DOE/ER-0120

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Summary Outline of DOE Geoscience and Geoscience — Related Research

Published: February 1982

NOTICE

U.S. Department of Energy
Office of Basic Energy Sciences
Geosciences Program

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Published: February 1982

U.S. Department of Energy
Office of Basic Energy Sciences
Geosciences Program
Washington, DC 20545

CONTENTS

FOREWORD

This document is being issued during a period of rapid change, both technically and organizationally, in the Department of Energy. Nevertheless, we feel that the information contained herein will be useful for those concerned with the Geosciences aspects of the U. S. Energy Program.

Research is supported principally at National Laboratories and Universities. The amount of University support during the time covered by this report was $16,000,000.

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DOE Geosciences Working Group

233-5822

1980-81

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  Area code 202 for 252 prefix

OFFICE OF BASIC ENERGY SCIENCES

The Office of Basic Energy Sciences (OBES) supports long-range, basic research in those areas of the geosciences which are relevant to the nation's energy needs. The scientific objective of the Geoscience program is to develop a quantitative and predictive understanding of geological, geophysical and geochemical structures and processes in the solid earth and in solar-terrestrial relationships. This understanding is to assure an effective knowledge base for energy resource recognition, evaluation and utilization in an environmentally acceptable manner. The work is carried out primarily in DOE laboratories and in universities, although some is conducted by other Federal agencies and by the National Academy of Sciences. Principal areas of interest include:

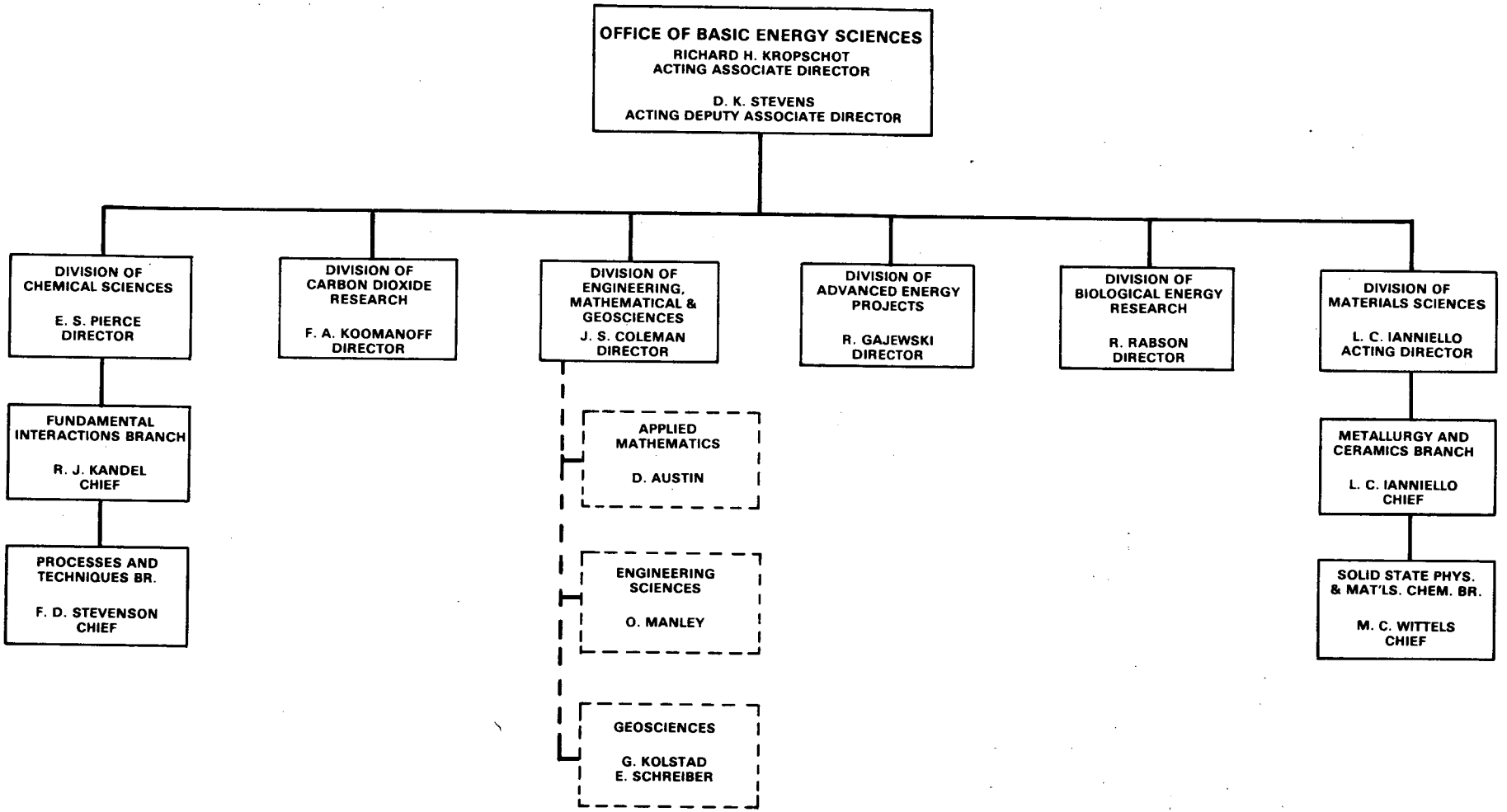
1. Geology, Geophysics and Earth Dynamics - large-scale earth movements; evolution of geologic structures; properties of earth materials, rock flow, fracture and failure; Continental Scientific Drilling Program.

