLECTORS; RADIONUCLIDE KINETICS; MANUALS; CRITICALITY; MAN.

150181 Quantitative Assessment of Aquatic Impacts of Power Plant. Watson, D.G. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2072. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$197,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology.

The objectives are: to develop an improved design for environmental monitoring programs based on analyses of the findings of the detailed analyses of records of operating nuclear power plants; to identify generic problems in the existing programs; and to develop technical bases for sampling frequency, sample size, statistical power and methods of analyses related to specific classes of organisms.
Keywords: AQUATIC ECOSYSTEMS; NUCLEAR POWER PLANTS; ENVIRONMENTAL EFFECTS; SAMPLING; MATHEMATICAL MODELS; THERMAL EFFLUENTS; PLUMES; WATER QUALITY; MONITORING.

150183 Sampling Designs and Validation of Fish Impingement Prediction Model. Murarka, I.P. (Argonne National Laboratory, Division of Environmental Impact Studies, 9700 S. Cass Avenue, Argonne, IL, 60439). **Project number:** A2049. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The objectives are to develop sampling designs to permit estimating fish impingement losses at cooling water intakes and to develop analysis methods for efficient estimation of fish impingement losses to validate and modify the ANL fish impingement model as a predictive and analytical tool for the assessment of fish impingement losses. Statistical and mathematical modelling techniques were used to arrive at statistically sound sampling schemes that would allow efficient monitoring and assessment of fish impingements. The model was validated and shown to be capable of effective uses.
Keywords: FISHES; IMPINGEMENT; BIOLOGICAL MODELS; FORECASTING; COOLING; INTAKE STRUCTURES; SAM-

PLING; ECOLOGY; MATHEMATICAL MODELS; POPULATION DYNAMICS; POWER PLANTS; STATISTICS; RISK ASSESSMENT; DESIGN.

150184 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$269,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects; Ecological/biological processes and effects.

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 (currently in preparation at this laboratory) 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.

150185 Environmental Iodine Species Behavior. Keller, J. (Idaho National Engineering Lab., Idaho Falls, ID). **Project number:** A6078. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$1,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objective is to study the physical and biological transport of chemical forms of radioiodine in the environment. The distribution of chemical species of radioiodine in air-water steam mixtures will be determined. The influence of wet deposition (rain or dew) will be determined for meteorological models and the iodine-air-grass-milk models. An additional objective is to determine the environmental pathways for tritium and carbon-14 released from nuclear power stations.
Keywords: IODINE ISOTOPES; RADIOISOTOPES; FOOD CHAINS; RADIOECOLOGICAL CONCENTRATION; RADIONUCLIDE MIGRATION; AIR; GRASS; MILK; BIOLOGICAL MODELS; TRITIUM; CARBON 14; WASTE MANAGEMENT; RADIOACTIVE EFFLUENTS; NUCLEAR POWER PLANTS.

150186 Threadfin Shad Impingement: Effect of Cold Stress. McLean, R.B. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN, 37830). **Project number:** B0406. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$191,000.
Related energy source: fossil fuels(50); nuclear fuels(general)(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Ecological/biological processes and effects.

The impact of cooling water systems on fisheries is assessed in NRC's environmental impact statements. Threadfin Shad Impingement: Effect of Cold Stress 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; and (4) to determine the possibility of using blood chemistry (serum electrolytes) as a method to quantify lethal and sublethal stress in threadfin shad. 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.
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.

150188 Properties of Radioactive Wastes and Containers. Columbo; Neilson, R. Jr. (Brookhaven National Laboratory, Upton, NY). **Project number:** A-3027. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$450,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objectives of this program are to: (1) develop information on the physical and chemical characteristics of low-level wastes which can be used to assess the safety of land burial operations, interim storage and transportation of low specific activity materials; and (2) to provide data which will support standards for quality control on radwaste treatment systems in operating nuclear reactors.
Keywords: LOW-LEVEL RADIOACTIVE WASTES; PHYSICAL PROPERTIES; CHEMICAL PROPERTIES; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; TRANSPORT; CONTAINERS; SAFETY; RADIOACTIVE WASTE MANAGEMENT; RADIOACTIVE WASTE STORAGE.

150205 Effect of Liquid Pathways in Consequence Calculations. Niemczyk, S.J. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1200. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$133,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives of this project are to: (1) establish the degree of potential radiation exposure to the population from hypothetical accident sequences involving a core melt-down due to radionuclides reaching the public via liquid pathways; and (2a) to quantify the magnitude and likelihood of releases to the hydrosphere, (2b) to characterize ranges of hydrogeologic soil properties and determine time dependent radionuclide outflow characteristics, (2c) to model dispersion in surface water, (2d) to estimate the transport of radionuclides between the various trophic levels of the hydrosphere and ultimately to man, (2e) to estimate health effects and population dose, and (2f) to discuss actions to reduce risk to the public.
Keywords: NUCLEAR POWER PLANTS; MELTDOWN; FISSION PRODUCT RELEASE; AQUATIC ECOSYSTEMS; RADIOECOLOGICAL CONCENTRATION; ENVIRONMENTAL EXPOSURE PATHWAY; RADIOISOTOPES; FOOD CHAINS; RADIONUCLIDE MIGRATION; SURFACE WATERS; HUMAN POPULATIONS; RADIATION DOSES; INGESTION; RISK ASSESSMENT; CONTAMINATION; MATHEMATICAL MODELS.

150207 Engineering Support to Division of Operating Reactors, NRR. Allen, G.C. (Sandia Labs., Albuquerque, NM, 87115). **Contract:** A1097;A1106;A1108. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$150,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective of the project is to assist the Division of Operating Reactors with the review of nuclear power plant operational problems and events.
Keywords: POWER REACTORS; REACTOR OPERATION; ENGINEERING; DATA COMPILATION.

150208 Engineering Support to Division of Operating Reactors--NRR. Dearian, J.A. (EG and G Idaho, Inc., Idaho National Engineering Laboratory, Idaho Falls, ID, 83401). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$800,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of the project are to assist the Division of Operating Reactors in evaluations of nuclear power plant operational problems and events and to assist with review of proposed changes to operating licenses.

Keywords: NUCLEAR POWER PLANTS; REACTOR OPERATION; REACTOR TECHNOLOGY; NUCLEAR ENGINEERING; PERFORMANCE.

150210 Effect of Scale on Two-Phase Countercurrent Flow Flooding in Vertical Tubes. Richter, H.J. (Dartmouth College, Thayer School of Engineering, Hanover, NH, 03755). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$26,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

A series of air-water flooding experiments with countercurrent flow will be conducted in vertical tubes of various diameters to determine the scale effects and to investigate competing scaling theories. The tests will use water introduced into the top of the tube, followed by water injection into the side of the tube and then side injection into an annulus. In FY78 this work will be extended to annuli tests to develop an understanding of differences between tubes and annuli.
Keywords: PWR TYPE REACTORS; REACTOR SAFETY; LOSS OF COOLANT; HYDRAULICS; HEAT TRANSFER; TWO-PHASE FLOW; MOCKUP.

150211 Core Meltdown Sensitivity Studies. Baybutt, P. (Battelle Columbus Laboratories, 505 King Avenue, Columbus, OH, 43201). **Project number:** A4067. **Contract:** NRC-04-76-293. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$442,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Health effects.

The objectives of the program are to determine the areas of greatest uncertainty in the calculation of accident consequences; to identify priority areas for reactor meltdown accident research which would reduce these uncertainties in accident consequences; and to evaluate the effect of methodology assumptions on the importance ranking of variables.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR SAFETY; MELTDOWN; STATISTICAL MODELS; PROBABILITY.

150212 GESMO (Generic Environmental Impact Statement for Mixed Oxide Fuel) Waste Management. Luner, C. (Argonne National Laboratory, Division of Environmental Impact Studies, Argonne, IL, 60439). **Project number:** A2152. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management. **Funding:** NRC-$35,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

The objective of the project is to prepare and submit supplemental testimony that will expand the number of fuel cycles options, give a more detailed description of each option and explicate more thoroughly the difference between options. In all, three recycle options and three no-recycle options are considered. The three recycle options considered are: (1) recycle of uranium only with the recovered plutonium stored below ground in a retrievable form for possible future use as an energy resource; (2) recycle of uranium only with the recovered plutonium considered to be a waste which is disposed below ground; and (3) full recycle of both uranium and plutonium. The three no-recycle options considered are: (1) surface storage of spent fuel; (2) deep geologic emplacement of spent fuel in a retrievable form for possible future use (stowaway option); and (3) deep geologic emplacement of spent fuel with no intent or designed features for retrievability (throwaway option). The environmental impacts of the six options are considered with respect to the number of repositories required, land commitments, and radiation doses for both normal and off-normal operating conditions. It is determined that there is a moderate range in the land and dose commitments for the six options. However, the environmental impacts in the management of nuclear wastes are not sufficiently large to preclude any option.
Keywords: FUEL CYCLE; EVALUATION; ENVIRONMENTAL IMPACTS; RADIOACTIVE WASTE MANAGEMENT; PLUTONIUM; URANIUM; REPROCESSING.

150213 Reed Keppler Park. Frigerio, N.A. (Argonne National Laboratory, Division of Environmental Impact Studies, Argonne, IL, 60439). **Project number:** A2131. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement. **Funding:** NRC-$25,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to locate and quantify, by ground and aerial survey, all possible thorium residuals in the West Chicago Area. These arose from operations of the Lindsay Chemical Company from 1931 to 1974. They were used as landfill in Reed Keppler Park and several other areas around the city, and were unintentionally spread to many additional city locations as well.
Keywords: CHICAGO; THORIUM; MILL TAILINGS; GROUND WATER; RADIATION MONITORING.

150214 Systematic Approach to the Evaluation of Sites for Nuclear Power Plants. Wolsko, T.D. (Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL, 60439). **Project number:** A2012. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Site Standards. **Funding:** NRC-$55,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Integrated assessment.

The Information on Nuclear Site (INSITE) data system is specifically designed for support of current NRC efforts to develop site evaluation guidelines and to establish interfaces with state agencies that are expected to assume increased responsibilities in the site designation process. In fulfillment of its responsibilities for the development of the reference data system for nuclear facilities, ANL staff will collect information for the data base and develop and implement for NRC an interactive data management system. This data base will include approximately 2000 information elements on all commercial nuclear power plants that are proposed, under construction or operating.
Keywords: NUCLEAR POWER PLANTS; SITE SELECTION; DATA COMPILATION; REACTOR SITES; US NRC.

150215 Blast Hardening Design Criteria for Nuclear Power Plants. Valentin, R.A.; Kot, C.A. (Argonne National Laboratory, Building 335, Argonne, IL, 60439). **Project number:** A20059. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). *Office of Standards Development.* **Funding:** NRC-$38,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Health effects.

The objective is to develop information to assist in the formulation of draft design criteria for the protection of safety-related structures, systems, and components against the effects of explosive detonations near nuclear power plants.
Keywords: NUCLEAR POWER PLANTS; CHEMICAL EXPLOSIONS; BLAST EFFECTS; DESIGN; SPECIFICATIONS.

150216 Fuel Cycle Facility Accident Analysis. Frigerio, N.A. (Argonne National Laboratory, Division of Environmental Impact Studies, Building 11, Argonne, IL, 60439). **Project number:** A2071. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$149,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment.

The objectives are to collect together all accidents, incidents and abnormal occurrences in the nuclear industry, from its inception to date emphasizing fuel cycle facilities and to analyze these for frequency, type, and impact on health, safety and environment.
Keywords: NUCLEAR INDUSTRY; ACCIDENTS; FUEL CYCLE; ENVIRONMENTAL IMPACTS; SAFETY.

150217 Publication of UDAD (Uranium Dispersion and Dosimetry) Code--Volume I, Dosimetry. Roberts, C.J. (Argonne National Laboratory, 9700 South Cass Avenue (EIS-10), Argonne, IL, 60439). **Project number:** A2073-8. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$40,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment.

Methodology for radiological assessment of individual uranium mills and generic milling operations is contained in a comprehensive computer code: Argonne National Laboratory Uranium Dispersion and Dosimetry code (UDAD). The UDAD code is a modularized program for computation of radiological parameters related to the radioactive effluents released during mining and milling operations. The code has been used in the radiological assessment for several existing and planned uranium mills. When published, Volume I--Dosimetry of the UDAD report will contain the following calculational procedures and information: (1) introduction, (2) dispersion logic, (3) depletion logic, (4) radioactive decay and ingrowth of radionuclides, (5) resuspension, (6) ground deposition, (7) inhalation dosimetry logic, (8) ingestion dosimetry logic, (9) external exposure logic, (10) individual dose rate to standard man tissues at risk, (12) population dose commitment, (13) environmental dose commitment, (14) test mill analysis and output, (15) computational inputs and default values, (16) program listing, and (17) references.
Keywords: FEED MATERIALS PLANTS; RADIATION HAZARDS; COMPUTER CODES; U CODES; RADIOACTIVE EFFLUENTS; URANIUM MINES; RISK ASSESSMENT.

150218 Hazards to Nuclear Power Plants from Large Liquified Natural Gas (LNG) Spills on Water Transportation Routes. Valentin, R.A.; Kot, C.A. (Argonne National Laboratory, Building 335, 9700 S. Cass Avenue, Argonne, IL, 60439). **Project number:** A20728.

Supported by: Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$35,000. **Related energy source:** oil and gas(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects.

The objective is to determine the hazards to nuclear power plants located along water transportation routes, arising from large shipments of LNG. Of prime interest is the extent to which the plant's safety related systems are affected by a spill or accident environment. To accomplish this objective the program effort is organized into two major areas of investigation, namely, (1) the LNG spill and combustion phenomenology and (2) the effects on nuclear power plants of the accident environment. While shipment rates and expected accident frequencies for LNG tankers are significant factors in estimating risk, they are not part of the current program effort. A completely deterministic engineering analysis approach is employed in the investigation, and uncertainties in the results are bounded by performing parameter and sensitivity studies. **Keywords:** NUCLEAR POWER PLANTS; CHEMICAL EXPLOSIONS; HAZARDS; LIQUEFIED NATURAL GAS; ACCIDENTS; TRANSPORT; TANKER SHIPS; GAS SPILLS.

150219 Projection Models for Health Effects Assessment in Populations Exposed to Radioactive and Non-Radioactive Pollutants. Lundy, R.T. (Argonne National Laboratory, Division of Biological and Medical Research, 9700 South Cass Avenue, Argonne, IL, 60439). **Project number:** A2059. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$48,000. **Related energy source:** all(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects.

The objectives of this program are to develop a model which will predict risks to human health realistically at both the individual and population levels over time for any population structure. The approach is to develop a comprehensive system of dose-response models and demographic projection models which can be integrated to assess any conceivable situation. To date, a comprehensive closed-population assessment system has been developed. It includes simple dose/response modules for radioactive and some airborne combustion effluents. Future plans call for the development of an open population model, the development of more sophisticated d/r models, extension of the effluent types considered to include a greater variety of toxic and carcinogenic substances, and the morbidity projections. **Keywords:** HUMAN POPULATIONS; BIOLOGICAL RADIATION EFFECTS; FORECASTING; HEALTH HAZARDS; BIOLOGICAL MODELS; DOSE-RESPONSE RELATIONSHIPS; IONIZING RADIATIONS; MAN; COMBUSTION PRODUCTS; CHEMICAL EFFLUENTS; TOXICITY; CARCINOGENESIS; POPULATION RELOCATION; AIR POLLUTION; ENERGY; RISK ASSESSMENT; POPULATION DYNAMICS; STATISTICAL MODELS.

150220 Licensing Program Support: Technical Projects for the Office of Nuclear Reactor Regulation. Gustafson, P.F. (Argonne National Lab., 9700 S. Cass Avenue (EIS-10), Argonne, IL, 60439). **Project number:** A2098. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC. **Related energy source:** all(100).

The objective of the project is to perform studies of issues identified during the preparation of environmental impact statements as having potential for improving the technical quality of future environmental statements. As authorized by NRC, studies will be performed of generic issues and the results published. **Keywords:** NUCLEAR POWER PLANTS; REACTOR LICENSING; ENVIRONMENTAL IMPACT STATEMENTS; RESEARCH PROGRAMS.

150221 Licensing Program Support Environmental Assistance for Office of Nuclear Reactor Regulation. Gustafson, P.F. (Argonne National Laboratory, 9700 South Cass Ave. (EIS-10), Argonne, IL, 60439). **Project number:** A2001. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$624,000. **Related energy source:** nuclear fission(100).

The objective is to prepare environmental impact statements for nuclear power plants. An independent assessment of the potential impacts due to construction and/or operation of a specific nuclear power plant is developed by a team of engineers and scientists. **Keywords:** NUCLEAR POWER PLANTS; ENVIRONMENTAL IMPACT STATEMENTS.

150222 Analysis of the Effects of Natural Phenomena upon Existing Plutonium Fabrication Facilities. Gustafson, P.F.; Carson, J.E. (Argonne National Laboratory, Division of Environmental Impact Studies, Argonne, IL, 60439). **Project number:** A2150. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$200,000. **Related energy source:** nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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.

150223 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:** A2142. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$60,000. **Related energy source:** all(100). **R and D categories:** Integrated assessment.

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 betwwen 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. **Keywords:** BWR TYPE REACTORS; PWR TYPE REACTORS; SPENT FUEL STORAGE; ENVIRONMENTAL IMPACT STATEMENTS; FORECASTING; RESEARCH PROGRAMS; PLANNING.

150224 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. **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).

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.

150225 Generic Safeguards. Opelka, J.H. (Argonne National Laboratory, 9700 South Cass Ave. (EIS-10), Argonne, IL, 60439). **Project number:** A2148-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$35,000.
Related energy source: nuclear fission(100). **R and D categories:** Integrated assessment.

The objective of the study is to ascertain the proper way to represent environmental impacts of a safeguards system. An outline of a safeguards chapter or an environmental impact statement for a spent fuel storage facility was written. Included are the environmental effects of sabotage-induced radioactive releases.
Keywords: SAFEGUARDS; ENVIRONMENTAL IMPACTS; SABOTAGE; SPENT FUEL STORAGE; STORAGE FACILITIES; PLUTONIUM; RISK ASSESSMENT.

150226 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$391,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Integrated 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 has been prepared, 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.

150227 Development of Uranium Mill Tailings Management Strategies. Gustafson, P.F. (Argonne National Laboratory, 9700 South Cass Ave. (EIS-10), Argonne, IL, 60439). **Project number:** A2145. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$13,000.
Related energy source: nuclear fission(100).

The objective is to provide a technical basis from which strategies for managing uranium mill tailings can be developed. A task force of people knowledgeable in the issues surrounding management of uranium mill tailings will analyze information, recommend performance criteria, and suggest waste management strategies.
Keywords: FEED MATERIALS PLANTS; MILL TAILINGS; RADIOACTIVE WASTE MANAGEMENT; MONITORING; RADIOACTIVE WASTE DISPOSAL.

150228 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$613,000.
Related energy source: nuclear fission(100).

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.

150229 Atmospheric Effects of Cooling Towers. Policastro, A.J. (Argonne National Laboratory, 9700 S. Cass Avenue (EIS-T-11 No. 3), Argonne, IL, 60439). **Project number:** A2032. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC.
Related energy source: fossil fuels(30); nuclear fission(70). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Health effects.

A survey of data bases is underway for cooling tower visible plume dispersion and salt drift deposition to identify trends and evaluate internal consistency. Also in progress is the development of three mathematical models, for plume dispersion from natural draft cooling tower, for plume dispersion from mechanical draft cooling tower and for salt-drift deposition from both types of tower. The approach is to draw the best features from 22 state-of-the-art models and calibrate against world data base.
Keywords: AIR POLLUTION; ENVIRONMENTAL EFFECTS; DIFFUSION; MATHEMATICAL MODELS; PLUMES; NATURAL DRAFT COOLING TOWERS; GLOBAL ASPECTS; MOISTURE; SALTS; CHLORINE; EARTH ATMOSPHERE; EMISSION; CHEMICAL EFFLUENTS.

150230 Health Effects of Industrial Exposure to Thorium. Stehney, A.F. (Argonne National Laboratory, 9700 South Cass Ave., Argonne, IL, 60439). **Project number:** A2050. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$187,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

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; BIOLOGICAL RADIATION EFFECTS; OCCUPATIONAL SAFETY; EPIDEMIOLOGY; RISK ASSESSMENT; NUCLEAR INDUSTRY; RESPIRATORY SYSTEM DISEASES; INHALATION; METABOLISM; MEDICAL SURVEILLANCE.

150231 Coastal Zone Predictive Modeling at Power Plant Sites. Ditmars, J.D. (Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL, 60439). **Project number:** A2055. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$141,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The project is confirmatory in nature and the objectives are to apply an existing numerical predictive model of the physical littoral environment to an existing nuclear power plant site on the Great Lakes where historical data are available on pre-construction, construction, and post-construction coastal changes; to calibrate the model for specific severe-storm conditions using data collected early in the project to evaluate the predictive ability of the calibrated model with data collected during a second severe storm; and to assess the feasibility of applying the model to power plant sites on estuarine and oceanic sites. To date, the model has been calibrated using data collected during a storm which occurred along the southwestern shore of Lake Michigan during November, 1977. The model's predictive ability is presently being evaluated by comparing model predictions with data collected at the same site during a storm which occurred in April, 1978.
Keywords: NUCLEAR POWER PLANTS; ENVIRONMENT; MATHEMATICAL MODELS; SITE SELECTION; GREAT LAKES; STORMS; DATA.

150232 Fire Protection Research. Klamerus, L.J. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1010. **Contract:** A1010. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$300,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of this Fire Protection Research Program is to confirm the capability of safety features in use or planned for use in nuclear power plants. This objective is to be achieved by full scale testing and experimental and analytical evaluation of fire phenomenology.
Keywords: NUCLEAR POWER PLANTS; FIRE PREVENTION; SAFETY ENGINEERING; PLANNING.

150233 LOCA (Loss of Coolant Accident) Analysis. Berman, M. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1014. **Contract:** FIN: A1014;B and R: 20-19-03-01-1. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$155,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

Project objectives are to: (1) perform required analyses of ECCS designs which employ injection of ECCS water above the

core in addition to cold leg injections; (2) assist in the licensing evaluation of plants employing various methods of top injection; and (3) aid in the staff evaluation of vendor computer programs and system models for calculating hydraulic loads during subcooled decompression following a LOCA. The following approaches will be employed: (1) modify computer programs as required to provide capability for LOCA evaluation model type calculations with UHI; (2) include satisfactory correlations and models for the entire LOCA scenario; and (3) provide required calculations and assistance to NRC in the licensing review of plants and vendor models for LOCA analysis and subcooled loads. Review of vendor subcooled loads analysis methods will be completed. Interim calculations on UHI will be completed and compared to vendor calculations.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; LOSS OF COOLANT; HYDRODYNAMICS; MATHEMATICAL MODELS; FLUID FLOW.

150234 Enironmental Analysis: Radionuclide Airship--EIS. Luna, R.E. (Sandia Laboratories, Systems Safety Technology Division, Albuquerque, NM, 87115). **Project number:** A10298;02-04. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$15,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to evaluate the environmental impacts of the transportation of radioactive materials, including wastes, and materials used in medicine, industry, nuclear fuel cycle, and consumer products. Three circumstances under which impacts may be produced were considered: (1) normal transport conditions; (2) accidents involving the transport vehicle; and (3) theft and sabotage.
Keywords: RADIOACTIVE MATERIALS; TRANSPORT; ENVIRONMENTAL IMPACTS; ACCIDENTS; SABOTAGE; THEFT.

150235 Qualification Testing Evaluation. Bonzon, L.L. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1051. **Contract:** A1051. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$775,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the Qualification Testing Evaluation Program are to obtain data needed for confirmation of the suitability of current test standards and regulatory guides used in conjunction with the licensing of nuclear power plants for safety-related equipment and to obtain data that will provide an improved technical basis for modifications of these standards and guides where appropriate.
Keywords: POWER; REACTOR COMPONENTS; PERFORMANCE TESTING; SPECIFICATIONS.

150236 Controllable Unit Accountability. Foster, K.W. (Mound Laboratory, Miamisburg, OH, 45342). **Project number:** A10758. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$305,000.
Related energy source: nuclear fuels(general)(100).

This project is designed to demonstrate the applicability of the controllable unit concept to the safeguarding of SNM with the purpose of improving the timeliness and sensitivity of material loss estimators. The concepts involved have been applied to a hypothetical plant by simulation techniques; application to an operating plant has been initiated.
Keywords: NUCLEAR MATERIALS MANAGEMENT; ACCOUNTING; SAFEGUARDS; PLUTONIUM; MATHEMATICAL MODELS.

150237 Generic Environmental ASMT Transportation of Radioactive Materials in Dense Population Area. DuCharme, A.R.; Ericson, D.M.; Sheldon, D.D.; Taylor, J.M. (Sandia Laboratories, Nuclear Fuel Cycle Division, Albuquerque, NM, 87115). **Project number:** A1077(8). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$257,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The general objective of this study is the preparation of a generic environmental assessment of the possible radiologic, nonradiologic and economic impacts on a densely populated, urban area produced from transportation of all radioactive material to and through such an area. A programmatic approach is used in this study to analyze risk. Consequences of both normal and accident transportation situations are determined and factored, respectively, by the relative traffic and accident probabilities. Radiologic environmental impacts are quantified in person-rem/year and other measures of health effects. Economic impacts are measured in terms of dollars/year. In addition, certain special studies such as consideration of social impacts and safeguards are undertaken using less quantitative methods than those used to assess risk. The methods developed will be applicable to any urban area. Initially New York City is being used as an example to develop and exercise the assessment methodology. Subsequently, a sensitivity study will be performed to analyze the effects of variation of model parameters so that a tentative assessment for cities other than New York will be obtained.
Keywords: RADIOACTIVE MATERIALS; TRANSPORT; ENVIRONMENTAL IMPACTS; RISK ASSESSMENT; URBAN AREAS; SOCIO-ECONOMIC FACTORS.

150238 Nuclear Power Plant Fire Protection Subsystems. Luna, R. (Sandia Laboratories, Division 5432, Albuquerque, NM, 87185). **Project number:** A10808. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

The purpose of this research is to develop a firm basis for future work in assessing the adequacy and development of improved design criteria for nuclear power plant fire protection. Investigations have proceeded in four separate areas of concern: ventilation systems; fire detection systems; fire barriers; and fire hazard analysis.
Keywords: NUCLEAR POWER PLANTS; REACTOR PROTECTION SYSTEMS; FIRE PREVENTION; FIRE HAZARDS.

150239 Maintenance of Radioactive Materials Shipment Base Data. Kaestner, P.C. (Sandia Laboratories, Albuquerque, NM, 87185). **Project number:** A1082(7)(8). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$4,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Integrated assessment.

The objectives are to maintain and improve the data base of radioactive material shipments, and to provide specific or summarized shipment information as requested by NRC. NRC was provided with specific information on shipments in Colorado and Chicago. Additional requests are expected in the near future.
Keywords: RADIOACTIVE MATERIALS; TRANSPORT; DATA COMPILATION.

150240 Handbook of Safeguards Measurements Methods. Smith, W.H. (Mound Laboratory, Miamisburg, OH, 45342). **Project number:** A1083(8). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$244,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

The objective is to provide an up-to-date reliable Handbook of Safeguards Measurements which will provide a useful reference document for the NRC staff and for the licensees in the design and/or evaluation of SNM measurement systems. The contractor will conduct a literature search and a user survey to gather information on measurement technology, evaluate the survey results, and finally, prepare the handbook.
Keywords: SAFEGUARDS; MANUALS; MEASURING METHODS; URANIUM 233; URANIUM 235; PLUTONIUM.

150241 Systems Interaction. Hickman, J.W. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1084. **Contract:** A1084. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$183,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

The project has the following objectives: (1) develop a methodology for conducting a disciplined and systematic review of nuclear power plant systems to assure that all systems interactions which are important to public safety have been identified and their significance evaluated; and (2) develop a technical base for criteria, procedures and information requirements appropriate for use by applicants in their design and review of plant designs for systems interactions.
Keywords: NUCLEAR POWER PLANTS; SAFETY ENGINEERING; REACTOR SAFETY; REACTOR PROTECTION SYSTEMS; RELIABILITY.

150242 Exercise Scenarios for Emergency Response Plans for Nuclear Facilities. Sprung, J.L. (Sandia Laboratories, Albuquerque Operations Office, Albuquerque, NM, 87115). **Project number:** A10858. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$36,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Charac-

terization, measurement, and monitoring; Physical and chemical processes and effects; Health effects.

As part of the overall emergency preparedness program, this contract is intended to develop 12 to 15 scenarios describing possible accidents at commercial nuclear power plants, and the associated offsite response to these accidents, for the purpose of exercising State and local government emergency plans.
Keywords: NUCLEAR FACILITIES; NUCLEAR POWER PLANTS; EMERGENCY PLAN; RECOMMENDATIONS.

150243 Dynamic Calibration for Nondestructive Assay of Uranium. Lemming, J.F. (Mound Laboratory, Miamisburg, OH, 45342). **Project number:** A1086. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$65,000.
Related energy source: nuclear fuels(general)(100).

The objective is to provide a methodology for calibrating NDA systems to assure their reliability. The contractor will develop the criteria and methodologies necessary to implement the Dynamic Calibration Technique for the 235-U fuel cycle. The initial work on sampling plans will evaluate the data from the Confirmatory Assessment Experiments. (The Confirmatory Assessment Experiments is a study supported by the NRC (RES) in FY-77 on plutonium samples for its generic application in dynamic calibration.) Then, an experimental program designed to assess the applicability of calorimetric assay in the HTGR fuel cycle will be initiated. Interim reports shall be prepared for criteria for selection of Control Measurements in the U-235 fuel cycle and the sampling plans applicable in the U-235 fuel cycle. Upon completion of this task in fiscal year 1980, a final report will be published.
Keywords: NONDESTRUCTIVE ANALYSIS; CALIBRATION; URANIUM 235; MEASURING INSTRUMENTS.

150244 Core Melt Characteristics Important to Radiological Releases. Dahlgren, D. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1107. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Site Safety and Environmental Analysis. **Funding:** NRC-$65,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The project is directed toward evaluating core melt characteristics important to radiological releases including: leaching from core debris; core debris fragmentation on cooling; and steam explosion phenomena and effects. Existing data and theory will be utilized to determine appropriateness of assumptions made by applicants and recommend appropriate assumptions to be made by the NRC staff in performing independent analyses.
Keywords: POWER REACTORS; MELTDOWN; FISSION PRODUCT RELEASE; FRAGMENTATION; HYDRODYNAMICS; MOLTEN METAL-WATER REACTIONS.

150245 Hazards to Nuclear Plants from Release of Volatile Fuels. Hardee, H. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1109. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$20,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The project is directed toward evaluating the hazard to nuclear plants from ignition of volatile fuels accidentally released in the vicinity of nuclear plants. Existing theory and data will be utilized in evaluating flammable gas hazards and reviewing applicants' submittals for specific plant applications. Assistance in reviewing and evaluating standards and guides and in developing branch technical positions related to hazards from ignition of volatile fuels will be provided.
Keywords: NUCLEAR POWER PLANTS; CHEMICAL EXPLOSIONS; HAZARDS; REACTOR ACCIDENTS; LIQUID FUELS.

150246 Atmospheric Transport and Diffusion of Hazardous Vapors. Church, H.W. (Sandia Laboratories, Box 5800, Albuquerque, NM, 87115). **Project number:** Fin. No. A1110. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Site Safety and Environmental Analysis. **Funding:** NRC-$20,000. **Related energy source:** nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Health effects.

The objectives of this project are: to investigate the known properties of atmospheric transport and diffusion pertinent to the source characteristics of flammable and toxic gases which are often stored or transported by barge, truck, or rail; to perform a literature survey on transport kinetics; and to report recommendations concerning the atmospheric transport and diffusion modeling of these gases.
Keywords: TOXIC MATERIALS; HAZARDOUS MATERIALS; EARTH ATMOSPHERE; ENVIRONMENTAL TRANSPORT; PLUMES; DIFFUSION; METEOROLOGY; MATHEMATICAL MODELS; VAPORS; RISK ASSESSMENT.

150247 Aerosol Characterization from a Simulated HCDA. Zanotelli, W.A. (Mound Laboratory, Monsanto Research Corp., P.O. Box 32, Miamisburg, OH, 45342). **Project number:** A1171. **Contract:** A1171. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$130,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objective of the project is the characterization of chemical species formed from interaction of mixed oxide fuel and sodium in a simulated HCDA. This information is needed to address chemical form of actinide for solubility consideration in radiological dose assessments. Laser vaporization of mixed-oxide fuel in flowing sodium system will be utilized as well as instrumental characterization so that (1) system testing with UO—2 fuels and results analysis will be underway, (2) initial testing with PuO—2 fuels will have been initiated, (3) laser pulse heating of UO—2/SS pressed pellets in a Na/inert gas environment will be investigated, and (4) static laser heating of UO—2/PuO—2/SS/Na will be initiated.
Keywords: LMFBR TYPE REACTORS; REACTOR CORE DISRUPTION; FISSION PRODUCT RELEASE; RADIOACTIVE AEROSOLS; SIMULATION; DIFFUSION; CHEMICAL REACTION KINETICS.

150248 Handbook of Human Reliability Analysis for Nuclear Power Plant Operations. Swain, A.D. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1188. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The project has the following objectives: (1) prepare a Human Factors Handbook which can be used for the evaluation of engineered safety systems in nuclear power plants; and (2) for each class of operator actions, prepare estimates of error rates and their ranges of uncertainty due to such factors as individual differences and gross differences in human engineering of equipment. Estimates will be derived from real data and expert judgment. A search of human error data from other government agencies and contractors will be made. Scaling K factors will be derived for application to the above estimates of error rates.
Keywords: NUCLEAR POWER PLANTS; PERSONNEL; RELIABILITY; CALCULATION METHODS; REACTOR OPERATION.

150249 Emergency Planning and Response Evaluation. Sprung, J.L. (Sandia Laboratories, Albuquerque, NM, 87115). **Project number:** A1189. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$73,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective is to extend the basis from which practical emergency plans and response procedures can be developed to mitigate the consequences of potential accidents at nuclear fuel cycle facilities or in radioactive material transport systems. The steps include completion of scenario book fixed facility accidents; incident selection of transportation phase of study; evaluation of incidents for transportation phase of study; and measurement of effectiveness of protective measures such as evacuation or sheltering.
Keywords: FUEL CYCLE; RADIOACTIVE MATERIALS; TRANSPORT; ACCIDENTS; EMERGENCY PLAN; NUCLEAR FACILITIES; TRANSPORTATION SYSTEMS.

150250 Risk Methodology for Waste Isolation in Deep Geologic Media. Campbell, J.E. (Sandia Laboratories, P.O. Box 5400, Albuquerque, NM, 87115). **Project number:** A1192. **Contract:** AT(29-1)-789. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$658,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objectives are: (1) to develop a methodology for risk assessment of long-term geologic isolation of nuclear wastes; and (2) to derive insights which will assist in formulating regulatory criteria for site selection and for repository design. The project is expected to: (1) provide insights into the system properties and processes

important to long-term safety; (2) determine if uncertainties in data are small enough to allow a meaningful risk estimate; and (3) identify important data deficiencies.
Keywords: RADIOACTIVE WASTE DISPOSAL; GEOLOGIC DEPOSITS; RISK ASSESSMENT; SITE SELECTION; SAFETY.

150251 Evaluation of Methods for Determination of X- and Gamma-Ray Exposure Attributable to a Nuclear Facility Using Environmental TLD Measurements. McLaughlin, J.E. (Department of Energy, Environmental Measurements Lab., New York, NY, 10014). **Project number:** A30758. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$33,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

This project will determine and evaluate current capabilities for determining x and gamma radiation exposure resulting from the operation of NRC-licensed nuclear facilities using various methods of background subtraction. A report is expected at the end of FY 78 describing the results of this study. These results should provide the technical basis for providing guidance on methods for estimating the direct x- and gamma-ray exposures resulting from operation of nuclear facilities by using environmental TLD measurements, supplementing the guidance in Regulatory Guide 4.13.
Keywords: NUCLEAR POWER PLANTS; NUCLEAR FACILITIES; RADIATION MONITORING; PERSONNEL MONITORING; THERMOLUMINESCENT DOSIMETRY; X RADIATION; GAMMA RADIATION.

150252 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:** A4065. **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:** Operational safety.

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. A second task will provide analytical evaluation of a series of equation-of-state experiments being performed at Sandia Laboratories. 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.

150253 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:** A4079. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$40,000.
Related energy source: nuclear fusion(100).

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.

150254 Containment Analysis. Wells, R.A. (Idaho National Engineering Laboratory, Idaho Falls, ID, 83401). **Project number:** A6009. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The project objective is the development and application of analytical models to predict the response of nuclear power plant containment buildings to postulated accidents within the building through formulation of models using theoretical equations and empirical test results.
Keywords: POWER REACTORS; REACTOR ACCIDENTS; CONTAINMENT; CONTAINMENT BUILDINGS; STRESS ANALYSIS.

150255 Failure Mode Analysis. Obenchain, C. (EG and G Idaho, Inc., Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6025. **Contract:** B and R 20-19-03-01-3. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$55,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of the project is to systematically identify the areas of reactor strengths and vulnerabilities in regard to the reactor systems essential to mitigating the consequences of abnormal events. The following areas are reviewed and analyzed with respect to plant safety: (1) GESSAR--FMEA, (2) missiles, (3) long-term system availability, (4) operator action, (5) event classification, and (6) inadvertent lift of relief valves.
Keywords: NUCLEAR POWER PLANTS; SAFETY ENGINEERING; REACTOR COMPONENTS; FAILURE MODE ANALYSIS; REACTOR PROTECTION SYSTEMS.

150256 Working Calibration Test Material. Baldwin, J.M. (Allied Chemical Corporation, INEL, 550 2nd Street, Idaho Falls, ID, 83401). **Project number:** A60338. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$30,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring.

Accurate and precise measurements of the concentration and isotopic abundance of U and/or Pu in Special Nuclear Material (SNM) are very important for SNM accountability and safeguards. Therefore, well-characterized materials must be used for the calibration and quality control surveillance of the analysis methods. The objective is to publish reports detailing the preparation of the above well-characterized materials previously called Working Calibration and Test Materials (WCTMs) and now called Working Reference Materials (WRMs). These reports discuss production of stable WRMs, establishment of their certified values, and packaging.
Keywords: URANIUM; PLUTONIUM; CALIBRATION STANDARDS; ACCOUNTING; SAFEGUARDS; NUCLEAR MATERIALS MANAGEMENT.

150257 3D Technical Support and Instrumentation. Rice, D. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6100. **Contract:** A6100. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$3,340,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

The objective of the project is to provide technical support and instrumentation for the 3-D experimental program.
Keywords: REACTOR SAFETY; TEST FACILITIES; REACTOR INSTRUMENTATION; DESIGN.

150258 Human Factors Methods Development. Nertney, R. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6119. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$35,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The project involves investigating the extent and character of the relationship between compliance with NRC regulations and human error in commercial nuclear power plants. It is hypothesized that the plants achieving higher compliance will have less human error and fewer safety problems. As staff time permits, a short-term feasibility study will be conducted on the alarm system(s) and the human factors implications.
Keywords: NUCLEAR POWER PLANTS; REACTOR OPERATION; PERSONNEL; OCCUPATIONS; PERFORMANCE.

150259 PWR/BWR System Response Analysis to LOCA Excitation. Saffell, B. (EG and G Idaho, Inc., Idaho National Engineering Lab., Reactor Operations and Programs Division, Idaho Falls, ID, 83401). **Contract:** B and R: 20-19-03-02-1;FIN: A-6152. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$103,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the project are to provide the NRC staff with the analytical tools necessary to independently verify the selection of design basis pipe rupture locations and to verify that the criteria for assurance of integrity under LOCA and SSE loads have been implemented correctly for Reactor Coolant Piping, the Reactor Vessel, Steam Generators, main coolant pumps and the supports for these components.

Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; LOSS OF COOLANT; REACTOR COOLING SYSTEMS; STRESSES; DYNAMIC LOADS; HYDRODYNAMICS.

150260 **ECC Standard Problem Program.** Gruen, E.G. (Idaho National Eng. Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6154. **Contract:** FIN: A6154 B&R 20-19-03-01-1. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$130,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The project provides for a series of carefully controlled experiments for benchmarking of computer codes which model the Loss-of-Coolant Accident (LOCA) scenario of nuclear power reactors. The purpose of this program is consistent with the provisions of Appendix K of 10 CFR 50, Paragraph II 4, which states: "To the extent practicable, predictions of the evaluation model, or portions thereof, shall be compared with applicable experimental information." The Standard Problem Program is implemented by (a) best-estimate pre-test predictions of each selected problem, (b) evaluation model (EM) predictions of selected problems, (c) post-test analysis of participant's results to quantify major deviations from the data, and (d) evaluation of the comparative results.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; ECCS; PERFORMANCE; MATHEMATICAL MODELS; LOSS OF COOLANT.

150261 **Fuel Assembly: Seismic and LOCA Response.** Dearien, J.A. (Idaho National Eng. Lab., 550 Second St., Idaho Falls, ID, 83401). **Project number:** A6157. **Contract:** EY-76-C-07-1570. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$75,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety.

As part of the licensing process, the Nuclear Regulatory Commission requires that the initial core geometry be maintained in the presence of combined seismic and loss-of-coolant accident loads. Also, to assure that the control rods will function properly the NRC imposes structural integrity requirements on the fuel assemblies. Demonstration that these requirements are met is the objective of vendor (applicant) analysis. Since these calculations cannot be verified experimentally, confirmation can only come from independent calculation. The project has the following objectives: (1) use publicly available structural code to establish a staff audit code; (2) perform audit calculations for each vendor's new generation fuel assembly such as Westinghouse 17 x 17 and General Electric 8 x 8; (3) assist staff in vendor review; (4) make recommendations regarding: (a) bounding calculations, (b) safety significance of post-shock wave response, and (c) experiments or full-scale tests.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR CORES; FUEL ASSEMBLIES; SEISMIC EFFECTS; LOSS OF COOLANT; DYNAMIC LOADS; STRESS ANALYSIS.

150262 **Emergency Effluent Monitoring Instrumentation Bases.** Slagle, W.L. (Allied Chemical, Idaho Chemical Programs-Operations Office, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** FIN No. A6160. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Site Safety and Environmental Analysis. **Funding:** NRC-$7,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The object of this project was to develop source terms for specific types of accidents, postulated to occur at light-water-cooled nuclear power plants, for the purpose of developing bases for the specification of design ranges and sensitivities for radioactive effluent monitoring instrumentation for accident applications. Existing computer program codes for calculation of normal operating source terms were modified to account for accident conditions. Results were obtained for accidents categorized as Classes 3 through 8 for both PWRs and BWRs. No additional work in this project area is contemplated. Results will be phased into ongoing programs for development of accident monitoring instrumentation criteria.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR ACCIDENTS; RADIOACTIVE EFFLUENTS; RADIATION MONITORING; FISSION PRODUCT RELEASE; RADIATION MONITORS; SPECIFICATIONS; DATA COMPILATION.