2. Geochemistry - thermochemical properties of geologic materials; static rock-water interactions; organic geochemistry; geochemical migration.

3. Energy Resource Recognition, Evaluation and Utilization - resource definition and utilization; reservoir dynamics and modeling; magma energy resources.

4. Hydrologic and Marine Sciences.

5. Solar-Terrestrial/Atmospheric Interactions - magnetospheric physics and chemistry; upper atmosphere chemistry and physics; solar radiation.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OFFICE OF BASIC ENERGY SCIENCES
DOE GEOSCIENCE PROGRAM
(Operating Costs, Thousands)

LABORATORY AND EFFORT	*PRINCIPAL INVESTIGATOR(s)*	*FY 80*
ARGONNE NATIONAL LABORATORY		
Thermochemistry of Geothermal Materials	Cafasso/O'Hare	100
Trace Element Transport	Seitz/Couture	90
Migration of Heavy Element Chemical Species in Geologic Strata	Fields/Fried	50
LOS ALAMOS SCIENTIFIC NATIONAL LABORATORY		
Geophysics & Geology Base Program	Riecker	770
Continental Scientific Drilling Program - Curatorial Needs Assessment	Heiken/Goff	40
Continental Scientific Drilling Program - Comparative Site Assessment (Geology)	Goff	60
Geochemical Research	Vidale/Holley/Herrick	350
Element Migration and Fixation in Rocks	Vidale/Duffy	50
Energy Conversion & Transport in Space Plasmas	Feldman/Asbridge/Bame/Gosling	80
Study of the Electrodynamical Aspects of the Solar Wind-Magnetosphere Interaction	Hones	70
LAWRENCE BERKELEY LABORATORY		
Deep Electromagnetic Sounding of the Crust	Morrison	60
Thermodynamics of High Temperature Brines	Pitzer	105
Reservoir Dynamics	Tsang	155
Properties & Behavior of Rock-Fluid Systems	Somerton	90
Thermodynamic Properties of Silicate Liquids	Carmichael	110

OFFICE OF BASIC ENERGY SCIENCES
DOE GEOSCIENCE PROGRAM
(Operating Costs, Thousands)

LABORATORY AND EFFORT	*PRINCIPAL INVESTIGATOR(s)*	*FY 80*
LAWRENCE BERKELEY LABORATORY (CONT'D)		
Rock-Water Interactions	Apps	100
Chemical Transport in Natural Systems	Carnahan	150
Continental Scientific Drilling Program - Comparative Site Assessment (Geochemistry)	White	60
Feasibility of Shear Wave Generators for Deep Crustal Studies	Coen/Morrison	90
Aqueous Solutions Data Base	Phillips	75
LAWRENCE LIVERMORE NATIONAL LABORATORY		
Diffusion in Earth Materials	Condit/Piwinskii	70
Determination of Seismic Q With Depth	Patton/Nakanishi	170
Underground Imaging	Duba/Lytle	140
Thermodynamics, Kinetics & Transport in Aqueous Electrolyte Solutions	Miller/Rard	190
Rock Mechanics	Heuze	100
Continental Scientific Drilling Program - Information and Data Management	Howard	180
Continental Scientific Drilling Program - Comparative Site Assessment (Geophysics)	Kasameyer	60
OAK RIDGE NATIONAL LABORATORY		
Physical Chemistry of Geothermal Solutions and Materials	Mesmer/Naney	190
Investigations of Aqueous Media with Constituents of Natural Formations	Dickson	90

OFFICE OF BASIC ENERGY SCIENCES
DOE GEOSCIENCE PROGRAM
(Operating Costs, Thousands)

LABORATORY AND EFFORT	PRINCIPAL INVESTIGATOR(s)	FY 80
Insolation and Aeronomy Studies	Stokes/Michalsky/Smith/Kleckner	300
Remote Sensing: Geoscience Data Analysis Methodology	Foote/Blair	95
Trace Constituent Sorption and Migration in Geologic Media	Rai	90
Chemical Migration by Contact Metamorphism in Granite-Carbonate Rocks	Laul	80
SANDIA NATIONAL LABORATORIES--ALBUQUERQUE		
Magma Energy Research	Colp/Gerlach/Hardee	900
Continental Scientific Drilling Program--Magma Research	Luth/Hardee/Gerlach	120
Continental Scientific Drilling Program--Comparative Site Assessment (Energy Transport)	Hardee/Luth	60
Continental Scientific Drilling Program--Coordination	Jones/Hardee/Luth	25
Modeling of Geodetic Crustal Strain Data	Rundle/Passman	60
	LABORATORY TOTAL	$5575