150263 **Inservice Inspection.** Cook, J.F. (EG&G Idaho, Inc., Idaho National Eng. Lab., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6162. **Contract:** EY-76-C-07-1570. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The project is directed toward evaluation of ASME Code examination requirements or proposed inservice inspection plans by employing engineering evaluations based on literature surveys or past experience.
Keywords: POWER REACTORS; REACTOR COMPONENTS; IN-SERVICE INSPECTION; SPECIFICATIONS.

150264 **Reactor Systems Case Reviews.** Obenchain, C. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6165. **Contract:** B&R # 20-19-03-01-3. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$120,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of the project is to assist Reactor Systems Branch in the routine case reviews of selected plants. Using the Standard Review Plans (SRP) which cover those sections of Safety Analysis Reports for which the Reactor Systems Branch has primary review responsibility, the Safety Analysis Reports for designated plants are to be evaluated. Materials for plant reviews will be forwarded under separate cover. Level of effort work is also required for safety concerns which arise from case reviews and which are of generic applicability.
Keywords: POWER REACTORS; NUCLEAR POWER PLANTS; REACTOR SAFETY; DOCUMENTATION.

150265 **Fracture Toughness Criteria.** Reuter, W.G. (EG and G Idaho, Directorate Research & Engineering/Fuels & Materials Division, P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6166. **Contract:** EY-76-C-07-1570. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of the project is to evaluate material fracture toughness for the development of criteria to ensure adequate safety margins for mechanical components in LWR nuclear plants.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR COMPONENTS; REACTOR MATERIALS; SPECIFICATIONS; FRACTURE PROPERTIES.

150266 **Fuel Performance Code Applications.** Dearien, J.A. (Idaho National Engineering Laboratory, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** A6167. **Contract:** EY-76-C-07-1570. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$75,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety.

In reactor licensing reviews, the Nuclear Regulatory Commission must evaluate the applicant's ability to predict fuel performance under operating conditions. The NRC requires technical assistance in auditing the vendor fuel codes used for these predictions. This task involves the adaptation of existing thermal and mechanical performance models developed by the NRC's Fuel Behavior Research Branch into a new evaluation code called FRAPCON.
Keywords: POWER REACTORS; FUEL ELEMENTS; PERFORMANCE; MATHEMATICAL MODELS; CALCULATION METHODS.

150267 **Component Failure Considerations.** **Project number:** A6168. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The evaluation will provide the NRC staff with information leading to a definitive basis for the categorization of some events and development of passive single failure criterion for fluid systems in the licensing process. This evaluation could also lead to further research in developing criteria for more reliable safety systems. For typical LWR designs, components and systems important to safety both as initiators of abnormal conditions and mitigators of accidents and their operational environment will be identified. The extent of analysis, such as the review of electrical drawings to identify failure causes, will be developed. Experience data will be collected for the components and systems selected. Data will be catalogued to show failures and the sources or causes of these failures. For normal operation and accident conditions, failure rates identifying the fractional contribution from common causes (including operator caused failures) will be developed. Using system designs, component failure rates, component downtimes, test duration, test frequency, and system condition during tests, the unavailability estimates and/or technical specification requirements will be used as a variational parameter to estimate the significance of this contributor to the overall unavailability estimate.
Keywords: REACTOR COMPONENTS; RELIABILITY; FAILURES; DATA COMPILATION; BWR TYPE REACTORS; PWR TYPE REACTORS.

150268 **LWR Fuel Transient Analysis.** Dearien, J.A. (Idaho National Engineering Laboratory, 550 Second Street, Idaho Falls, ID, 83401). **Project number:** A6172. **Contract:** EY-76-C-07-1570. **Support-**

ed by: Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$40,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety.

The Nuclear Regulatory Commission requires assistance in evaluation of reactor vendor predictions of fuel duty in support of the NRC Fuel Failure Limit Study. The objectives of the project are to develop improved capability to assess fuel behavior, damage and failure under certain transient and accident conditions through the use of computer models; and to determine the applicability of the FRAP-T4 code to fuel damage studies by analyzing fuel duty and extent of damage resulting from various transients and accident scenarios as addressed in Chapter 15 of vendor Safety Analysis Reports and the NRC Standard Review Plan.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; FUEL ELEMENT FAILURE; MATHEMATICAL MODELS; PERFORMANCE.

150269 Water Hammer Review and Evaluation. Obenchain, C. (EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID, 83401). **Project number:** A6251-8. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Safety. **Funding:** NRC-$55,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The project is directed toward the following objectives: (1) provide a state-of-the-art review of experimental, analytical, and design work reported in domestic and foreign literature which is pertinent to water hammer in nuclear power plants; (2) review will emphasize identification and evaluation of analytical techniques for analyzing various water hammer mechanisms, the experimental verification of these techniques, and design approaches for preventing water hammer; (3) actual and potential water hammer events for selected water hammer mechanisms in safety-related systems of nuclear plant will be reviewed and evaluated.
Keywords: POWER REACTORS; REACTOR COOLING SYSTEMS; WATER HAMMER; MATHEMATICAL MODELS; DATA ANALYSIS; HYDRAULICS; FLUID FLOW.

150270 Review and Critique of Plutonium Package Certification. (National Academy of Sciences, Washington, DC, 20418). **Project number:** B1487. **Contract:** NRC-02-77-004. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$35,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

A technical assessment of the package design to withstand a crash and explosion of a high flying aircraft for plutonium packages was provided by this contract.
Keywords: PLUTONIUM; AIR TRANSPORT; CONTAINERS; PERFORMANCE TESTING; DESIGN.

150271 Study of Alternative Methods for the Disposal of Low Level Wastes. (Ford, Bacon and Davis Utah, Inc., P.O. Box 8009, Salt Lake City, UT, 84108). **Project number:** B1521. **Contract:** NRC-02-77-168. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$97,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

In preparation for a national low-level waste management program, the Nuclear Regulatory Commission (NRC) contracted Ford, Bacon and Davis Utah, Inc., to research the alternatives to shallow land burial as a means of disposal of low-level waste. They must compile all alternatives and in a preliminary assessment determine which are viable possibilities. The final report handed to NRC is to contain those alternatives which have been thoroughly researched and determined as the most feasible to implement.
Keywords: RADIOACTIVE WASTE DISPOSAL; LOW-LEVEL RADIOACTIVE WASTES; UNDERGROUND DISPOSAL; RADIOACTIVE WASTE MANAGEMENT.

150272 Evaluation of Scientific and Technical Aspects of Certain Problems Involving the Management of Radioactive Wastes. (National Academy of Sciences, Washington, DC, 20418). **Project number:** B1523. **Contract:** NRC-02-77-003. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The National Academy of Sciences (NAS) conducted a study of the scientific and technological problems associated with the conversion of liquid and semi-liquid high-level radioactive waste into a stable form suitable for transportation and disposition. This study was conducted in accordance with NAS proposal entitled, A Study of the Solidification of High-Level Radioactive Waste, dated September 1976, which is incorporated herein by reference.
Keywords: HIGH-LEVEL RADIOACTIVE WASTES; RADIOACTIVE WASTE PROCESSING; LIQUID WASTES; SOLIDIFICATION.

150273 Primary Coolant Rupture Study. Danko, J.C. (General Electric, 175 Curtner Ave. Code 581, San Jose, CA, 95114). **Project number:** B3012. **Contract:** B3012. **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:** Characterization, measurement, and monitoring.

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.

150274 Single vs. Multiple Snubber Installation. Onesto, A.T. (Energy Technology Engineering Center, Energy Systems Group, P.O. Box 1449, Canoga Park, CA, 91304). **Project number:** B3055(8). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$67,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50).

The project has the following objectives: (1) verify the feasibility of parallel operation of snubbers and its range of operation limits; and (2) analytically study a mathematical model, then verify by test.
Keywords: NUCLEAR POWER PLANTS; SHOCK ABSORBERS; PERFORMANCE TESTING.

150275 Alternate ECC Concepts. Chapin, D. (MPR Associates, Inc., 1140 Connecticut Avenue NW, Washington, DC, 20036). **Project number:** B5537. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$415,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

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.

150276 Field Application of Synthetic Aperture Focusing Technique for Ultrasonic Testing of Reactor Components. Jackson, J. (Southwest Research Institute, 8500 Culebra Road, P.O. Drawer 28510, San Antonio, TX, 78284). **Project number:** B5605. **Contract:** B5605. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$241,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

Project objectives are: (1) to design and build an advanced system capable of actually performing in-service inspections of nuclear reactors based on the synthetic aperture focussing technique for ultrasonic testing (SAFT-UT) developed at the University of Michigan; and (2) to evaluate and characterize the degree of performance of this advanced SAFT UT system for producing accurate information describing the size, location and orientation of flaws from in-service inspections of nuclear reactors.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR COMPONENTS; IN-SERVICE INSPECTION; ULTRASONIC TESTING; MEASURING INSTRUMENTS; DESIGN; PERFORMANCE TESTING; APERTURES; IMAGES.

150277 Residual Stresses at Weld Repairs in Pressure Vessels. Rybicki, E.F. (Battelle Memorial Inst., 505 King Ave., Columbus, OH, 43201). **Project number:** B5608. **Contract:** B5608. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC-$150,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of the project is to develop, verify, and utilize an analytical model or models for calculating residual stresses due to welding. Of primary concern are residual stresses from vessel weld

repair and girth butt welding of piping, electron beam welding of fracture toughness specimens, and cladding.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; PRESSURE VESSELS; WELDED JOINTS; RESIDUAL STRESSES; MATHEMATICAL MODELS; FUEL CANS.

150278 Assessment of Reactor Piping Research. Rodabaugh, E.C. (Battelle Memorial Institute, 505 King Ave., Columbus, OH, 43201). **Project number:** B5609. **Contract:** B5609. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Water Reactor Safety. **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The project objective is to evaluate all significant research on piping systems, to correlate that research with current design practices, and to quantify the piping used in nuclear power plants in terms of reliability.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; REACTOR COOLING SYSTEMS; PIPES; RELIABILITY.

150279 Two-Phase Interactions in Counter-Current Flow. Dukler, A.E. (Univ. of Houston, Houston, TX, 77004). **Project number:** B5684. **Contract:** B5684. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$62,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the project are to conduct experimental evaluation of flooding mechanisms and wave structure and interfacial interactions during upflow and to develop models and correlations.
Keywords: REACTOR COOLING SYSTEMS; TWO-PHASE FLOW; MATHEMATICAL MODELS.

150280 Seismic Shear Transfer in Secondary Containment Vessels. White, R.N.; Gergely, P. (Cornell Univ., College of Engineering, Ithaca, NY, 14853). **Project number:** B5688. **Contract:** B5688. **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:** Operational safety; Characterization, measurement, and monitoring.

The level of shear stress to be allowed in licensing containment buildings will eventually be determined from test data. The shear stress will be determined in biaxial field of stress caused by loads in plane of the field and normal to the field.
Keywords: NUCLEAR POWER PLANTS; CONTAINMENT BUILDINGS; SEISMIC EFFECTS; DYNAMIC LOADS.

150281 Hydrodynamic and Meteorological Measurements of High Wind over Shallow Water along the East Coast of Florida. Smutz, M. (Univ. of Florida, Gainesville, FL, 32611). **Project number:** B5865. **Contract:** B5865. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$98,000.
Related energy source: nuclear fission(100).

The measurement program is intended to obtain simultaneous time recordings of the barometric pressure, storm surge, wind speed and wave height of the hurrricanes at the coast of Florida.
Keywords: METEOROLOGY; HYDRODYNAMICS; FLORIDA; HURRICANES; WIND; WEATHER; WATER WAVES.

150282 Studies of Dynamic Loads in Pressure Suppression Containment. Catton, I. (UCLA, Los Angeles, CA, 90024). **Project number:** B5875. **Contract:** B5875. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$210,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of the project is to provide experimental data on transient thermal-hydraulic phenomena in BWR suppression pools through experimental investigations of bubble expansion, vent interference on clearing and hydrodynamic forces, and steam injection under typical BWR conditions.
Keywords: BWR TYPE REACTORS; CONTAINMENT SYSTEMS; CONDENSATION CHAMBERS; PRESSURE SUPPRESSION; LOSS OF COOLANT; DYNAMIC LOADS.

150283 Properties of Reactor Materials at Constant True Strain Rates. Hartley, C.S. (Univ. of Florida, Division of Sponsored Research, Department of Materials Science and Engineering, Gainesville, FL, 32611). **Project number:** B5948. **Contract:** B5948. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$250,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

Objectives are to: (1) determine basic correlation for true stress—true strain properties of Zircoloy in uniaxial and biaxial stress as functions of constant true strain rate, temperature, and stress ratios; (2) develop equipment and test method for measuring stress-strain properties at constant true strain rates at elevated temperatures, conduct uniaxial and biaxial stress tests of Zircoloy in argon; and (3) establish basic deformation law for Zircoloy to high plastic strains for use in code calculations of burst strains and loss of cross-sectional area for coolant flow in LWR fuel bundles during LOCA.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; FUEL CANS; DEFORMATION; ZIRCALOY; MECHANICAL PROPERTIES.

150284 Component Failure Rate Data in Nuclear Power Plants. Shultis, J.K. (Kansas State Univ., Dept. of Nuclear Engineering, Manhattan, KS, 66506). **Project number:** B5973. **Contract:** NCR-04-76-339. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$16,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment.

Objectives are to (1) investigate the capabilities and limitations of both the Bayesian and classical statistical approaches for obtaining the probability distribution function of various component failures from multi-plant failure data, and (2) develop numerical algorithms to determine the optimal technique for obtaining the probability distribution parameters.
Keywords: NUCLEAR POWER PLANTS; REACTOR COMPONENTS; RELIABILITY; FAILURES; DATA COMPILATION.

150285 Experimental Measurement of Aerodynamic Properties of Sodium Aerosol. Shaw, D. (State Univ. of New York at Buffalo, 4232 Ridge LGA Road, Room 2B, Buffalo, NY, 14226). **Project number:** B5974. **Contract:** B5974. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$25,000.
Related energy source: nuclear fuels(general)(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

This research program covers work in two related areas. The first area involves experimental determination of the aero-dynamic shape factor of sodium aerosol in a Stober spiral centrifuge. The second area involves the determination of the particle size distribution function of the aerosol generated from burning sodium in the spiral centrifuge and an evaluation of the applicability of the centrifuge to in-situ measurements in large experiments at ORNL. This work will be coordinated with the analytical and experimental work in Aerosol Measurements and Modeling being done at BCL.
Keywords: LMFBR TYPE REACTORS; REACTOR CORE DISRUPTION; RADIOACTIVE AEROSOLS; SODIUM; PARTICLE SIZE; DIFFUSION.

150286 Analysis of Aerosol Particles Undergoing Gravitational Agglomeration. Loyalka, S.K. (Univ. of Missouri-Columbia, College of Engineering, 1026 Engineering, Columbia, MO, 65201). **Project number:** B5975. **Contract:** B5975. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$35,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives of the project are (1) to obtain improved theoretical expressions for gravitational collision efficiency of aerosol particles characteristics of past HCDA containments of LMFBR, and (2) to conduct experiments to verify the theoretical expressions.
Keywords: LMFBR TYPE REACTORS; REACTOR CORE DISRUPTION; CONTAINMENT; RADIOACTIVE AEROSOLS; AGGLOMERATION; PARTICLES.

150287 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:** B5988. **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:** Operational safety; Characterization, measurement, and monitoring.

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.

150288 Consulting Assistance Pertaining to the Structural Response of Nuclear Facilities to Ground Motion. Newmark, N.M. (Nathan M. Newmark, Consulting Engineering Services, 1211 Civil Engineering Building, Urbana, IL, 61801). **Project number:** B6123. **Contract:** AT(49)-0116. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-.$225,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

This contract provides for consultation services to review existing licensed plutonium facilities to determine their capability to resist natural phenomena events such as severe weather, seismic disturbances and floods.
Keywords: NUCLEAR FACILITIES; PLUTONIUM; GROUND MOTION; FLOODS; STORMS; SEISMIC EFFECTS.

150289 Study of Uranium Concentrate Spill. Colton. (Stanford Research Institute, International, 333 Ravenswood Drive, Menlo Park, CA, 94025). **Project number:** B6124. **Contract:** NRC-02-78-076. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$17,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The Nuclear Regulatory Commission requires technical assistance in documenting the uranium transportation accident of September 27, 1977, U.S. Highway 287, near Springfield, CO. The contractor collects, reviews and analyses the appropriate mechanical data from the accident and suggests possible alternatives to improve accident resistance.
Keywords: COLORADO; URANIUM; TRANSPORT; ACCIDENTS; SAFETY.

150290 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). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$63,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

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.

150291 Definition of Design Performance Criteria for a Radioactive Waste Repository. Kearney, M. (Analytic Sciences Corporation, Reading, MA, 01867). **Project number:** B1630. **Contract:** NRC-02-77-129. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$264,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

To prepare for licensing actions on geologic repositories for the disposal of high-level radioactive wastes, the Nuclear Regulatory Commission initiated a program directed toward promulgating regulations. The contractor was responsible for (1) determining the state-of-the-art for shaft sealing technology, predicting waste/rock interactions, and excavation technology; (2) defining performance requirements for the shaft seal, mining and storage equipment, designs to accomodate waste/rock interactions, and proposed decommissioning techniques; and (3) evaluating the impacts of mine structural features which directly affect nuclear safety.
Keywords: RADIOACTIVE WASTE FACILITIES; RADIOACTIVE WASTE DISPOSAL; GEOLOGIC DEPOSITS; HIGH-LEVEL RADIOACTIVE WASTES; ROCKS; CHEMICAL REACTIONS; SHAFT EXCAVATIONS; DESIGN.

150292 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). Div. of Fuel Cycle and Material Safety. **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Integrated 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.

150293 Site Suitability for Geological Storage or Disposal of High Level Radioactive Waste. (National Academy of Sciences, 2101 Constitution Avenue, Washington, DC, 20418). **Project number:** B6132. **Contract:** NRC-02-77-162. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Integrated assessment.

The National Academy of Sciences (NAS) conducted a study to assist the Nuclear Regulatory Commission (NRC) in developing the criteria that must be satisfied to ensure the suitability of sites chosen for deep geological repositories for radioactive waste. This study was conducted in accordance with the NAS proposal entitled "A Study of the Criteria Needed to Determine the Suitability of Sites for Geological Storage or Disposal of High-Level Radioactive Waste," and the NAS letter dated July 8, 1977 revising this proposal which are incorporated therein by reference. NAS shall convene a panel on geological site criteria to review all available scientific and technical information to include current NRC studies and the assessment of NRC developed site suitability criteria for geologic repositories of high-level radioactive waste.
Keywords: RADIOACTIVE WASTE DISPOSAL; GEOLOGIC DEPOSITS; SITE SELECTION; HIGH-LEVEL RADIOACTIVE WASTES; GEOLOGY; HYDROLOGY.

150294 Peer Review of High-Level Waste Site Suitability Criteria. (TRW, Inc., Energy Systems Planning Div., 7600 Colshire Drive, McLean, VA, 22101). **Project number:** B6137. **Contract:** NRC-02-77-143. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The Nuclear Regulatory Commission is continually reviewing the site suitability criteria (SSC) upon which a decision to site a nuclear waste facility must be based. In establishing these criteria, the NRC requires the help of experts in an exceptionally large variety of scientific and socioscientific disciplines. The contractor was required to convene a group of experts, not to exceed 20 members, to review the SSC in terms of the most modern knowledge. After individually reviewing the background information, experts in the socioscientific fields convened as one unit whereas experts in the physical and geological/oceanographic sciences were grouped separately for interdisciplinary contact for a two-day workshop. The contractor provided a finalized list of SSC in the form of a prioritized matrix reflecting the views of the peer group.
Keywords: RADIOACTIVE WASTE DISPOSAL; SITE SELECTION; HIGH-LEVEL RADIOACTIVE WASTES; GEOLOGY; RADIOACTIVE WASTE FACILITIES.

150295 Licensing Process Study. Coldwell. (Science Management Corporation, Washington, DC, 20036). **Project number:** B6139. **Contract:** NRC-02-77-188. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$40,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

This study is designed to identify improvements that can be made in the processing of documentation related to the licensing functions of the radioisotopes licensing branch. A definition of alternative approaches for streamlining current processing procedures for licenses and related communications will result.
Keywords: RADIOISOTOPES; LICENSING; PLANNING.

150296 Review of the ERDA GEIS. Belotte, C. (The BDM Corp., McLean, VA, 22101). **Project number:** B6143. **Contract:** NRC-02-77-155. **Supported by:** Nuclear Regulatory Commission,

Washington, DC (USA). Div. of Fuel Cycle and Material Safety. Funding: NRC-$35,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

Technical assistance was required for the detailed review of those portions of the draft environmental impact statement on commercial radioactive waste (CWMS) which address: the alternative treatment, storage, and disposal technologies; the non-technical areas; and the alternative geologies for final isolation. In addition all mathematical analysis and computer modeling were reviewed.
Keywords: RADIOACTIVE WASTE PROCESSING; RADIOACTIVE WASTE DISPOSAL; RADIOACTIVE WASTE STORAGE; ENVIRONMENTAL IMPACTS; ENVIRONMENTAL IMPACT STATEMENTS.

150297 Modeling of Pool Swell Hydrodynamics. Sonin, A.A. (Massachusetts Institute of Technology, Cambridge, MA, 02139). **Project number:** B6167. **Contract:** B6167. **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:** Operational safety; Characterization, measurement, and monitoring.

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.

150298 Hydrodynamics Numerical Simulation of the November 29, 1975, Hawaiian Tsunami. Loomis, H.G. (University of Hawaii at Manoa, Honolulu, HI, 96822). **Project number:** B6194. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fission(100).

The objective of the project is to verify mathematical models for near shore tsunami analysis based on observations of the November 23, 1975 event at Hawaii.
Keywords: NUCLEAR POWER PLANTS; REACTOR SAFETY; TSUNAMIS; SEISMIC EFFECTS; MATHEMATICAL MODELS; SIMULATION; HAWAII; PACIFIC OCEAN; DATA ANALYSIS.

150299 Fire Protection Research. Christian, V. (Underwriter's Laboratory, Northbrook, IL, 60062). **Project number:** B6197. **Contract:** B6197. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100).

The objective of this fire protection research is to evaluate the effectiveness of the flame test portion of IEEE-383-74 and the draft Fire Stop Standard IEEE-P-634-78.
Keywords: NUCLEAR POWER PLANTS; FIRE PREVENTION; SAFETY ENGINEERING; PLANNING; RECOMMENDATIONS; SPECIFICATIONS.

150300 Safety Assessment of Concrete Nuclear Structures (Parts I, II, and III). Connor, J.J.; Buyukozturk, O. (Massachusetts Institute of Technology, Dept. of Civil Engineering, Cambridge, MA, 02139). **Project number:** B6202. **Contract:** B6202. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of the project is the development of analytical methods for evaluating stresses in containment walls subject to biaxial tension and shear and verification of static code (three dimensional non-linear analysis) calculations.
Keywords: NUCLEAR POWER PLANTS; CONTAINMENT BUILDINGS; STRESS ANALYSIS.

150301 Testing of Reinforcement Concrete Containments Under Combined Membrane Tension and Tangential Shear. Russel, H.; Oesterly, R.G. (Portland Cement Association, Old Orchard Road, Skokie, IL, 60076). **Project number:** B6203. **Contract:** B6203. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$150,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of the project is the determination of the behavior of reinforced concrete containment walls in a biaxial field of stress and subjected to shear stresses.
Keywords: NUCLEAR POWER PLANTS; CONTAINMENT BUILDINGS; MECHANICAL TESTS; STRESSES; REINFORCED CONCRETE.

150302 Fire Protection Research. Hunter, L.W. (Johns Hopkins University, Applied Physics Laboratory, Laurel, MD, 20810). **Project number:** B6207. **Contract:** B6207. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$27,000.
Related energy source: nuclear fission(100).

The objective of this fire protection research is to provide an analytical basis for the experimental programs being conducted by the Nuclear Regulatory Commission. The work is focused towards providing a capability of predicting results from experimental programs and determining the experimental parameter sensitivity so that more meaningful experiments can be designed.
Keywords: NUCLEAR POWER PLANTS; FIRE PREVENTION; SAFETY ENGINEERING; RESEARCH PROGRAMS; PLANNING; RECOMMENDATIONS.

150303 Application of the Internal Friction Nondestructive Evaluation Technique for Detecting Incipient Cracking of Bypass Lines and Pipes in Boiling Water Reactor Piping Systems. Hochrein, A.A. (Daedalean Associates, Inc., 15110 Frederick Road, Woodbine, MD, 21797). **Project number:** B6212. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$196,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

This research study entails the application of the Internal Friction Nondestructive Evaluation Technique for the detection of incipient cracking of bypass lines and pipes in boiling water reactors (BWR) systems. Procedurally, the technique monitors the specific damping capacity (dynamic response) of a piping system in order to detect cracking. The basic principle of the technique is derived from the assessment of specific damping capacities for engineering materials after exposure to various environmental conditions under stress loads. Changes in the specific damping capacity (internal friction) indicates incipient cracking. Materials are excited to a preselected vibration frequency and the vibration is then allowed to decay. Changes in the decay rate over the monitored life of the component are the specific indication of incipient cracking within that component.
Keywords: BWR TYPE REACTORS; REACTOR COOLING SYSTEMS; PIPES; CRACKS; NONDESTRUCTIVE TESTING; FRICTION; MECHANICAL VIBRATIONS; DAMPING.

150304 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:** B6213. **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:** Characterization, measurement, and monitoring.

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.

150305 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:** B6224. **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:** Operational safety; Characterization, measurement, and monitoring.

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.

150306 LOFT Advanced Fuel Rod Instrumentation Development. Sheen, E.; Day C.K. (Hanford Engineering Laboratory, P.O. Box 1970, Richland, WA, 99352). **Project number:** B6228. **Contract:** B6228. **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:** Operational safety; Environmental control technology.

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.

150307 Strainrange Partitioning as a Framework for Creep-Fatigue Assessment. Manson, S.S. (Case Western Reserve U., Cleveland, OH, 44106). **Project number:** B6252. **Contract:** B6252. **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:** Operational safety; Characterization, measurement, and monitoring.

The objective of this project is the development of strainrange partitioning as a framework for creep-fatigue assessment in nuclear components operating at elevated temperatures. Both analytical and experimental aspects will be included.
Keywords: REACTOR COMPONENTS; REACTOR MATERIALS; HIGH TEMPERATURE; CREEP; FATIGUE; MECHANICAL TESTS.

150308 Investigation on the Use of Cyclic Torsional Screw Plate Test to Determine In-Situ Liquefaction Potential of Cohesionless Soils. Schmertmann, J.H. (University of Florida, Gainesville, FL, 32611). **Project number:** B6254. **Contract:** B6254. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$85,000.
Related energy source: nuclear fission(100).

The objective of the project is to develop a field method for determining the liquefaction potential of sands in situ at the sites of the Nuclear Power Plants necessary for non-arbitrary assessment of the safety of foundations needed for licensing.
Keywords: NUCLEAR POWER PLANTS; REACTOR SITES; SOIL MECHANICS.

150309 Modular Approach to Fault Tree Analysis. Wolf, L. (Massachusetts Inst. of Technology, Cambridge, MA, 02139). **Project number:** B6256. **Contract:** NRC-04-77-158. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$24,000.

The objectives of the project are to (1) assess and extend the computer code PL-MOD to provide NRC with an effective and powerful tool for analysis and evaluation of complex fault trees; (2a) develop Boolean techniques to analyze system models; (2b) develop methods and computer software to quantitatively analyze time-dependent system behaviors; and (2c) develop methods and computer software to handle Monte Carlo simulation.**Keywords:** REACTOR COMPONENTS; RELIABILITY; FAILURE MODE ANALYSIS; CALCULATION METHODS; FAULT TREE ANALYSIS.

150310 Studies of Methods of Generating Few Broad-Group Cross Sections for Fast Reactor Accident Analysis. Addae, A.K. (Howard University, Mechanical/Nuclear Engineering Dept., 2300 6th Street, Washington, DC, 20059). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$35,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of this program of analytical development in LMFBR safety research is to develop methods for generating few broad-group neutron cross sections as a function of material composition to be used in fast reactor safety codes such as SIMMER. The studies will be made to develop a suitable definition for the background cross section so that self-shielding factors for specfied compositions rather than isotopes will be employed in the computations and thereby reduce the time required for the calculation of shielded pointwise cross sections. Investigations will be made to determine if the redefined background cross section avoids the sigma-ambiguity which has been pointed out by Segev. The range of isotopic concentrations as well as the combination of isotopes within a composition to be considered in the study will be limited to those normally expected during a hypothetical LMFBR core disruptive accident.
Keywords: LMFBR TYPE REACTORS; REACTOR ACCIDENTS; REACTOR SAFETY; REACTOR KINETICS; REACTOR CORE DISRUPTION; MATHEMATICAL MODELS; NUCLEAR REACTION KINETICS; CROSS SECTIONS; CALCULATION METHODS.

150311 Gap Conductance Studies. Loyalka, S.K. (University of Missouri at Columbia, Nuclear Engineering Department, Columbia, MO, 65201). **Project number:** B6274. **Contract:** NRC-04-78-201. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$26,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The analysis program is directed toward providing theoretical predictions for the gap conductance values obtained from the MPD and MLD experiments being conducted by the Pacific Northwest Laboratories (Richland, Washington). Gap conductance is an important parameter in calculating stored energy and temperatures in a fuel rod. The response of the rod during off-normal conditions or in a hypothetical accident is an important consideration from a safety standpoint.
Keywords: POWER REACTORS; FUEL ELEMENTS; HEAT TRANSFER.

150312 Fire Risk Systems Analysis. Apostolakis, G. (Univ. of California at Los Angeles (UCLA), Chemical, Nuclear & Thermal Engineering Dept., Los Angeles, CA, 90024). **Project number:** B6284. **Contract:** NRC-04-78-198. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

The project has the following objectives: (1) provide a probabilistic assessment of fire initiation, fire severity, and fire effects of systems and operations; (2) construct event trees with fire as the initiating event; and (3) develop a general fire-risk model and perform various sensitivity studies.
Keywords: NUCLEAR POWER PLANTS; FIRE HAZARDS; FIRES; SAFETY ENGINEERING; SYSTEMS ANALYSIS.

150313 Advanced Fracture Mechanics Methodology. Paris, D.C. (Washington University, Box 1087, St. Louis, MO, 63130). **Project number:** B6288. **Contract:** B6288. **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:** Operational safety; Characterization, measurement, and monitoring.

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.

150314 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:** B6290. **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:** Operational safety; Characterization, measurement, and monitoring.

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.

150315 Fire Risk Data Analysis. Hockenbury, R.W. (Rensselaer Polytechnic Institute, Department of Nuclear Engineering, Troy, NY, 12181). **Project number:** B6302. **Contract:** NRC-04-78-220. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$41,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

The project has the following objectives: (1) analyze more than 300 reported fire incidents to obtain probabilistic characterizations of fires to be used in risk evaluations of nuclear power plants; and (2) review significant data on the properties, fire locations,

detection response times, factors influencing fire severities, and mitigating effects of fire protection systems.
Keywords: NUCLEAR POWER PLANTS; FIRE HAZARDS; DATA ANALYSIS.

150316 Dynamic Modeling of Geologic Processes. Shaw, H.R. (U.S. Geological Survey, Menlo Park, CA, 94025). **Project number:** B6303. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$87,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The objectives are to simulate the effects of emplacement of nuclear waste in the layered salt reference site and other sites involving different rock types and geologic settings and to simulate the effects coupled to those of external events. This will be accomplished by: (1) performing rough scoping analyses of near-field interactions of mineral breakdown reactions with pore pressure and mechanical failure of materials in canister vicinity; (2) beginning comparative analyses relative to another media, such as shale; and (3) establishing the existing data base for igneous event consequences in the region of a repository.
Keywords: RADIOACTIVE WASTE DISPOSAL; SALT DEPOSITS; GEOLOGY; ROCK MECHANICS; GEOLOGIC DEPOSITS; GROUND WATER; MATHEMATICAL MODELS.

150317 LER Analysis of Human Error Rates. Sabri, Z.A. (Iowa State University, Department of Nuclear Engineering, Ames, IA, 50011). **Project number:** B6305. **Contract:** NRC-04-78-221. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$69,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The project has the following objectives: (1) to evaluate operator error rates based on actual commercial nuclear power plant data; and (2) to quantify and model human performance for a range of operational conditions.
Keywords: NUCLEAR POWER PLANTS; PERSONNEL; RELIABILITY; REACTOR OPERATION; OCCUPATIONS; PERFORMANCE.

150318 Hot Pressing, Swelling and Gas Release of UO2 During Steady State and Transient Conditions. Solomon, A.A. (Purdue University, West Lafayette, IN, 47907). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$42,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Physical and chemical processes and effects.

The objective of the project is to measure the hot pressing kinetics, swelling, and gas release of unirradiated UO2 at temperatures and pressures between 1000 and 1700 degrees C and 0 and 10,000 psi, respectively.
Keywords: POWER REACTORS; FUEL ELEMENTS; SWELLING; FISSION PRODUCT RELEASE; FABRICATION; VERY HIGH TEMPERATURE; URANIUM DIOXIDE; PHYSICAL RADIATION EFFECTS.

150319 Damage and Integrity Aspects of Safety in a Nuclear Plant Subjected to Creep and Fatigue. Miller, K.J. (The University of Sheffield, Sheffield, England). **Project number:** B6320. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$30,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective of this program is the evaluation of crack propagation rates under biaxial states of strain. The separate and combined effects of loading phase, creep behavior at notches, creep behavior of notches with prior fatigue and various states of strain and stress levels, and the fatigue behavior of notches with prior creep will be studied.
Keywords: POWER REACTORS; REACTOR COMPONENTS; CREEP; REACTOR MATERIALS; FATIGUE; CRACKS; FRACTURE PROPERTIES.

150320 Compilation of the Radioactive Waste Disposal Classification System. Rogers, V. (Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT, 84101). **Project number:** B6358. **Contract:** NRC-02-77-197. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$171,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

The Nuclear Regulatory Commission requires technical assistance in the compilation of the data base required to support the development of regulations, guides, and environmental impact statements for implementation of the radioactive material disposal classification system (RMDCS). This project relates to a concept of classification of radioactive material developed by one contractor and the methodology for applying this concept which was developed by another firm.
Keywords: RADIOACTIVE WASTE DISPOSAL; CLASSIFICATION; DATA COMPILATION.

150321 Table S-3 Rulemaking: Expert Testimony (M.J.R. Lariviere of SAI). (Science Applications, Inc., La Jolla, CA, 92037). **Project number:** B6360. **Contract:** NRC-02-78-026. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$10,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

This contract provides for the services of a consultant who will be needed for his expert testimony related to the final rulemaking on Table S3 of 10 CFR 51.20(e).
Keywords: REACTOR LICENSING; LEGAL ASPECTS.

150322 Conference on High-Level Radioactive Solid Waste Forms. Shilesky, D.M. (SCS Engineers, 11800 Sunrise Valley Drive, Reston, VA, 22091). **Project number:** B6381. **Contract:** NRC-02-78-034. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$13,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Integrated assessment.

The Nuclear Regulatory Commission (NRC), being responsible for all regulatory aspects of high-level waste management, is sponsoring a three-day conference and workshop on the subject during the period from November 27 to December 2, 1978. The contractor is to provide and plan the location and accomodations for the conference and its participants, send out invitations, and assemble a report on the conference upon its conclusion for NRC.
Keywords: RADIOACTIVE WASTE MANAGEMENT; HIGH-LEVEL RADIOACTIVE WASTES; MEETINGS; SOLID WASTES.

150323 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). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$146,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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.

150324 Review of PAT-I Package Film. Schaefer, J. (Audio Visual Specialists, Washington, DC, 20008). **Project number:** B6389. **Contract:** NRC-02-78-069. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$7,000.
R and D categories: Characterization, measurement, and monitoring.

Audio Visual Specialists, Inc. was contracted to provide a suitable documentary movie describing the qualification tests of the PAT-I package.
Keywords: PACKAGING; PHOTOGRAPHIC FILMS; EDUCATION; QUALITY CONTROL.

150325 Department of State Translation Services. Lejins, N.M. (Department of State, Language Service Division, Room 2214, Washington, DC, 20520). **Project number:** B6406-8. **Contract:** NRC-02-78-057. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$7,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Integrated assessment.

To promote better understanding, the Nuclear Regulatory Commission contracted four French/English translators from the State Department to handle interpretations at the NEA Conference on Uranium Mill Tailings, in Albuquerque, NM, 24--28 July 1978.

Keywords: MEETINGS; URANIUM ORES; MILL TAILINGS; PERSONNEL.

150326 NRC Waste Management Contractors Conference. Ashelman. (Coolfont Re-Creation, Berkely Springs, WV, 25411). **Project number:** B6421. **Contract:** NRC-02-78-075. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$9,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The Nuclear Regulatory Commission is assessing the National Waste Management Program and is preparing for forthcoming licensing activities. In support of these efforts, several private consultant companies, universities and national laboratories have received contracts from NRC to study specific areas of concern to the staff. To further better communications between the contractors and NRC, NRC is sponsoring a conference to discuss the status and goals of the Waste Management Program. The contractor is to provide a site for the conference and make accommodation arrangements for meals, rooms, and equipment.
Keywords: RADIOACTIVE WASTE MANAGEMENT; LICENSING; SAFETY; CONTRACTS.

150327 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). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$270,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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 environmental 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.

150328 PAT Package Specifications and Drawings. Williams, C.E. (NL Industries, Nuclear Division, P.O. Box 2046, Wilmington, DE, 19899). **Project number:** B6384. **Contract:** NRC-02-78-038. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding:** NRC-$8,000.
R and D categories: Operational safety.

The Nuclear Regulatory Commission (NRC) required technical assistance in producing engineering drawings of PAT I. The contractor supplied NRC with two sets of full size reproducible drawings and six sets of full size prints of the expected 22 sheet drawings.
Keywords: PHYSICAL PROTECTION DEVICES; DESIGN; SPECIFICATIONS; DIAGRAMS; SAFEGUARDS.

150329 Management Analysis. Block, H. (H.B. Block and Associates, 1010 Playford Lane, Silver Spring, MD, 20910). **Project number:** B6392. **Contract:** NRC-02-78-048. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$10,000.
R and D categories: Operational safety.

The objective of this contract is to identify perceived management problems in the Radioisotopes Licensing Branch of the Division of Fuel Cycle and Material Safety and recommend no more than three alternative ways to solve any identified problems. The contractor is to develop an office survey, collect the data, analyze the data, and make a final report on their findings to accomplish the objective for the Nuclear Regulatory Commission.
Keywords: RADIOISOTOPES; LICENSING; MANAGEMENT; NUMERICAL SOLUTION; DATA COMPILATION; DATA ANALYSIS; US NRC.

150330 PAT Drawings. Williams, C.E. (NL Industries, Willmington, DE, 19801). **Project number:** B6416. **Contract:** NRC-02-78-070. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. **Funding** NRC-$3,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring.

The Nuclear Regulatory Commission required professional drafting services to restore the Sandia drawings of the PAT-I package for air transport of plutonium. They were supplied with two sets of full-size, reproducible drawings and two sets of full-size prints of the Model PAT-I package with specific tolerances added.
Keywords: AIR TRANSPORT; CONTAINERS; PLUTONIUM; SPECIFICATIONS.

150331 Critical Pathways of Radionuclides to Man from Agro-Ecosystems. Smith, M.H. (University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC, 29801). **Contract:** EY-76-C-09-0819. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$116,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective of this project is to examine contamination modes of agricultural crops grown in the vicinity of an operating nuclear fuel reprocessing facility. Crops are grown both in field and greenhouse situations in order to separate and evaluate the possible modes of contamination (e.g., root uptake, resuspension, and direct deposition). The aim is to determine the feasibility of agriculturally cropping lands in the vicinity of a reprocessing facility or lands that have been contaminated by such a facility.
Keywords: FUEL REPROCESSING PLANTS; RADIOACTIVE EFFLUENTS; ENVIRONMENTAL TRANSPORT; CURIUM ISOTOPES; PLUTONIUM ISOTOPES; URANIUM ISOTOPES; ROOT ABSORPTION; FOLIAR UPTAKE; PARTICLE RESUSPENSION; CROPS; CONTAMINATION; ROOTS; LEAVES; RADIONUCLIDE KINETICS; AGRICULTURE; FEASIBILITY STUDIES; SOILS.

150332 Reactor Safety Study Update Methodology Applications. Cybulskis, P. (Battelle Columbus Laboratories, 505 King Avenue, Columbus, OH, 43201). **Project number:** B6332. **Contract:** NRC-04-76-293. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

The objective of the program is to investigate the effects of LWR plant design variations on the risks associated with reactor meltdown accidents. The effects of plant design variations on the probability and nature of the radionuclide source term released during key meltdown accident sequences are studied.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; REACTOR SAFETY; MELTDOWN; RADIATION HAZARDS; FISSION PRODUCT RELEASE; PROBABILITY.

150333 Meteorological Studies. Van der Hoven, I. (National Oceanic and Atmospheric Administration, Environmental Research Labs., 8060 13th Street, Silver Spring, MD, 20910). **Project number:** RD 842260. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$265,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

The objective of the program is to conduct research in meteorological dispersion in order to obtain diffusion parameters for a variety 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 are to be made.
Keywords: LMFBR TYPE REACTORS; REACTOR SITES; METEOROLOGY; SITE SELECTION.

150334 Monitoring of Radioiodine from Containment Accidents. Distenfeld, C.H. (Brookhaven National Laboratory, Safety and Environmental Protection Division, Building 535, Upton, NY, 11973). **Project number:** 07163. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$47,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

This study will determine the practicality of using readily available Civil Defense instruments and specially trained Civil Defense personnel to delineate the public health impact of an accidental release of radioiodine from a fixed nuclear facility. Instrumentation efforts will focus on iodine air sampling and assessment with some work on vegetation, milk and ground contamination survey. For example, preliminary studies show that a modified shop vacuum cleaner used in conjunction with a CDV-700 GM survey instrument

and a simple collector is adequate to detect airborne iodine concentration which would lead to a dose commitment well within EPA guidelines (< 5 rem to a child's thyroid). As a complementary effort, the study will determine the most effective way to collate, reduce and present the data from a network of monitoring locations. This analysis will lead to the development of a emergency exercise to test the total plan. An accurate estimate of costs will be generated so that an informed decision on emergency instruction alternates can be made.
Keywords: IODINE ISOTOPES; RADIATION ACCIDENTS; NUCLEAR FACILITIES; HEALTH HAZARDS; RADIOACTIVE EFFLUENTS; RADIONUCLIDE KINETICS; FOOD CHAINS; AIR POLLUTION; EMERGENCY PLAN; CONTAMINATION.

150335 Survey of Radioactivity Monitoring Practices in Liquid and Gaseous Effluent Streams from Nuclear Power Reactors. Hull, A.P. (Brookhaven National Laboratory, Safety and Environmental Protection Division, Building 535, Upton, NY, 11973). **Project number:** 07496. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$3,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology.

The objective of this technical assistance program will be to obtain sufficient information from field surveys to characterize the currently employed practices and procedures for the monitoring of radioactivity in liquid and gaseous effluent streams from operating light-water-cooled nuclear power plants. The survey will compare the typical effluent monitoring and sampling systems and the apparent state-of-the-art (best available) systems. Recommendations will be made, as appropriate, on the need for improvement in the state-of-the-art in order: (1) to assure the reliability of the isolation function of monitoring systems and the adequacy of the effluent monitoring data to establish compliance with as low as reasonably achievable (10 CFR 50, Appendix I) limits; and (2) to characterize the extent and severity and extent of a release under accident conditions.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; RADIOACTIVE EFFLUENTS; RADIATION MONITORING; LIQUID WASTES; GASEOUS WASTES; SAMPLING.

150336 Reactor Operator Licensing Examination Assistance. Hamrick, T.P. (Oak Ridge National Laboratory, Building 3001, Oak Ridge, TN, 37830). **Project number:** A9019. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$70,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

Three ORNL personnel are consultant examiners for the Operator Licensing Branch of the Directorate of Licensing. They prepare and administer written, oral, and operating examinations in accordance with 10 CFR, Part 55, to applicants for a license to operate power, research, and test reactors in the United States as requested by the Nuclear Regulatory Commission.
Keywords: POWER REACTORS; RESEARCH REACTORS; PERSONNEL; LEGAL ASPECTS.

150337 Evaluation of Docket Files for Terminated Licenses. Dickson, H.W. (Oak Ridge National Laboratory, Bldg. 7710, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** 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:** Operational safety.

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. The results to date include completion of 85 percent of the computer input/data analysis forms and 10 percent of the computer input.
Keywords: NUCLEAR POWER PLANTS; REACTOR DECOMMISSIONING; RADIATION PROTECTION; RADIATION HAZARDS; DATA PROCESSING; LEGAL ASPECTS; DATA BASE MANAGEMENT.

150338 Radiation Shielding Information Center (RSIC). Maienschein, F.C. (Oak Ridge National Laboratory, Building 6025, Oak Ridge, TN, 37830). **Project number:** A9096. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$110,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of this project are to acquire, evaluate, organize, and distribute information (including data and computing technology) in support of programmatic needs of NRC staff and contractors. Disciplinary areas include: physics interaction of radiation with matter; radiation production, protection, transport, and shielding; radiation detectors and measurements; engineering design techniques; shielding materials properties; computer codes; and nuclear data compilations. Although primary emphasis is on analysis of penetrating radiation (neutrons and gamma-rays) in an external exposure context, the scope includes computation of internal dose and other radiation protection analysis functions.
Keywords: INFORMATION SYSTEMS; SHIELDING; RADIATIONS; RADIATION PROTECTION; RADIATION TRANSPORT; RADIATION DETECTORS; RADIATION DETECTION; SHIELDING MATERIALS; NEUTRONS; GAMMA RADIATION; GAMMA DETECTION; NEUTRON DETECTION; NEUTRON DOSIMETRY; GAMMA DOSIMETRY; RADIATION DOSES; COMPUTER CODES; NUCLEAR DATA COLLECTIONS.

150339 Environmental Statements Project. Zittel, H.E. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0001. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$1,789,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The Environmental Statements Project (ESP) was established in 1971 to assist the AEC as an extension of the staff in the preparation of environmental statements for commercial nuclear power plants. The work is continuing for the Office of Nuclear Reactor Regulation, Division of Reactor Licensing of NRC. This activity responds to the National Environmental Policy Act, where NRC rules require an independent assessment of the environmental impacts of nuclear power plants as part of the licensing procedure. The work includes writing of sections of environmental statements dealing with: plant and site description, nonradiological environmental effects on land, water and air use due to construction and routine plant operation, irreversible, irretrievable commitment of resources, and social and economic effects. The ESP staff also assesses the need for the plant and makes an overall evaluation based on the costs and benefits of alternatives.
Keywords: NUCLEAR POWER PLANTS; ENVIRONMENTAL IMPACTS; ENVIRONMENTAL IMPACT STATEMENTS.

150340 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. **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:** Operational safety; Environmental control technology; Health effects.

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.

150341 Environmental Statements for Use of Radioactive Materials in Consumer Products. Row, T.H. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0076. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$37,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety.

When consumer products containing radioactive materials are developed for use by the general public, the Transportation and Product Standards Branch of NRC is petitioned to amend its rules and regulations, contained in 10 CFR 30 or 40, to exempt from licensing requirements the distribution, use transfer, importation, and disposal of the products. Prior to reaching a decision on a petition, the NRC must assess in detail the potential environmental impacts associated with the action proposed by the petition. This assessment must satisfy the requirements of Section 102(2)(C) of the National Environmental Policy Act. The objective of this project is to provide technical assistance to the NRC in preparation of detailed assessment of environmental impacts potentially associated with consumer products that contain either byproduct or source materials. Assistance will consist of preparation of Draft and Final Environmental Statements and the development of testimony or other

supportive data as required by the environmental review process. This assistance will be provided as needed by a national laboratory team versed in assessment of environmental impacts and all other aspects of the environmental impact review process.
Keywords: ENVIRONMENTAL IMPACTS; RADIOISOTOPES; HEALTH HAZARDS; CONSUMER PRODUCTS; RADIATION PROTECTION LAWS; PUBLIC HEALTH; LEGAL ASPECTS; LICENSING; SAFETY STANDARDS; PLANNING.

150342 Power Plant Cost Studies. Bowers, H.I. (Oak Ridge National Laboratory, Building 9104-1, Oak Ridge, TN, 37830). **Project number:** B0090. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$88,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The scope of this activity is to assist the Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Site Safety and Environmental Analysis (DSE), in estimating capital investment costs and operation and maintenance (O and M) costs of nuclear power plant projects and alternative fossil-fueled projects. This activity utilizes existing techniques and computer codes, such as the CONCEPT code for capital investment costs and the OMCST code for nonfuel O and M costs, to the maximum extent possible and also includes the updating of these codes and the development of new cost information when required.
Keywords: NUCLEAR POWER PLANTS; FOSSIL-FUEL POWER PLANTS; COST; CONSTRUCTION; REACTOR OPERATION; CAPITAL; REACTOR MAINTENANCE; COMPARATIVE EVALUATIONS.

150343 Noise Surveillance and Diagnostics. Fry, D.N. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0092. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the program are to provide specialized engineering services (analytical, experimental, and technical review) to the NRC for reactor surveillance, diagnostics, and loose-parts monitoring to aid the NRC in evaluating the performance of specific nuclear power plants now in operation and assessing the adequacy of existing noise monitoring and diagnostic techniques, and in reviewing and upgrading planned surveillance instrumentation designs and diagnostic procedures.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; HTGR TYPE REACTORS; LOOSE PARTS MONITORING; REACTOR INSTRUMENTATION.

150344 Radiation Exposures from Products Containing Radioactive Materials. O'Donnell, F.R. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0114. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$51,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment; Health effects.

The objectives are to develop a methodology for estimating radiation doses to man from consumer products containing radioactive materials and to apply the methodology in estimating doses from distribution, use, and disposal of such products. A general computer code should be developed to estimate radiation doses if the necessary exposure parameters are specified. Given the computer code, a search of available data on radionuclide-containing consumer products will be made to specify the necessary exposure parameters. Methodology development is complete. The computer code has been, and will be used to estimate radiation doses from specific products. Documentation of the computer code is to be completed and a summary of the product assessments is to be prepared.
Keywords: RADIATION DOSES; CONSUMER PRODUCTS; PUBLIC HEALTH; SAFETY STANDARDS; RADIOISOTOPES; RADIATION PROTECTION LAWS; MAN; PLANNING.

150345 Safety Review of Nuclear Facilities. Frederick, E.J. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0102. **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:** Operational safety.

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.

150346 Additional Requirements for Materials. Slaughter, G.M. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0103. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$275,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the program are to review state-of-the-art technology and to provide technical expertise and assistance to the Office of Standards Development in the review of national codes and standards which are referenced in NRC regulations or guides related to nuclear reactor components. The ORNL will provide comments, proposed modifications, and supplementary information, as appropriate, for those codes and standards in the areas of design, materials, fabrication, and inspection. When necessary, specific information (or data) will be developed and/or analyzed to support recommendations related to the regulations, guides, or referenced codes and standards.
Keywords: REACTOR COMPONENTS; REACTOR MATERIALS; STANDARDS.

150347 Fracture and Irradiation Effects. Whitman, G.D. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0104. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the program are to review current guides and to develop a better technical basis for the preparation of regulatory guides on the prevention of fracture or excessive deformation under the environmental conditions expected in the pressure boundary of light-water reactors. The program consists of (1) clarification of the relationship between Charpy V-notch impact energy, fracture toughness and mode of crack extension in the upper shelf temperature range, particularly at the CVN = 50 ft lb energy level; (2) correlation of the temperature shift of fracture toughness K/sub Ic/ due to irradiation with the temperature shift of Charpy V-notch impact values below the 50 ft lb level; (3) determination of the value of RT/sub NDT/ for the original HSST Program test plates; (4) the development of stress-strain data for austenitic materials up to strain of at least two percent in the temperature range from room temperature to 316 degrees C; and (5) consultation with NRC as required.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; PRESSURE VESSELS; PRIMARY COOLANT CIRCUITS; FRACTURES; FAILURES; STEELS; REACTOR MATERIALS; FRACTURE PROPERTIES; DEFORMATION.

150348 NSIC Assistance to ACRS. Cottrell, W.B. (Oak Ridge National Laboratory, Building 9764, Oak Ridge, TN, 37830). **Project number:** B0160. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$12,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

At the request of the ACRS, NSIC produces periodic indexed bibliographies of topical and progress reports that are kept on the permanent reference shelf of the ACRS. The bibliographies, which were initiated in 1974, are distributed only to the ACRS. Limited distribution documents are included in their coverage as well as open literature reports.
Keywords: REACTOR SAFETY; RADIATION PROTECTION; INFORMATION SYSTEMS; BIBLIOGRAPHIES.

150349 Generic Reports on Radwaste Treatment at Nuclear Power Plants. Frederick, F.J. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0171. **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:** Operational safety.

Generic reports are of use in preparing environmental impact statements on the engineering operations used for the treatment of

radioactive wastes at installations in all segments of the nuclear fuel cycle. The information in these reports is used to verify the assumptions used in the preparation of environmental reports and statements. They will also provide technical background and will be referenced in revisions to regulatory guides. Each generic report generally contains: (1) a brief review of theoretical considerations, (2) a literature survey, (3) a survey of industrial experience, (4) a discussion of operation problems, (5) observations on recent trends and areas that need to be upgraded, and (6) recommendations for the radwaste treatment efficiencies and decontamination factors to be used by the NRC and industry.
Keywords: NUCLEAR POWER PLANTS; RADIOACTIVE WASTE PROCESSING; ENVIRONMENTAL IMPACTS.

150350 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$137,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects; Health effects.

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) is underway.
Keywords: RADIONUCLIDE MIGRATION; MATHEMATICAL MODELS; DATA BASE MANAGEMENT; DOSIMETRY; RADIATION DOSES; HUMAN POPULATIONS; ENVIRONMENTAL EXPOSURE PATHWAY; RADIOISOTOPES; BIOLOGICAL PATHWAYS; BIOLOGICAL MODELS; RBE.

150351 Fission Product Scale Test. Malinauskas, A.P. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0189. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$115,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of this program is to complete the conceptual and detailed designs of a facility to use in the development validation of thermal-hydraulic/fission product transport computational models which are being formulated to describe fission product behavior in commercial light water reactors during core meltdown accidents.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; REACTOR SAFETY; MELTDOWN; LOSS OF COOLANT; FISSION PRODUCT RELEASE.

150352 Radwaste Systems Cost Estimates. Bowers, H.I. (Oak Ridge National Laboratory, Building 9104-1, Oak Ridge, TN, 37830). **Project number:** B0236. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$15,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The scope of this activity is to provide ad hoc technical assistance to the Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Site Safety and Environmental Analysis (DSE), in the development of cost estimates for augmented radioactive waste systems for plants presently in operation or construction, in evaluation of applicant's cost estimates of radioactive waste systems for plants in the design phase, and in review of models being used by staff and applicants for performing cost-benefit analysis required by Appendix I to 10 CFR Part 50. It also includes testimony at Atomic Safety and Licensing Board (ASLB) hearings when requested.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; RADIOACTIVE WASTE FACILITIES; RADIOACTIVE WASTE PROCESSING; COST.

150353 Technical Assistance Program: Power Systems Analysis. Anderson, J.L. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0238. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$105,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of the program is to provide technical assistance to the Power Systems Branch of the Division of Systems Safety for evaluation of specific licensing issues. Two subtasks are in process: evaluation of the hazard of using dedicated (1E) power sources and distribution systems to serve non-1E loads, and evaluation of current standards and practices for the design and installation of electrical penetrations of containment barriers.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; ELECTRICAL EQUIPMENT.

150354 Sensitivity Analysis of Electricity Demand for Ongoing Case Review. Carlsmith, R.S. (Oak Ridge National Laboratory, Building 3550, Oak Ridge, TN, 37830). **Project number:** B0245. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$25,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The proposed project is a continuation of the project FIN No. B-0245 initiated in FY78. The objectives of this project are: (1) to compile, review, and examine the most recent estimates of important exogenous variables of electricity demand, and (2) to perform sensitivity analyses for appropriate scenarios using the regional electricity demand forecasting models developed for another NRC-sponsored project, Forecasting Electricity Demand by States in the U.S. on an Annual Basis, conducted at ORNL. Specifically, that project provides two relevant inputs for this project: (1) a regional econometric forecasting model which is capable of forecasting electricity demand by sector and by state; and (2) a computer-based model for disaggregating state-level forecasts to utility service areas.
Keywords: USA; ELECTRIC POWER; ELECTRIC UTILITIES; ENERGY CONSUMPTION; ENERGY DEMAND; FORECASTING.

150355 Environmental Assessments of Fuel Cycle Facilities. Zittel, H.E. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0279. **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:** Operational safety.

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.

150356 Advanced Two-Phase Instrumentation. Jallouk, P.A. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0401. **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:** Operational safety.

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, farication, 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.
Keywords: PWR TYPE REACTORS; REACTOR SAFETY; LOSS OF COOLANT; HYDRAULICS; TWO-PHASE FLOW; TEST FACILITIES; FLOWMETERS; BOILING DETECTION.

150357 NRC Measured Data Repository (MDR). Maienschein, F.C. (Oak Ridge National Laboratory, Building 6025, Oak Ridge, TN, 37830). **Project number:** B0402. **Supported by:** Nuclear Regula-

tory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

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.

150358 Criticality Studies: Capital Equipment. Whitesides, G.E. (Oak Ridge National Laboratory, Computer Sciences Division, Bldg. 6025, X-10 Site, Oak Ridge, TN, 37830). **Project number:** B0408. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$31,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Health effects.

Capital equipment funding in support of B0172, Standardized Analysis of Fuel Shipping Containers, is described. Funds used for acquisition of computer disk drives, terminals, and hard copy unit and inventory items selected on basis of support of B0172 are discussed.
Keywords: CRITICALITY; RESEARCH PROGRAMS; CAPITAL; FINANCING; BUDGETS; EQUIPMENT; COMPUTER CODES; COMPUTERS.

150359 Reviewed Critical Experiments Performed for Fuel Cycle Safety Guidance. Whitesides, G.E. (Oak Ridge National Laboratory, Computer Sciences Division, X-10 Site, Building 6025, Oak Ridge, TN, 37830). **Project number:** B0409. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$55,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Health effects.

The objective of this program is to provide advice and guidance on the experimental programs being conducted at the Rocky Flats Nuclear Safety Facility and at the Battelle-Northwest Critical Mass Laboratory for the Nuclear Regulatory Commission. The work entails a continuing review of the experimental programs to determine if the series of experiments adequately cover needed ranges of applicability. Also involved is the analysis of selected configurations to aid in the design of future experiments and to determine if the reported experimental data yield well-defined analytical models.
Keywords: FUEL CYCLE; CRITICALITY; SAFETY; REVIEWS; ANALYTICAL SOLUTION; MATHEMATICAL MODELS.

150360 Methods in Dosimetry for Nuclear Regulation. Ford, M.R.; Cristy, M. (Oak Ridge National Laboratory, P.O. Box X, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0410. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$196,000.
Related energy source: nuclear fission(80); nuclear fusion(20). **R and D categories:** Operational safety; Health effects.

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 interest is the examination of the risk to pediatric members of the population. The approach will include development and documentation of a series of pediatric mathematical phantoms and appropriate age-dependent metabolic models to permit calculation of appropriate dose conversion factors for children, for radionuclides of concern in fission energy technology. The results include a consistent series of mathematical phantoms for newborn, 1, 5, 10 and 15 years. Age-dependent metabolic models will be derived from available literature. Preliminary estimates of the age dependency factor in the calculated dose have been made.
Keywords: DOSIMETRY; RISK ASSESSMENT; DATA BASE MANAGEMENT; CHILDREN; PHANTOMS; MATHEMATICAL MODELS; AGE DEPENDENCE; METABOLISM; RADIATION DOSES; RADIONUCLIDE KINETICS; ADOLESCENTS; RADIOISOTOPES.

150361 Generic Review of the Impact of Conservation, Rate Structure, and Load Management Alternatives on the Need for Power. Row, T.H. (Oak Ridge National Laboratory, Building 4500N, Oak Ridge, TN, 37830). **Project number:** B0411. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$34,000.
Related energy source: conservation(100). **R and D categories:** Operational safety.

Over the last two years, a large volume of published material has appeared relevant to various issues associated with the need for power provided by ne generating stations. Much of this material presents initial evidence from modeling efforts as well as utility- and government-funded field experiments, and offers the cost-benefit analyst the opportunity to assess more explicitly and accurately the possible impacts of conservation, rate restructuring, load management, and cogeneration programs on the future need for power. To be useful, however, this material requires a detailed review, evaluation, and synthesis. Thus, the purpose of this project is to assess the likely future impact of various alternative nonprice energy conservation programs, electricity rate structure changes, load management strategies, and cogeneration systems on the need for power. The principal result of this project will be a basic report which reviews and summarizes the results of recent studies and which puts into perspective the future prospects of these alternatives. This report will serve as a reference document for use by cost-benefit analysts in preparing selected portions of the Need for Power sections of Environmental Impact Statements and in preparing supplementary testimony in response to contentions on these issues.
Keywords: CO-GENERATION; LOAD MANAGEMENT; RATE STRUCTURE; ELECTRIC UTILITIES; ENERGY CONSERVATION; COST BENEFIT ANALYSIS; ENVIRONMENTAL IMPACTS; POWER DEMAND; FORECASTING.

150362 Resident Engineer, Karlsruhe, Germany. Whitman, G.D. (Oak Ridge National Laboratory, Building 9204-1, Oak Ridge, TN, 37830). **Project number:** B0412. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$70,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The purpose of this activity is to provide a resident representative of the NRC at Gesellschaft fuer Kernforschung (GfK) in the Federal Republic of Germany. In addition to active participation as a project scientist in the Heis Dampf Reactor (HDR) and 3D test programs, this individual is to provide technical liaison between the aforementioned test program activities in Germany and their related counterparts in the U.S. The HDR Program will explore thermal hydraulic and material response of the deactivated PWR at Kahl, under simulated conditions of blowdown, thermal shock and other off-normal conditions, eventually testing the reactor vessel to destruction.
Keywords: PWR TYPE REACTORS; LOSS OF COOLANT; BLOWDOWN; HYDRAULICS; THERMAL STRESSES; THERMAL SHOCK; DESTRUCTIVE TESTING; REACTOR INTERNALS; PRESSURE VESSELS.

150363 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. **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:** Operational safety.

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.

150364 Light Water Reactor (LWR) Pressure Vessel Irradiation Program. Cox, J.A. (Oak Ridge National Laboratory, Building 3047, Oak Ridge, TN, 37830). **Project number:** B0415. **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:** Operational safety.

One of the major problems in the LWR PVS program is the extrapolation of measured data from positions exterior to the pres-

sure 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.

150365 Eddy-Current In-Service Inspection for Steam Generators. Slaughter, G.M. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0417. **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:** Operational safety.

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.

150366 Pathogenic Amoebae in Closed Cycle Cooling Systems of Operating Power Stations. Coutant, C.C. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0418. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$50,000.
Related energy source: fossil fuels(25); nuclear fission(75). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The objective is to determine the incidence of pathogenic (for man) amoebae in heated areas of closed cycle cooling systems (reservoirs, ponds, canals, etc.) compared to non-heated water bodies nearby. Water and sediment are being sampled in representative cooling systems nationwide and the thermophilic amoebae are being cultured and identified and their virulence determined. The result expected is an indication of the prevalence of these microorganisms (which cause a rapidly fatal encephalitis) in cooling systems as a first-stage analysis of the potential risk to human health.
Keywords: PATHOGENESIS; AMOEBA; CLOSED-CYCLE COOLING SYSTEMS; THERMAL EFFLUENTS; TEMPERATURE EFFECTS; HEALTH HAZARDS; POPULATION DYNAMICS; HUMAN POPULATIONS.

150367 Criticality Safety Methods Solid Angle: Surface Density. Thomas, J.T. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0419. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$85,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the program include the analysis of the surface density method in sufficient detail to define the method, the safety limits, and the areas of applicability; provision of documentation sufficient to serve as a guide for use of the method; demonstration by examples of application; analysis of the solid angle method in sufficient detail to resolve outstanding questions on areas of applicability and criteria for acceptability; and 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 shall 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 percent /sup 235/U or less will be conducted. Oxides and metal will be studied. The effects of density, hydrogen content, mass and shape of fissionable materials will be characterized.
Keywords: CRITICALITY; SAFETY; URANIUM 235; DENSITY; STANDARDS; HYDROGEN; FISSIONABLE MATERIALS; SHAPE; MASS.

150368 Safety-Related Operator Actions. Mynatt, F.R. (Oak Ridge National Laboratory, Building 9201-3, Oak Ridge, TN, 37830). **Project number:** B0421. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$60,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

There currently do not exist generally accepted criteria for safety-related operator actions. Data and scientific analysis of operator reliability in a nuclear power plant environment sufficient to support final criteria will come only as the result of a comprehensive human factors research program, and will not be available in the near future. In the meantime, there is a need for specific, consistent and reasonably conservative criteria to serve as guidelines for design, safety assessment and licensing. This program is designed to supply NRC with data, information and analysis useful for assessing proposed interim criteria (such as the current draft version of ANSI N660 developed by ANS working groups) and/or establishing alternative criteria.
Keywords: NUCLEAR POWER PLANTS; PERSONNEL; REACTOR SAFETY; RADIATION PROTECTION.

150369 Methods to Assess Impacts on Hudson River White Perch. Van Winkle, W. (Oak Ridge National Laboratory, P.O. Box X, Building 1505, Oak Ridge, TN, 37830). **Project number:** B0423. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$25,000.
Related energy source: fossil fuels(50); nuclear fission(50). **R and D categories:** Operational safety; Environmental control technology; Integrated assessment; Ecological/biological processes and effects.

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.

150370 Regulatory Guides for Nuclear Reactor Surveillance and Diagnostics. Kryter, R.C. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0723. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$25,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective of the program is to provide specialized services (analysis and computation, consultation, technical input, and technical review) that will aid NRC/DES in their preparation of regulatory guides and related standards for system surveillance and diagnostics in nuclear power plants.
Keywords: NUCLEAR POWER PLANTS; REACTOR OPERATION; MONITORING; REGULATORY GUIDES.

150371 Review of Materials for Code Applications. Slaughter, G.M. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0724. **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:** Operational safety.

The objective of the program is to review ASME Code Documents, Addenda, and Code Cases as requested by the NRC Office of Standards Development. The efforts will include an in-depth review of the specific requirements of the ASME Code. The merits of those requirements will be judged in the light of the safety and reliability of LWRs. Recommendations regarding the adequacy of these requirements in meeting the needs of the Regulatory Standards will be made. Another responsibility of this program is to provide consultation services to NRC as required.
Keywords: PWR TYPE REACTORS; BWR TYPE REACTORS; REACTOR MATERIALS; REGULATORY GUIDES; LEGAL ASPECTS.

150372 Safeguards Analysis for Byproduct Materials and Small Quantities of Special Nuclear Materials (SNM). Chester, R.O. (Oak Ridge National Laboraory, P.O. Box X, Building 7509, Oak Ridge, TN, 37830). **Project number:** B6108. **Supported by:** Nuclear Regula-

tory 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:** Operational safety; Health effects.

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.

150373 Noise Diagnostics for Safety Assessment. Oakes, L.C. (Oak Ridge National Laboratory, Building 3500, Oak Ridge, TN, 37830). **Project number:** B0191. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$150,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the project are to: provide experimental and analytical assessment of noise diagnostic techniques to develop the technical basis for the preparation of guides and standards by NRC/SD, the performance evaluation of operating reactors by NRC/NRR (DOR), and the review by NRC/NRR (DSS) of licensee-proposed noise diagnostics, loose-parts monitoring, and automated surveillance systems; provide technical advice on the principles and workabilities of monitoring systems employing advanced noise analysis techniques; and help to identify new techniques and application areas that show future promise for reactor safety assessment
Keywords: POWER REACTORS; REACTOR NOISE; DIAGNOSTIC TECHNIQUES; MONITORING; REACTOR SAFETY; LOOSE PARTS MONITORING.

150374 Validation of Nuclear Fuel Cycle Dose Assessment Models. Hoffman, F.O. (Oak Ridge National Laboratory, P.O. Box X, Building 7509, Oak Ridge, TN, 37830). **Project number:** B0209. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$115,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Physical and chemical processes and effects.

The purpose of this project is to determine the adequacy of NRC Appendix I models currently being applied to routine releases of radioactivity from Nuclear Power Reactors for assessment of individual doses to man. This includes delineating the sensitivity of NRC dose models to variations in the choice of input parameter values and estimating the uncertainty associated with model predictions. These models will be subjected to a systematic evaluation methodology which is designed to facilitate the identification of critical parameters and to specify additional improvements required to reduce the uncertainty associated with the use of the models.
Keywords: NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; RADIATION DOSES; CALCULATION METHODS; MATHEMATICAL MODELS; FISSION PRODUCTS; FISSION PRODUCT RELEASE.

150375 Internal Dosimetry and Methods of ICRP. Ford, M.R.; Bernard, S.R. (Oak Ridge National Laboratory, P.O. Box X, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0213(9). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development. **Funding:** NRC-$70,000.
Related energy source: nuclear fission(80); nuclear fusion(20). **R and D categories:** Operational safety; Health effects.

The objective of this project is to provide complete and timely reporting of data and calculational methodology used in carrying out ICRP formulation for recommendations on permissible internal dose and intakes of radionuclides for occupational exposures. Timely letter and topical reports will be submitted on significant changes in data or methodology. Additionally, rapid response will be provided to NRC requests for assistance in risk assessments, and alternative methodologies will be presented where applicable. The investigators have provided during FY 1978 the basic formulations of some of the equations used to calculate permissible dose and intakes. While work for the ICRP is underway, NRC will be provided with continuing updated information on the rationale for selection of data to be included in the determination of permissible intakes, the methods of calculation of permissible intakes for purposes of the ICRP recommendations, and possible alternate methods of calculation that would be useful to NRC for more accurate dose assessment for other conditions and purposes.
Keywords: RADIOISOTOPES; MAXIMUM PERMISSIBLE DOSE; MAXIMUM PERMISSIBLE INTAKE; PERSONNEL DOSIMETRY; ICRP; RECOMMENDATIONS; RISK ASSESSMENT; PERSONNEL; CALCULATION METHODS.

150376 Technical Assistance Program: Electrical and Control Analysis. Anderson, J.L. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0230. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$165,000.
Related energy source: nuclear fission(100).

The objective of the project is to provide the Instrumentation and Control Systems Branch of the Division of Systems Safety with technical assistance on specific licensing issues, including both generic and specific docket activities. Remote multiplexed systems have been reviewed, and the results and appropriate guides and standards were reported to the DSS. Methods available to perform tests of the response time of sensors in plant protection systems were surveyed. Current NRC requirements and applicable guides and standards were reviewed. Reactor manufacturers and utility companies offering response-time testing services to the nuclear industry were consulted, their testing techniques were evaluated, and recommendations were made to the NRC/DSS.
Keywords: NUCLEAR POWER PLANTS; REACTOR CONTROL SYSTEMS; REACTOR INSTRUMENTATION; RESEARCH PROGRAMS; PERFORMANCE.

150377 Nondestructive Examination Evaluation Support. Slaughter, G.M. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0233. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$30,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objectives of the program are: (1) to provide NRC-ONRR an independent evaluation of the results of nondestructive examination on components of operating nuclear power plants and the state-of-the-art of NDE techniques; and (2) to provide recommendations for alternate and improved inspection techniques.
Keywords: REACTOR COMPONENTS; NONDESTRUCTIVE TESTING; INSPECTION; RECOMMENDATIONS.

150378 Welding Evaluation. Slaughter, G.M. (Oak Ridge National Laboratory, Building 4500S, Oak Ridge, TN, 37830). **Project number:** B0234. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$56,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The project has the following objectives: (1) review state-of-the-art technology, including suggested topical reports, in order to provide NRC with technical consultation on welding and associated metallurgical problem areas; (2) maintain liaison with ASME Code, AWS and related welding activities and, where desired, assist NRC in preparing documentation for submissions to these bodies; (3) assist in development of staff posistions, in hearing participation, and in general welding assistance to special NRC groups; and (4) when lack of information exists for a specific area or problem, suggest needed development programs.
Keywords: REACTOR COMPONENTS; WELDED JOINTS; SPECIFICATIONS.

150379 Technical Assistance Program: Electrical Systems Analysis. Anderson, J.L. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN, 37830). **Project number:** B0235. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$150,000.
Related energy source: nuclear fission(100).

A current task includes evaluation of factors that determine the stability of the large power grids for nuclear power generating stations. A second task includes an evaluation of the potential for auxiliary control-protection interaction. A study of offsite power systems, including an evaluation of loss-of-power experience, an investigation of recent upsets, estimates of expected maximum rates of power system frequency decay and the effects of such decay on emergency cooling systems, and a determination of transmission system configurations that may approach instability is continued. A detailed study was made of the Babcock and Wilcox designed Integrated Control System (ICS) as applied to the Oconee and North Anna plants. No direct or potential interactions between the control and protection systems were identified that, in the opinion of the reviewers, could significantly reduce their protective capability or increase the challenge rate. To the contrary, the challenge to the protective systems as a result of control or load anomalies should be significantly reduced by the design features of the comprehensive integrated system. Similar evaluations are continuing for boiling-

water reactor plants and pressurized-water reactor plants manufactured by Westinghouse and Combustion Engineering.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; POWER SUPPLIES; ELECTRIC POWER; FAILURES; RELIABILITY; REACTOR CONTROL SYSTEMS.

150380 ARAC Feasibility Study for NRC. Dickerson, M.H. (Lawrence Livermore Laboratory, P.O. Box 808, L-262, Livermore, CA, 94550). **Project number:** 20-78-69. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. **Funding:** NRC-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

The study involves the feasibility of appying the ARAC (Atmospheric Release Advisory Capability) service to the private nuclear power industry licensed by the NRC. A specific nuclear power plant site was chosen to investigate the requirements for ARAC to meet the emergency preparedness requirement of a nuclear power plant. This phase of the study will involve a generic investigation of the application of ARAC to the nuclear power industry as a whole.
Keywords: NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; EMERGENCY PLAN.

150381 Chemical Effluents from Nuclear Power Plants. Harrison, F.L. (Lawrence Livermore Laboratory, P.O. Box 5507, L-453, Livermore, CA, 94550). **Project number:** 60-78-042. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$214,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

Use of surface waters in the operation of nuclear power plants might 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 plants or produced by chemical reactions of substances released from nuclear power plants in the receiving water; (2) to determine the magnitude of the effects of these substances on representative, economically important aquatic species; and (3) to develop models to predict the behavior and impact of the discharged substances. These substances include corrosion products that are leached by water circulating in cooling systems and chemicals that are added to the cooling system water. The impact of copper on aquatic organisms in both the laboratory and the field are being investigated. Some major chemical and physical processes that determine the behavior of copper in aquatic ecosystems are being studied and the toxic effects of the predominant forms of copper found in the water on representative aquatic organisms are being assessed.
Keywords: NUCLEAR POWER PLANTS; CHEMICAL EFFLUENTS; SURFACE WATERS; WATER POLLUTION; TOXICITY; AQUATIC ORGANISMS; BIOLOGICAL EFFECTS; ECOLOGICAL CONCENTRATION; ENVIRONMENTAL TRANSPORT; MATHEMATICAL MODELS; CORROSION INHIBITORS; ANTIFOULANTS; COPPER; MORTALITY; AQUATIC ECOSYSTEMS.

150382 Experimental and Analytical Assessment of Shipping Container Puncture Environments. Larder, R. (Lawrence Livermore Laboratory, Livermore, CA, 94550). **Project number:** A0127-8. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$151,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective is to develop and improve methods for evaluating the response of shipping containers to the puncture environment specified in 10 CFR 71. Review of existing plate puncture test data (and also initial puncture test results obtained to date) indicates that the existing prismatic cask puncture test data developed by the previous investigators may not be adequate to form a sound basis for package reviews. This is primarily due to the fact that plate configurations (plate shape, width, lead thickness, etc., and boundary conditions) used in generating these test data may not be comparable or compatible with those of the pertinent cask components in use. Furthermore, several important parameters (such as plate width or ameter) have not been addressed in these studies. Experimental idence shows that, in addition to punch diameter d and plate ickness t varying in degree, the other parameters, such as plate diameter D, lead thickness t/sub 00/, and temperature T, may also have important effects on puncture resistance capacity of lead shielded cask end plate components. In order to be of maximum benefit, the on-going plate puncture program should be modified to take the above attributes/variables into consideration.
Keywords: CASKS; PERFORMANCE TESTING; RUPTURES.

150383 Acute Morbidity and Mortality Estimates for Different Nuclear Accidents. Hahn, F. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM, 87105). **Project number:** A1203-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$151,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Early mortality and morbidity can occur as a result of inhalation of radioactive materials released during a potential accident or sabotage incident. However, our knowledge of the early (within one year) effects of inhalation is insufficient for risk assessment. The objective is to improve our knowledge of the dose-response relationship for early mortality and morbidity following inhalation of radionuclides. Phase I will be directed toward reviewing the published studies of early mortality from radiation exposures and developing a quantitative model for predicting early mortality following inhalation of radioactive materials that might be released in potential accidents or sabotage incidents at NRC-licensed facilities. The most critical deficiencies in our knowledge of early mortality will be identified. Phase II will be initiated with the remaining funds based on the results of Phase I and the experimental design developed. Phase II will consist of animal exposure experiments and radiobiological analyses.
Keywords: NUCLEAR FACILITIES; RADIATION ACCIDENTS; RADIOISOTOPES; INHALATION; MAN; EARLY RADIATION EFFECTS; MORTALITY; RISK ASSESSMENT; RADIATION INJURIES; SABOTAGE; RADIATION HAZARDS.

150384 Biological Characterization of Radiation Exposure and Dose Estimates for Inhaled Uranium Milling Effluents. Edison, A.F. (Lovelace Foundation, Inhalation Toxicology Research Institute, Albuquerque, NM). **Project number:** A1222. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects; Ecological/biological processes and effects.

The primary objective is to study the metabolic behavior of inhaled yellowcake in order to determine the applicable concentration limits in air for occupational exposure. A secondary objective is to relate the physical and chemical characteristics of the yellowcake samples to the observed biological behavior in order to characterize the aerosol properties which determine the resulting patterns of radiation dose.
Keywords: URANIUM OXIDES U3O8; INHALATION; DOSE RATES; AEROSOLS; RADIATION DOSES; FEED MATERIALS PLANTS; PERSONNEL; RADIATION HAZARDS; BIOLOGICAL EFFECTS.

150385 Monitoring of Radioiodine from Containment Accidents. Distenfeld, C.H. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** A3056-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

NRC must assess impact to the public health and safety from accidental releases of radioactive materials. This study will determine the practicality of using available Civil Defense instruments to delineate the public health impact of an accidental release of radioiodine from nuclear facilities. Instrumentation efforts will focus on radioiodine sampling and detection using a CDV-700 GM survey instrument with some work on vegetation, milk, and ground contamination survey. The study will determine the most effective means to collate, reduce, and present data from a network of monitoring locations. Estimates of costs will be determined.
Keywords: ACCIDENTS; NUCLEAR FACILITIES; COST; IODINE ISOTOPES; RADIATION MONITORING; CONTAMINATION.

150386 Study of UF6/UO2F2 in Experimental Animals. Morrow, P. (University of Rochester, Rochester, NY). **Project number:** A4083-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$36,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective is to determine the temporal and quantitative relationships which exist between controlled exposures to UF6 or known body burdens of UO2F2 and the urinary elimination of uranium in experimental animals. Experiments involving single intratracheal administrations and short term inhalation exposures will be performed. Animals will be whole-body counted and urine and feces collected at frequency intervals. Groups of animals will be serially sacrificed and the tissue distribution of uranium determined. Histopathologic examinations will be performed on the tissue samples. Efforts will be made to determine if uranium is deposited in significant quantity in the skeleton following exposure to airborne UF6/

UO2F2, and to determine if exposure to UF6/UO2F2 causes significant kidney damage.
Keywords: URANIUM HEXAFLUORIDE; URANYL FLUORIDES; SINGLE INTAKE; INTRATRACHEAL ADMINISTRATION; ACUTE EXPOSURE; INHALATION; LABORATORY ANIMALS; URANIUM; TISSUE DISTRIBUTION; BIOLOGICAL LOCALIZATION; EXCRETION; RADIONUCLIDE KINETICS; BIOLOGICAL RADIATION EFFECTS; KIDNEYS; RADIATION INJURIES; SKELETON; RADIATION HAZARDS; METABOLISM.

150387 HEPA Filter Performance in Tornado. Gregory, W. (Los Alamos Scientific Laboratory, Los Alamos, NM, 87544). **Project number:** A7028. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$292,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring.

The objective is to confirm experimentally the predicted performance of full size HEPA filters under pressure transietns simulating tornado environments and high velocity flow rates. The program is divided into three principal areas of investigation: structural testing of filters, filter efficiency tests, and analysis of Nuclear Fuel Services plant at West Valley, NY. The types of HEPA filters available from various manufacturers will be determined. The possible effects of these design variations on response to simulated tornado conditions will be evaluated and a recommendation made to NRC regarding the types to be tested. A sufficient number of filters of each type to be tested will be obtained to assure statistically meaningful results. Tests of the as-received filters will provide variation of peak filter pressure drop, duration at peak pressure and filter orientation in order to determine the threshold for structural failure. The mechanism of structural failure will be determined and the functional relation to filter characteristics (e.g., unsupported length) and transient conditions will be established. Filter efficiency tests in the small-scale facility will be conducted. Tests of two types will be performed. In the first, filters will be loaded with particulates then the filters will be subjected to transients and the particulate release measured. In the second series, aerosols will be injected upstream of the filter during the transient to establish filter efficiency under a variety of transient conditions. Filter efficiency tests on full scale filters will also be initiated. Los Alamos Scientific Laboratory will, in concert with the staff of the Oak Ridge National Laboratory, conduct a review of the ventilation system at the Nuclear Fuel Services plant at West Valley, NY. From this review, the Laboratory should develop the basic input data required for the TVENT ventilation system computer code and should exercise this code to describe the NFS ventilation system response to a tornado environment or other specific parameters to be defined by NRC.
Keywords: TORNADOES; AIR FILTERS; PERFORMANCE TESTING; NUCLEAR FACILITIES; SAFETY; EFFICIENCY; VENTILATION SYSTEMS.

150388 *Investigation of Accident Induced Flow and Material Transport in Fuel Cycle Facilities.* Gregory, W.S.; Martin, R.A. (Los Alamos Scientific Laboratory, Los Alamos, NM, 87544). **Project number:** A7029. **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:** Operational safety.

The objective of this research is to develop the capability to analyze the induced flow and material transport within fuel cycle facilities and to the atmospheric boundaries of the facilities which result from internal sources generated by postulated accidents. The method is to conduct a literature review to determine availability of applicable experimental data and analysis models applicable to system flow, material transport and entrainment/de-entrainment analyses for fuel cycle accident conditions, and as required, to conduct experiments and develop analysis methods to provide the data and methods needed to reliably predict the flows and transport of radioactive materials to the atmospheric boundaries of the facility.
Keywords: NUCLEAR FACILITIES; ACCIDENTS; FUEL CYCLE; SAFETY; AIR POLLUTION; RADIOACTIVITY TRANSPORT.

150389 Assessment of Respiratory Protection Systems. Hack, A.L. (Los Alamos Scientific Laboratory, Los Alamos, NM). **Project number:** A7039. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$132,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

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.
Keywords: RESPIRATORS; RADIATION PROTECTION; RESPIRATORY SYSTEM; TESTING; US NRC; RADIOACTIVE AEROSOLS; HEALTH HAZARDS.

150390 Criteria and Test Methods for Certifying Air-Purifying Respirators Against Radioiodine. (Los Alamos Scientific Lab., Los Alamos, NM). **Project number:** A7041. **Contract:** Wood, G.O. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$102,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Health effects.

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.
Keywords: IODINE ISOTOPES; AIR POLLUTION; RESPIRATORS; TESTING; HEALTH HAZARDS.

150391 Radon from Open-Pit Uranium Mining. Gastopon, P. (Argonne National Laboratory, Argonne, IL). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

150392 Post Licensing Studies of the Socioeconomic Impacts of Nuclear Power Plant Siting. Chalmers, J. (Mountain West Research, Tempe, AZ). **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$506,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring.

The objective is to assess and analyze the socioeconomic impacts resulting from the construction and operation of nuclear power stations. The specific purposes of this research effort are to identify the characteristics and degree of individual, community, public sector, and private sector impacts for a spectrum of community and regional situations, and to identify those variables and their variations which determine, or at least influence, the kind and degree of socioeconomic impacts experienced by regions and communities and the communities' ability to cope with impacts of station construction. This information will be used to develop guidance for an a priori identification and evaluation of the most significant socioeconomic impacts during construction and operation in specific cases; to evaluate the validity and accuracy of models and techniques used in the study for the purpose of predicting the scope and scale of impacts; and finally, to provide guidance and recommendations to the NRC for improving its procedures and requirements with regard to the conduct of socioeconomic impact analysis and evaluation.
Keywords: NUCLEAR POWER PLANTS; SITE SELECTION; SOCIO-ECONOMIC FACTORS; HUMAN POPULATIONS; BEHAVIOR; REACTOR LICENSING; PUBLIC OPINION.

150393 Unified Transport Assessment (Chemical Impact). Patterson, M.R. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** B0169. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$2,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Ecological/biological processes and effects.

There are no acceptable, tested models available for the assessment of the impact of chlorine discharges to the aquatic environment. Such models, which relate the chemical transformations and interactions with the physical transport equations with unified computer codes, would aid and speed up environmental impact assessments. The objective of this project is to provide tested reliable methods (models) for predicting the chemical (chlorine) impact of power plant discharges to rivers, estuaries, ponds, lakes and coastal waters; the same mathematical and computational procedures are to be used for chemical, thermal, radioisotopic and entrainment analyses, thus optimizing input and computer requirements.
Keywords: CHLORINE; ENVIRONMENTAL IMPACTS; SURFACE WATERS; MATHEMATICAL MODELS; RIVERS; ESTUARIES; LAKES; COASTAL WATERS; PONDS; POWER PLANTS; MONITORING.

150394 Standardized Analysis of Fuel Shipping Containers. Greene, N. (Oak Ridge National Laboratory, Oak Ridge, TN, 37830). **Project number:** B0172. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$290,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective is to develop a system of unified computer programs for the standardized criticality safety, shielding and thermal analyses of fuel shipping containers.

Keywords: CASKS; CRITICALITY; SHIELDING; THERMAL STRESSES; COMPUTER CODES; SAFETY; PERFORMANCE TESTING.

150395 Measurement Technology For Plutonium in Humans and the Environment. Palmer, H.E. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2091-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$11,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects.

Objectives are to: demonstrate a capability to detect and measure an internal deposition of plutonium in the human lung on the order of 0.1 maximum permissible lung burden using prototypical gas scintillation proportional counters; and develop a reasonably priced portable large area counter for environmental measurement of plutonium.
Keywords: PLUTONIUM ISOTOPES; DEPOSITION; MAXIMUM PERMISSIBLE DOSE; LUNGS; SCINTILLATION COUNTERS; MAN; DOSIMETRY.

150397 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$332,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Health effects; Ecological/biological processes and effects.

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.

150398 Assessment of Sources of Occupational Radiation Exposure at Nuclear Power Plants. Hall, T.M. (United Nuclear Industries, Richland, WA). **Project number:** B2096. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$80,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Characterization, measurement, and monitoring; Integrated assessment; Health effects.

Radiation exposure reduction techniques are addressed in proposed revision of Regulatory Guide 8.8. It is necessary to assess the quantitative effectiveness of the guidance provided and implementation of the guide and recommended design features aimed at keeping occupational exposure in LWR's as low as reasonably achievable.
Keywords: NUCLEAR POWER PLANTS; PERSONNEL DOSIMETRY; RISK ASSESSMENT; RADIATION DOSES; PERSONNEL; OCCUPATIONAL SAFETY; HEALTH HAZARDS.

150399 Synthesis, Pathways, Effects, and Fate of Chlorination By-Products in Freshwater, Estuarine, and Marine Environments. Anderson, D.R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2098. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$585,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to: (1) measure and identify those chemical compounds formed when chlorine is added to freshwater and marine and estuarine waters, (2) develop methods for detecting concentrations of chlorinated hydrocarbons in the effluents discharged to receiving water bodies from nuclear stations, (3) investigate the acute and chronic toxicity of several chlorinated by-products to freshwater and marine species, (4) charcterize the pathways of chlorinated by-products in aquatic organisms, and (5) analyze for bioaccumulation and biomagnification of chlorinted hydrocarbons in aquatic species.
Keywords: CHLORINATION; ENVIRONMENTAL EFFECTS; FRESH WATER; ESTUARIES; SEAS; NUCLEAR POWER PLANTS; CHEMICAL EFFLUENTS; WATER QUALITY; WATER POLLUTION; AQUATIC ORGANISMS; US NRC; MONITORING; POLLUTION.

150400 Dynamic Analysis to Establish Normal Shock and Vibration Environments Experienced by Radioactive Material Shipping Packages. Fields, S.R. (Hanford Engineering Development Lab., Richland, WA). **Project number:** B2263. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$259,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objective of this study is to determine the extent to which the shocks and vibrations experienced by radioactive material shipping packages during normal transport conditions are influenced by, or are sensitive to, various structural parameters of the transport system (i.e., package, package supports, and vehicle). The purpose of this effort is to identify those parameters which significantly affect the normal shock and vibration environments so as to provide the basis for determining the forces transmitted to radioactive material packages. Determination of these forces will provide the input data necessary for a broad range of package-tiedown structural assessments.
Keywords: RADIOACTIVE MATERIALS; TRANSPORT; MECHANICAL VIBRATIONS; IMPACT SHOCK; CASKS.

150401 Nuclear Power Station Construction: Labor Force Migration and Residential Choice. Currie, W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2265. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$156,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives of this program are to identify and improve the understanding of the determinants of construction labor force migration and residential choice at nuclear power plant construction projects; and to provide NRC with a validated methodology for forecasting construction labor force migration patterns associated with nuclear power plant construction projects.
Keywords: NUCLEAR POWER PLANTS; CONSTRUCTION; SOCIO-ECONOMIC FACTORS; ENVIRONMENTAL IMPACTS; POPULATION DYNAMICS; LABOR.

150402 Study of the Visual Change Within a Region Due to Alternative Closed Cycle Cooling Systems and Associated Socioeconomic Impacts. Currie, J.W. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2266. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$85,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Integrated assessment.

The objective is to dimension the visual change resulting from alternative closed cycle cooling systems under a wide variety of landscape situations and the socioeconomic consequences of such change.
Keywords: CLOSED-CYCLE COOLING SYSTEMS; SOCIO-ECONOMIC FACTORS; AESTHETICS; LANDSCAPING; VISIBILITY; PLUMES; METEOROLOGY; MATHEMATICAL MODELS; ENVIRONMENTAL IMPACTS; THERMAL EFFLUENTS.

150403 Reactor Accident Inhalation Toxicology. Filipy, R.E. (Battelle Pacific Northwest Laboratory, Richland, WA, 99352). **Project number:** B2268-7. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$300,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

Early mortality and morbidity due to radiation pneumonitis are expected to result after inhalation of radioactive material following a reactor accident which releases mixed fission products. However, our knowledge of the early (within one year) effects of inhalation is insufficient for risk assessment. The objective is to provide projections of the potential human health effects from radiation exposures which might occur in the event of a reactor accident. Phase I will be directed toward reviewing the published studies of early mortality from radiation exposures and developing a quantitative model for predicting early mortality following inhalation of mixed fission products. The most critical deficiencies in our knowledge of early mortality will be identified. Phase II will be initiated with the remaining funds based on the results of Phase I and the experimental design developed from that effort. Phase II will consist of animal exposure experiments and radiobiological analyses.
Keywords: REACTOR ACCIDENTS; FISSION PRODUCT RELEASE; FISSION PRODUCTS; INHALATION; MAN; EARLY RADIATION EFFECTS; LUNGS; PNEUMONITIS; RADIOINDUCTION; MORTALITY; RISK ASSESSMENT; RADIATION HAZARDS; RADIATION INJURIES.

150404 Radon Exhalation from Uranium Mill Tailings Piles. Perkins, R. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland,

WA, 99352). **Project number:** B2269. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$77,000. **Related energy source:** nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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.

150406 Mathematical Simulation of Sediment and Contaminant Transport in Surface Waters. Onishi, Y. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2271. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$1,000.

Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are: 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 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.

Keywords: RADIONUCLIDE MIGRATION; SURFACE WATERS; SEDIMENTS; DISTRIBUTION; RADIOISOTOPES; ADSORPTION; MATHEMATICAL MODELS; RIVERS; LAKES; SEAS; ESTUARIES.

150407 Sediment and Radionuclide Transport in Rivers: Field Sampling Program, Cattarangus and Buttermilk Creeks, New York. Onishi, Y. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2275. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$220,000. **Related energy source:** nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are: (1) to collect data under varying water discharge conditions (low, medium, and high flows) on Cattarangus 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 described in NRR Program Letter, NRR 77-6, dated June 20, 1977, and RES Program No. B2087, which authorizes PNL to perform the mathematical simulation of raionuclide-sediment transport in Buttermilk and Cattarangus 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 Cattarangus Creek (Lake Erie).

Keywords: NEW YORK; SURFACE WATERS; RADIONUCLIDE MIGRATION; RIVERS; MATHEMATICAL MODELS; RADIOACTIVE WASTE DISPOSAL; SEDIMENTS; RADIOACTIVE WASTE STORAGE; SAMPLING.

150408 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$274,000.

Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment.

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.

150409 Decontamination Effects on Radwaste Systems. Perrigo, L. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2281. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$137,000.

Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives of the program are to establish through literature reviews and site visits the actual radwaste system design and operation for several operating LWRs and formulate composite baseline designs for evaluating radwaste capabilities; to establish through literature review and site visits utility plans for primary coolant system decontamination with detailed flow sheets for each process; to evaluate the effects of the candidate decontamination processes on the ability of baseline designs to function effectively and, if appropriate, provide conceptual designs for additional radwaste systems needed for acceptable radwaste system operation; and to provide cost estimates of additional radwaste systems required for candidate decontamination processes.

Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; DECONTAMINATION; RADIOACTIVE WASTE PROCESSING; RADIOACTIVE WASTE FACILITIES; COST; PERFORMANCE; SPECIFICATIONS.

150410 Aerosol Releases of Radioactive Materials from Fuel Cycle Facility Accidents. Mishima, J. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2286. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$100,000.

Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Physical and chemical processes and effects.

The objective of this research project is to determine the aerosol generation characteristics for generic accident scenarios applicable to the range of major, credible accidents in fuel cycle facilities and the transportation of these aerosols in the immediate vicinity of the release point.

Keywords: AEROSOL MONITORING; AIR POLLUTION; NUCLEAR FACILITIES; ACCIDENTS; FUEL CYCLE; RADIOACTIVE AEROSOLS; ENVIRONMENTAL TRANSPORT.

150411 Assessment of Leachate Movement from Ponded Uranium Mill Tailings. Serne, R.J. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** C2292. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.

Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to provide a measurement program to determine the interaction of tailings leachate with clay liner material and subsurface sediments representative of 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.

Keywords: MILL TAILINGS; LEACHING; RADIONUCLIDE MIGRATION; SEDIMENTS; RADIOACTIVE WASTE MANAGEMENT; CLAYS; CHEMICAL REACTIONS; MATHEMATICAL MODELS; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; GROUND WATER; SOILS.

150412 Effects of Nuclear Power Plant Operations on Populations of Boring and Fouling Invertebrates. Turner, R.D.; Hoagland, K.E. **Project number:** B5744. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$113,000.

Related energy source: nuclear fission(100). **R and D categories:** Ecological/biological processes and effects.

Tropical shipworms have been introduced into Oyster Creek, Waretown, New Jersey, and their larvae have been carried out of the creek in the thermal plume of the Oyster Creek Station. Adult populations are now established in an adjacent area of Barnegat Bay. This project will study the life history and population parameters of four species of boring bivalves and analyze the fouling community in which they exist. The scope of the project includes: comparison of the boring and fouling populations over time, with respect to temperature and salinity variations, within and without the thermal plume in the vicinity of the Oyster Creek Station and with control areas free of the above influence; pinpointing of thermal and salinity related changes in population dynamics which may be contributing to increased borer population size and immigration to Barnegat Bay; and evaluation of the influence of irregularities in the thermal discharge on population and community stability and structure.

Keywords: NEW JERSEY; NUCLEAR POWER PLANTS; CHEMICAL EFFLUENTS; THERMAL EFFLUENTS; BAYS; WATER POLLUTION; THERMAL POLLUTION; ENVIRONMENTAL EFFECTS; BIOLOGICAL EFFECTS; SALINITY; MOLLUSCS; POPULATION DYNAMICS; TEMPERATURE EFFECTS.

150413 Integrated Regional Approach to Regulating Energy Facility Siting. Eaton, S.H. (State of Massachusetts, Boston, MA). **Project number:** B5752. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$6,000.

Related energy source: nuclear fission(100). **R and D categories** Integrated assessment.

The objective is to develop a methodology for considering energy facility siting issues on a regional basis. The Energy Facilities Siting Council of the State of Massachusetts will coordinate the study with six New England states, the New England Regional Commission, the New England Water Basin Commission, utilities of

the New England Power Pool, Brookhaven National Lab, and the Energy Lab of MIT to create an organized plan for addressing the region's siting issues.
Keywords: NUCLEAR POWER PLANTS; SITE SELECTION; MATHEMATICAL MODELS; PLANNING.

150414 Projection Models for Health Effects Assessment in Populations Exposed to Radioactive and Non-Radioactive Pollutants. Lundy, R.T.; Grahn, D. (Argonne National Laboratory, Argonne, IL, 60439). **Project number:** B5753. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$208,000. **Related energy source:** coal(50); nuclear fission(50). **R and D categories:** Health effects.

The objective is to assess the potential health effects and life-shortening resulting from exposure to effluents from the uranium and coal fuel cycles. This requires development of a demographically correct projection model which will predict mortality for any population of specified age, race, and sex composition. The project consists of six tasks involving: (1) problems of demography--a model will be developed which will account for populations which change in composition over time; (2) dose-response functions--these functions will be adjusted and modified to related exposures to effluent concentrations to total mortality and to mortality from any specific cause for a given age/sex structure; (3) development of time-dependent dose-response functions--estimates of the latency period for various clinical conditions will be used to modify the linear dose-response models developed above; (4) non-linear dose-response functions--functions will be derived which are not linear with respect to pollution exposure; (5) extension to morbidity projection--from the number of deaths observed at any time the amount of debilitating illness prevailing in the population during previous periods can be inferred; and (6) superimposing short-term effect models on the long-term models--a single model will be developed from which both the static and dynamic aspects of health effect impacts can be analyzed. In FY78, the already developed basic mathematical model for projecting total mortality by age will be extended to enable projections of cause-specific mortality to be made. A single standard age/sex effect pattern will be chosen and used in adapting other data to the static long-term model. Work will begin on the problem of building latency into the simple linear long-term model and on fitting non-linear risk functions.
Keywords: FOSSIL-FUEL POWER PLANTS; NUCLEAR POWER PLANTS; URANIUM; COAL; FUEL CYCLE; RISK ASSESSMENT; HEALTH HAZARDS; MORTALITY; DOSE-RESPONSE RELATIONSHIPS; NONLINEAR PROBLEMS; CHEMICAL EFFLUENTS; HUMAN POPULATIONS; POPULATION DYNAMICS; MATHEMATICAL MODELS; RADIATION DOSES; AIR POLLUTION.

150415 Evaluation of Thorium Content of Human Tissues from Grand Junction, Colorado. Wrenn, M.E. (University of New York, Tuxedo, NY, 10987). **Project number:** B5756. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$32,000.
Related energy source: nuclear fission(100). **R and D categories:** Health effects.

The objective of the project is to measure and interpret the thorium content of human tissues obtained at autopsy from residents of Grand Junction, Colorado and elsewhere, with a view to establishing: (1) the natural background of the thorium nuclides Th-228, 230, and 232 in human tissues; (2) the thorium concentration in tissues of residents residing close to uranium mill tailings piles; and (3) the thorium content in tissues from other areas. Complete collection will be made of tissues from cadavers in Grand Junction, Colorado, and from New York State. Samples of lung, lymph node, liver, spleen, kidney, and bone will be analyzed for content of thorium isotopes.
Keywords: COLORADO; URANIUM ORES; ORE PROCESSING; MILL TAILINGS; THORIUM 228; THORIUM 230; THORIUM 232; TISSUE DISTRIBUTION; HUMAN POPULATIONS; NEW YORK; RADIONUCLIDE KINETICS; QUANTITY RATIO; COMPARATIVE EVALUATIONS; LUNGS; LIVER; LYMPH NODES; SPLEEN; KIDNEYS; SKELETON.

150416 Institutional Radioactive Wastes. Cooley, L.; Anderson, R. (University of Maryland, College Park, MD, 21201). **Project number:** B5959. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety. **Funding:** NRC-$98,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring.

The objective is to provide definitive data on the sources, haracteristics, volumes and treatment methods for low-level wastes arising in the medical/academic uses of radioisotopes. Follow-up questionnaries will be sent to approximately 600 universities and hospitals with and without active radiation medicine programs. These institutions are felt to comprise the major source of waste volumes. Projected increases in waste volumes will be made for the years 1976--1977. Using the data base developed in the initial study, the University shall attempt to characterize the physical and chemical forms of the significant waste types being generated in the medical/academic use of radioisotopes. Particular attention should be given to defining the chemical and biological toxicity of such wastes and the methods of treatment and packaging. The University will, using available facilities, develop a methodology by which estimates of the quantities of radioisotopes discharged to the sanitary sewer system can be determined and evaluated from readily available data such as patient records of diagnostic test procedures. Limited testing of this methodology shall be performed to verify its generic applicability. The University will update waste volume projections to include the years 1976--1977.
Keywords: LOW-LEVEL RADIOACTIVE WASTES; HOSPITALS; VOLUME; RADIOACTIVE WASTE MANAGEMENT; RADIOACTIVE WASTE PROCESSING; SCHOOL BUILDINGS.

150417 Radionuclide Retention and Land Form Modification in Surface Pathways. Davis, J.F.; Fakunding, R.H. (State University of New York, Stony Brook, NY). **Project number:** B6008. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are 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; assess the onsite movement of dissolved radionuclides and the radionuclides sorbed on suspended and bed-load sediments to determine their capability of being released to offsite environment; and determine the general pattern of radionuclide migration in backfill material contributing to sediment load of site drainages.
Keywords: WEST VALLEY PROCESSING PLANT; RADIOACTIVE WASTE DISPOSAL; RADIONUCLIDE MIGRATION; SURFACE WATERS; ENVIRONMENTAL EFFECTS; SEDIMENTS; PLUTONIUM 239; PLUTONIUM 240; NICKEL 63; IRON 55; TRITIUM; DISTRIBUTION; RADIOACTIVE WASTE MANAGEMENT.

150418 Environmental Behavior of Transuranics Discharged to Marine Environments from Nuclear Power Stations. Bowen, V.T. (Woods Hole Oceanographic Inst., Woods Hole, MA). **Project number:** B-6153. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$80,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

Under normal operating conditions, nuclear power stations discharge very low concentrations of radioactive materials to the aqueous environment. It is not known if transuranic radionuclides are released to the environment because no adequate data is available due to monitoring difficulties presented at the low concentrations expected. This program will attempt to characterize the transuranics released from nuclear stations to marine waters and to establish their environmental behavior in the corresponding receiving water bodies.
Keywords: NUCLEAR POWER PLANTS; RADIOACTIVE EFFLUENTS; TRANSURANIUM ELEMENTS; RADIOECOLOGICAL CONCENTRATION; RADIATION MONITORING; WATER POLLUTION; RADIONUCLIDE MIGRATION; RADIONUCLIDE KINETICS; ENVIRONMENTAL IMPACTS.

150419 Fate of Radionuclides in Estuaries. Goldberg, E.D. (Scripps Institution of Oceanography, La Jolla, CA). **Project number:** B6154. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$1,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

Transuranic elements, radionuclides, and other heavy metals released to the aqueous environment from nuclear fuel cycle facilities need to be carefully monitored to assess their environmental impact and fate. The benefit of baseline data at and in the surrounding environs of the Barnwell Nuclear Fuel Plant is important where contentions arise which imply that all existing measurements have inaccurately assessed the quantities, location, and fate of transuranics and heavy metals in the estuarine waters surrounding the site. The purpose of this research is to: (1) provide a history of plutonium entry into the Savannah River estuary system as recorded in the sediments and to compare the plutonium concentration levels with estimated plant discharges and with atmospheric fallout values; and (2) to evaluate the role of marsh grasses in regulating the behavior of heavy metals, including plutonium, in an estuarine system.

Keywords: WATER POLLUTION; BARNWELL FUEL PROCESSING PLANT; SEDIMENTS; MONITORING; SAVANNAH RIVER; RADIONUCLIDE MIGRATION; PLUTONIUM 238; PLUTONIUM 239; PLUTONIUM 240; GRASS; CHEMICAL ANALYSIS; FALLOUT; LEAD; COPPER; ZINC; COBALT; CHROMIUM; MANGANESE; ALUMINIUM; NITROGEN; VANADIUM; ARSENIC; SELENIUM.

150420 Assessment of Agricultural Land in Relation to Power Plant Siting and Cooling System Selection. Odum, H.T. (University of Florida, Gainesville, FL). **Project number:** B6155. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$8,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Integrated assessment; Ecological/biological processes and effects.

The NRC requires a comprehensive land-use assessment methodology. The study will be directed toward refining a methodology for net energy analysis as a quantitative means for assessing natural resources and land use. In particular, the study will be based on energy quality and flow and will be designed to aid in making land use decisions which involve choice of sites and alternate modes for cooling systems. The results of the study will be used by NRC staff to establish decision criteria in the selection of alternative cooling systems and in evaluating the impact on agricultural productivity.
Keywords: LAND USE; SITE SELECTION; NET ENERGY; NUCLEAR POWER PLANTS; AGRICULTURE; COOLING SYSTEMS; EVALUATION; ENVIRONMENTAL IMPACTS.

150421 Land Use and Land Value Changes Over Time in the Vicinity of a Nuclear Electric Generating Plant. Gamble, H.B. (Pennsylvania State University, Shenango Valley, PA). **Project number:** B6173. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$21,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring.

The objectives are to: (1) examine and document the shifts in land use that took place over time, from pre-installation to the present, in the vicinity of a nuclear electric generating plant; (2) determine, both separately and jointly, the net effects of a nuclear plant on real property values; and (3) determine real property value changes in the vicinity of several proposed nuclear generating plants where the sites have been acquired but the facilities not yet constructed.
Keywords: NUCLEAR POWER PLANTS; SITE SELECTION; LAND USE; PROPERTY VALUES; SOCIO-ECONOMIC FACTORS.

150422 Burial Ground Site Survey: Kentucky. Fry, R.M. (State of Kentucky, Maxey Flats, KY). **Project number:** B6192. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$408,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is a careful and concise analysis of those parameters which accurately describe the status of the shallow land burial site at Maxey Flats, Kentucky, with respect to its long-term viability and safety. The first task (Task 0) will provide a topographic contour map of the burial ground site which will be developed by the use of aerial photogranmetry and ground surveying techniques. It will also provide the establishment of a site grid for use in coordination of sample and measurement locations. Task 1, Water and Mass Balance, shall include five subtasks covering the emplacement of four continuous operating flow meters and samples for surface runoff measurements, the collection of twelve sediment samples from the stream bed of Rock Lick Creek, the installation of three secondary flow measuring devices for channel runoff measurements, collectionf eight sediment samples from runoff channels, and the setting of four precipitation stations. Task 3, Atmospheric Studies, consists of determining airborne emissions from the site through analysis of the radionuclide components of air samples and their contribution to surface contamination. A precise determination of the evaporator stock effluent contribution will be made. Task 5, Trench Studies, includes the study of effluents from four selected trenches for their contribution of off-site contamination. Gas generation and leachate chemistry will be analyzed in a manner complementary to the work underway by the Brookhaven National Laboratory.
Keywords: RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; KENTUCKY; RADIATION MONITORING; SEDIMENTS; GROUND WATER; RADIOACTIVE WASTE MANAGEMENT; SURFACE WATERS.

150423 Sensitivity Testing of Certain Aerial Photographic Techniques. Shipley, B.L. (INTERCOMP Resource Development and Engineering Inc., Houston, TX). **Project number:** B6205. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$59,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

The objectives are to: (1) determine the effectiveness of remote sensing techniques for detecting vegetative stress in the vicinity of operating salt water cooling towers; (2) establish sensitivity by correlating the results of aerial photography with ground based monitoring programs and with the predictions of drift dispersion models; and (3) develop and recommend applied remote sensing programs that could be used routinely to replace all or part of the field surveys currently being used to monitor vegetative stress around cooling towers.
Keywords: PLANTS; BIOLOGICAL STRESS; TOLERANCE; SALINITY; BRINES; COOLING TOWERS; ENVIRONMENTAL IMPACTS; AIR POLLUTION; MONITORING.

150424 Chlorine and Ammonia in Marine Waters. Inman, G.W. Jr.; Johnson, D.J. (University of North Carolina, Chapel Hill, NC). **Project number:** B6248. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$110,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objectives are: (1) to understand the chemical nature and lifetime of compounds formed when chlorine is added to marine waters containing ammonia; (2) to understand how the presence of naturally occurring bromine in marine waters effects the nature of the by-products formed when chlorine is added to marine water containing ammonia; (3) to provide information on alternative approaches to using chlorine for bifoulant control in main condenser cooling systems; (4) to provide quantitative data which could be used as input to mathematical models to predict the concentrations and lifetimes of chlorine by-products discharged to marine waters from nuclear power plants; and (5) to provide an understanding of chlorine demand in receiving water bodies.
Keywords: CHLORINE; AMMONIA; SEAWATER; BROMINE; CHEMICAL REACTIONS; COOLING SYSTEMS; MATHEMATICAL MODELS; NUCLEAR POWER PLANTS; ENVIRONMENTAL EFFECTS.

150425 Evaluation of Entrainment Effects Using a Power Plant Condenser Tube Simulator. Chezar, B.; O'Connor, J.M. (New York State Energy Research and Development Authority, New York, NY). **Project number:** B6298. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$90,000.
Related energy source: nuclear fission(100). **R and D categories:** Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are: (1) to use a moveable condenser tube simulator to examine the response of entrainable aquatic organisms to physical (thermal, hydraulic and mechanical) and chemical stresses associated with the pumpted entrainment process; (2) to provide statistically reliable estimates of mortalities and sublethal effects resulting from the physical and chemical stresses of the entrainment process; (3) 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 (condenser decompression, delta-T, and biocide injection rates to condenser cooling systems); and to determine the significance of entrainment effects as a siting constraint in NRC's licensing process.
Keywords: ENTRAINMENT; AQUATIC ECOSYSTEMS; MORTALITY; COOLING SYSTEMS; ENVIRONMENTAL EFFECTS; VERPLANCK-1 REACTOR; VERPLANCK-2 REACTOR; THERMAL EFFLUENTS; PRESSURE DEPENDENCE; TEMPERATURE EFFECTS; FLUID FLOW; CHLORINE; CONDENSERS; SIMULATION.

150426 Bulk Properties of Radwaste Glass. Litovitz, T. (Catholic University, Washington, DC). **Project number:** B6330. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$95,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

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) t development of tests for chemical durability of glasses and ceram that are generally applicable for predicting radwaste container lo gevity.
Keywords: RADIOACTIVE WASTE DISPOSAL; GLASS; CERAMICS; STABILITY; SOLIDIFICATION; RADIOACTIVE WASTE MANAGEMENT; MATERIALS.

150427 Indirect Rock Mass Investigations. Glass, C.E. (University of Arizona, Department of Mining and Geological Engineering, Tucson, AZ, 85721). **Project number:** B6337. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety Research. **Funding:** NRC-$153,000.
Related energy source: nuclear fusion(100). **R and D categories:** Operational safety; Environmental control technology.

The objective is to maximize the utilization of non-intrusive rock mass investigations by developing guidelines, performance standards and necessary controls as part of site licensing prerequisites. The research will consist of two phases initially with implementation of a third phase at some later date. Phase I will undertake the identification of existing geophysical techniques for non-intrusive field studies of rock masses and judge the techniques in terms of rock mass properties measured, effectiveness of measurement and the effective range of the technique from the surface, borehole or tunnel. A theoretical framework will be developed for interpretation of field tests. Predictability functions in terms of site parameters will be established to determine the amount of allowable drilling, optimum number and location of boreholes, etc. Phase II will involve in-situ field tests utilizing the most promising methods. The field work should be undertaken at the WIPP site if possible, but at a mutually agreed upon site that is geologically similar if the WIPP site is unavailable. The field investigations may involve subcontractors possessing unique capabilities, but the principal investigator shall be responsible for the interpretation of the geological, hydrological and geotechnical information.
Keywords: ROCKS; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; GEOLOGIC DEPOSITS; SITE SELECTION; ROCK MECHANICS; ROCK DRILLING.

150428 Mobility of Radioactive Waste Materials in Subsurface Migration by Particulate Transport. Eicholtz, G.G. (Georgia Institute of Technology, Atlanta, GA). **Project number:** B6338. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$119,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Ecological/biological processes and effects.

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: RADIOACTIVE WASTES; RADIONUCLIDE MIGRATION; UNDERGROUND; PARTICLES; AEROSOLS; AQUIFERS; RADIOACTIVITY; PARTICLE SIZE. .

150429 Thermal Stresses in Waste Disposal Systems. Martin, D.M. (Iowa State University, Ames, IA, 50312). **Project number:** B6340. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$155,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology.

The objective is to develop reliable analytical and experimental means of predicting thermal stress and the extent of fracture in glass/cannister nuclear waste disposal systems and identify procedures, specifications and criteria for use in developing waste management standards. The work will develop in three phases which are: (1) analytical modeling of macroscopic and microscopic stresses arising from thermal and radiation fields; (2) experimental determination of macroscopic thermal stresses and fracture in glass/cannister systems; and (3) experimental determination of microscopic thermal stresses and fracture in glass matrix/devitrification crystal systems. The three phases will merge into the prediction and experimental evaluation of microscopic and macroscopic stress and fracture in model nuclear waste/container systems. The nuclear waste container system will be scaled. The temperature profile history will be modeled by approximate methods. The detection of fracture will be done by acoustic emission and optical techniques. Stresses will be evaluated by photoelastic techniques and strain gages. A number of techniques will be explored for measuring surface area increase due to fracture. Cooperative testing of large-scale glass castings will possibly be arranged with other laboratories.
Keywords: RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; GLASS; CONTAINERS; THERMAL STRESSES; SOLID WASTES; FRACTURES.

150430 Migration and Retention Data from Natural and Inadvertent Repositories. Kruger, P. (Stanford University, Stanford, CA, 94305). **Project number:** B6341. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$36,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is 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. The proposed research should: (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 with 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: RADIOACTIVE WASTE DISPOSAL; GEOLOGIC DEPOSITS; UNDERGROUND DISPOSAL; CHEMICAL PROPERTIES; PHYSICAL PROPERTIES; RADIOACTIVE WASTE MANAGEMENT; RADIONUCLIDE MIGRATION; SAFETY.

150431 Subsurface Radar Profiling. Morey, R. (Geo-Centers Inc., 381 Elliott Street, Newton Upper Falls, MA, 02164). **Project number:** B-6349. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring.

The objective is to test and evaluate the use of subsurface radar as a non-intrusive investigative tool for studying the hydrogeology of the Maxey Flats Disposal Site.
Keywords: SOLID WASTES; RADIOACTIVE WASTES; RADIOACTIVE WASTE DISPOSAL; RADAR; RADIONUCLIDE MIGRATION; MONITORING; UNDERGROUND DISPOSAL; PERFORMANCE TESTING; EVALUATION; HYDROLOGY; ENVIRONMENTAL EFFECTS; GEOLOGY; SITE SELECTION.

150432 Evaluation of Relative Surface Properties of Alternative Nuclear Waste Encapsulants. Hench, L.L. (University of Florida, Gainesville, FL). **Project number:** B-6352. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$116,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective of the project is to evaluate the leaching and surface properties of solid nuclear waste encapsulants including glasses, glass-ceramics, polycrystalline ceramics, and composites.
Keywords: RADIOACTIVE WASTE DISPOSAL; ENVIRONMENTAL IMPACTS; LEACHING; RADIONUCLIDE MIGRATION; ENCAPSULATION; SOLID WASTES; SURFACE PROPERTIES; GLASS; CERAMICS; COMPOSITE MATERIALS; CHEMICAL RADIATION EFFECTS; CAPSULES; CRYSTALLIZATION; NUCLEAR ENERGY; RADIOACTIVE WASTE MANAGEMENT.

150433 Nuclear Waste Option Assessment. Wilson, R. (Harvard University, Cambridge, MA, 02138). **Project number:** B-6623. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$169,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objectives are to develop a procedure for the assessment of options for long-term disposal of nuclear waste, to undertake a comprehensive survey of proposed disposal schemes, and to establish a system of descriptors to permit decisions between alternatives. The assessment of options shall proceed with the following sequence of tasks: (1) a careful comprehensive delineation of the requirements to be met by any proposed long-term storage scheme, (2) the identification of a series of gates as part of an algorithm for assessing various options, (3) a quantitative basis for prediction of the most likely consequences associated with the selection of each option including upper and lower bounds, (4) a test of the adequacy of the statistical procedures of risk/consequence models of alternative strategies, and (5) a definition of the classes of episodes and consequences most worthy of detailed study.
Keywords: RADIOACTIVE WASTE DISPOSAL; SAFETY; RADIATION HAZARDS; TECHNOLOGY ASSESSMENT.

150434 Durability of Crystalline Nuclear Waste Forms and Their Natural Analogs at Geologic Storage Conditions. Shade, J.W. (Toledo University, Toledo, OH, 43606). **Project number:** B-6624. **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:** Environmental control technology.

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.

150435 Kinetics of Nuclear Waste/Repository Interface Reactions. Anderson, R.N. (San Jose State University, San Jose, CA, 95192). **Project number:** B-6625. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$115,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective is to confirm the interface reaction kinetics between waste/canister/rock as a function of concentration, temperature and pressure in a hypothetical high-level radioactive waste repository. The project is comprised of four tasks. Task One will establish the anticipated repository environments and define in situ temperatures and pressures with time. Task Two will study nuclear-waste/canister-materials/rock interface reactions under conditions of temperature and pressure that equal and exceed bottom hole conditions. Task Three will model the chemical and diffusional kinetics involved in nuclear-waste/canister/rock interactions. Development of the model will be based on data obtained from Task Two of this study and from the work of other investigators that are looking at the migration of nuclear materials under laboratory conditions. Task Four will use the study of the canister interface reactions to develop a basis for selection of canister materials and designs that will survive the physical and chemical environment of the repository.
Keywords: HIGH-LEVEL RADIOACTIVE WASTES; ROCKS; CONTAINERS; CHEMICAL REACTION KINETICS; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; MATERIALS; SAFETY.

150436 Thermal Conductivity of Minerals. (Cornell University, Ithaca, NY, 14850). **Project number:** B6626. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$163,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective is to measure the thermal conductivity of disordered minerals and rocks of a type associated with high-level waste repositories including the influence of ionizing radiation and elevated temperature. The program will measure the thermal conductivity of several amorphous metamict minerals provided from natural sources as a function of temperature up to temperatures comparable to that expected at high-level waste repositories. A comparison will be made with synthetic metamict solids supplied from the Battelle Pacific Northwest Laboratories. Thermal conductivity measurements will be made before and after crystallization by annealing of the metamict materials. The influence of ionizing radiation on thermal conductivity of such minerals will be studied by repeating measurements after irradiation in a Co-60 gamma-ray facility at the Oak Ridge National Laboratory.
Keywords: MINERALS; ROCKS; THERMAL CONDUCTIVITY; HIGH-LEVEL RADIOACTIVE WASTES; IONIZING RADIATIONS; TEMPERATURE EFFECTS; PHYSICAL RADIATION EFFECTS; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL.

150437 Sealing Rock Masses. Daemen, J.K. (University of Arizona, Tucson, AZ, 85721). **Project number:** B6627. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$363,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety; Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to conduct an evaluation of available technology for plugging boreholes and sealing dicontinuity planes in rock masses through a performance evaluation of sealing effectiveness by a comprehensive series of laboratory and field tests. The assessment should proceed in three steps: (1) a survey of past work, (2) laboratory confirmation of reported performance, and (3) field evaluations of reported sealing performance. The study should encompass methods for grouting using cement or chemical grouts and should consider alternative methods such as freezing and melting. Any assessment will be made in terms of suitability for utilization around HLW repositories. The laboratory part of the study should develop an efficient testing procedure for evaluating sealing techniques and the delineation of a series of standard laboratory tests that can be required as part of a licensing procedure. The field evaluations should be undertaken with near-surface and at-depth tests. The evaluation should include in-situ permeability tests, recovered core examinations and field tracing of leakage patterns. The final results should provide a technical basis for the establishment of guidelines and standards that will be used in repository design, construction and operation as well as licensing.
Keywords: ROCKS; RADIOACTIVE WASTE DISPOSAL; GEOLOGIC DEPOSITS; HIGH-LEVEL RADIOACTIVE WASTES; BOREHOLES; PLUGGING; SEALS; GROUTING; EVALUATION.

150438 Dating of Ground Water. Davis. (University of Arizona, Department of Geosciences and Department of Hydrology and Water Resources, Tucson, AZ, 85721). **Project number:** B6628. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards, Fuel Cycle and Environmental Research. **Funding:** NRC-$208,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects.

The objective is to provide critical information for relating dates of ground water to rates of movement in the vicinity of potential sites of nuclear repositories. The research will be designed to compare conventional methods of ground water dating, resolve problems of interpretation of divergent results and test selected new methods. The first stage will include collection of samples from an aquifer of simple geometry and with a known distribution of hydraulic heads. Results will be conditioned by consideration of problems of dispersion and cross-aquifer leakage. Waters from aquifers near proposed repository sites will be sampled and dated. Specific research tools will include: (1) coordination of results of this work with other funded work to estimate average water age on the basis of regional hydrogeologic data, (2) application of the late Cenozoric history method to an actual repository area if sampling can be completed, (3) dating by means of the decay of selected radionuclides, and (4) examination of the possibility of using noble gas, amino acid or uranium disequilibrium as viable tools of geochronology.
Keywords: GROUND WATER; ISOTOPE DATING; RADIOACTIVE WASTE FACILITIES; GEOCHEMISTRY; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; RADIONUCLIDE MIGRATION; RADIOACTIVE WASTE MANAGEMENT; HYDROLOGY; SITE SELECTION.

150440 Studies of the Corrosion of Nuclear Waste Containers. Wagner, J.B. (Arizona State University, Tempe, AZ). **Project number:** B-6661. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology.

The objective of the project is to perform corrosion studies on metals and alloys on candidate materials for use in the waste management program. Results will be used to estimate lifetimes and set standards for use and also to measure corrosion in environments anticipated during long-term storage.
Keywords: RADIOACTIVE WASTE DISPOSAL; CONTAINERS; RADIOACTIVE WASTE MANAGEMENT; ALLOYS; METALS; CORROSION; CHEMICAL RADIATION EFFECTS; SPENT FUEL CASKS; ENVIRONMENTAL IMPACTS.

150441 Solubility of Uraninite in Salt Brine. Holland, H.D. (Harvard University, Cambridge, MA). **Project number:** B-6662. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$99,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects.

The objective is to evaluate the solubility of uraninite in natural ore body form and as reactor fuel pellets in aqueous solution under conditions to be expected in deep geologic nuclear repositories. An ancillary objective is to study the potential for migration of the solution products formed.
Keywords: URANIUM ORES; SOLUBILITY; FUEL ELEMENTS; AQUEOUS SOLUTIONS; RADIOACTIVE WASTE DISPOSAL; UNDERGROUND DISPOSAL; NUCLEAR

FUELS; FUEL PELLETS; RADIONUCLIDE MIGRATION; URANIUM; BRINES; ENVIRONMENTAL IMPACTS.

150442 Influence of Genetic Immune Disorders and Anemia in Radiation Leukemogenesis. Shifrine, M.; Wilson, F.D. (University of California at Davis, Davis, CA). **Project number:** B6710. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Integrated assessment; Health effects; Ecological/biological processes and effects.

The basic objective is to determine if the genetic disorders producing immunological or hematological deficiencies enhance susceptibility to radiation-induced leukemia. The magnitude of these genetic factors on the latency period and total incidence to radiation induced leukemia in mice will be studied. Assays for lymphohematopoietic progenitors will be evaluated as predictors of radiation injury and leukemogenesis.
Keywords: LEUKEMOGENESIS; LEUKEMIA; RADIOINDUCTION; MICE; GENETICS; HEMIC DISEASES; BIOLOGICAL EFFECTS.

150443 Sediment and Radionuclide Transport in Rivers (Transport Modeling). Onishi, Y. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA, 99352). **Project number:** B2087. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$50,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objectives are: (1) to verify the unsteady, two-dimensional sediment and radionuclide transport model, SERATRA, by applied 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: NEW YORK; SURFACE WATERS; RADIOACTIVE WASTE DISPOSAL; RADIOACTIVE WASTE STORAGE; RADIONUCLIDE MIGRATION; SEDIMENTS; LAKE ERIE; MATHEMATICAL MODELS.

150444 Concept Code Update. (United Engineers and Constructors, Inc., Philadelphia, PA). **Project number:** B5738. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC.
Related energy source: coal(50); nuclear fission(50).

The objectives are to update and expand a generic computer code and document forecast costs of electricity generation for nuclear plants and base-load coal plants. The approach is to update the Concept Code and expand the documentation to include (1) the code and documentation for low sulfur coal, (2) the documentation for the BWR, (3) generating cost estimating code and documentation (principally fuel and operating and maintenance costs), (4) code and documentation for estimating plant startup costs such as fuel loading and testing known as front end costs, (5) code and documentation for alternative cooling system estimates, and (6) costs and documentation of scaling the 1200 MWe coal fired units to smaller units.
Keywords: COMPUTER CODES; FORECASTING; COST; ELECTRIC POWER; NUCLEAR POWER PLANTS; FOSSIL-FUEL POWER PLANTS.

150445 Source Term Evaluation: Radiopharmaceutical Manufacturing. Meinhold, C. (Brookhaven National Laboratory, Upton, NY, 11973). **Project number:** B-3207. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$100,000.
Related energy source: nuclear fission(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Ecological/biological processes and effects.

The objective is to develop verified data to support the establishment of generic ALARA guidance for the manufacture of radiopharmaceuticals. This project will provide data on the sources, volumes, physical and chemical properties of gaseous, liquid and solid radioactive effluents from the manufacture and distribution of radiopharmaceuticals. This study will include in-plant measurements of the efficiencies and costs associated with existing plant effluent control systems and determination of the cost effectiveness of additional control systems. This study will also provide information on the distribution and subsequent uptake of selected radionuclides in soil and plants in areas adjacent to operation facilities.
Keywords: RADIOPHARMACEUTICALS; PRODUCTION; INDUSTRIAL PLANTS; RADIOACTIVE WASTES; GASEOUS WASTES; SOLID WASTES; LIQUID WASTES; SOILS; PLANTS; RADIONUCLIDE MIGRATION.

150446 LOCA Analysis Verification. Charlton, T.R. (EG and G Idaho, Idaho Falls, ID, 83401). **Contract:** A6047. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. **Funding:** NRC-$1,031,000.
Related energy source: nuclear fission(100). **R and D categories:** Operational safety.

The objective is to provide an assessment of computer codes used for the calculation of primary system response of nuclear power plants during a loss of coolant accident (LOCA) by comparing computer code calculations to experimental data with emphasis upon prediction prior to test, and determination of the uncertainty of the calculation.
Keywords: BWR TYPE REACTORS; PWR TYPE REACTORS; LOSS OF COOLANT; MATHEMATICAL MODELS; COMPUTER CODES; R CODES; REACTOR SAFETY.

150505 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. **Supported by:** Nuclear Regulatory Commission, Washington, DC (USA). **Funding:** NRC-$271,000.
Related energy source: nuclear fuels(general)(100). **R and D categories:** Environmental control technology; Characterization, measurement, and monitoring; Physical and chemical processes and effects; Integrated assessment; Health effects; Ecological/biological processes and effects.

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.

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INDEXES

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INTRODUCTION

This volume contains indexes useful for accessing projects contained in the FY 1978 Federal Inventory. The indexes were generated using computer programs developed by the Department of Energy, Technical Information Center, Oak Ridge, Tenn. The three indexes are: (1) Performing organization; (2) Principal investigators; and (3) Subject, based on assigned subject terms. In each case, the index entry is followed by the project title and log number, providing easy access to the summary. There is no log number index, as the project listings are in log number order.

Each index contains a brief introduction that describes the format and content of the index. In the subject index, only the most significant subject terms were chosen for entries. The complete set of subject terms, however, is available for computer searching on the RECON system.

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In this index, projects are listed using the name of the organization or institution responsible for carrying out the research.

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SUBJECT INDEX

The subject index is based on the use of subject descriptors selected from a controlled thesaurus of terms. Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR/QUALIFIER
Project, (supplementary information), citation number.

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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☆ U. S. GOVERNMENT PRINTING OFFICE : 1980 O - 308-046 (Vol. 2)