OFFICE OF BASIC ENERGY SCIENCES
DOE GEOSCIENCE PROGRAM
(Operating Costs, Thousands)

CONTRACT RESEARCH	PRINCIPAL INVESTIGATOR(s)	FY 80
University of Alaska: Magnetic Field Annihilation Process in Magnetosphere and Some Geotechnical Applications	Akasofu	84.3
University of Alaska: Operation of a Telemetered Seismic Network on the Alaskan Peninsula	Pulpan	86.6
University of Arizona: Solar Variability Observed Through Changes in Solar Figure and Mean Density	Hill	90.6
Arizona State University: Silicate, Aluminosilicate and Borosilicate Glasses and Melts - Thermochemical Studies by High Temperature Calorimetry	Navrotsky	35
Aspen Institute for Humanistic Studies: Mechanisms for Effects of Solar Variability on Weather	Roberts	70.5
Brown University: Application of Natural Electromagnetic Field Methods	Hermance	140
University of California at Berkeley: Isotopic Studies on Rare Gases in Terrestrial Samples and in Natural Nucleosynthesis	Reynolds	144.1
University of California at Los Angeles: Relationship of Rock Physics and Petrology to Geothermal Energy Technology	Anderson/Warren	107
University of California at Los Angeles: Compressibility Measurements	Kennedy	72
University of Chicago: Depth to and Concentrations of Water in Large Bodies of Silicic Magma	Anderson	54
Columbia University: A Comprehensive Study of the Seismotectonics of the Eastern Aleutian Arc and Associated Volcanic Systems	Sykes/Jacobs/Davies	311.8
Columbia University: Rock Fracture Permeability at High Pressure and Temperature	Scholz/Engelder	140

OFFICE OF BASIC ENERGY SCIENCES
DOE GEOSCIENCE PROGRAM
(Operating Costs, Thousands)

CONTRACT RESEARCH	*PRINCIPAL INVESTIGATORS(s)*	*FY 80*
Indianapolis Center for Advanced Research: Computerized Underground Image Reconstruction	Dines	80
Massachusetts Institute of Technology: Seismology of Crack Formation in Hydraulic Rock Fracture and Natural Geothermal Environments	Aki	152
Massachusetts Institute of Technology: Microcrack Technology	Simmons	90
National Academy of Sciences/National Research Council: Studies in Geophysics	Hart	27
National Academy of Sciences/National Research Council: U. S. Geodynamics Committee	Hart	20
National Academy of Sciences/National Research Council: Continental Scientific Drilling Committee	Hart	60
National Academy of Sciences/National Research Council: Committee on Seismology	Berg	8.8
Pennsylvania State University: The Effect of Strain Rate and Stress Corrosion on Long-Term Strength of Crystalline Rocks	Martin	61.1
Rice University: Alteration of Organic Matter and Generation of Petroleum During Burial Diagenesis of Carbonate Sediments	Baker	15.6
Stanford University: Fluid Permeability, Porosity and Physical Properties of Crustal Rocks/A Study of Seismic Velocity Variations and Attenuation to Delineate Geothermal Reservoirs	Nur/Kovach	140
State University of New York at Stony Brook: Chemical Migration by Contact Metamorphism in Granite-Carbonate Rocks	Papike	59.1

OFFICE OF BASIC ENERGY SCIENCES
DOE GEOSCIENCE PROGRAM
(Operating Costs, Thousands)

CONTRACT RESEARCH	*PRINCIPAL INVESTIGATOR(s)*	*FY 80*
TEXAS A&M: Mechanical and Transport Properties of Rocks at High Temperatures and Pressures	Friedman/Carter/Johnson/Handin	208.5
University of Tulsa: Stability of Natural Gas in Deep Subsurface	Barker	NFE *
Woods Hole Oceanographic Institution: Organic Geochemistry of Continental Margin Sediments	Hunt	140.7
Yale University: Experimental Study of Opening Mode Crack Growth in Rock	Gordon	3.6
	CONTRACT RESEARCH TOTAL	$2402.8
	GRAND TOTAL	$7977.8

* No Fund Extension

CO_2 and Climate Division

Carbon dioxide research provides the scientific basis for the development of a national and global energy policy for the carbon dioxide issue through comprehensive investigation of the global carbon cylce, climate impact of carbon dioxide, environmental impacts of a climate change, societal consequences of an environmental change, and measures needed for ameliorating or adapting to the undesirable consequences from the future use of fossil fuels.

Integrated geoscience research on the CO_2 issue includes observation of atmospheric CO_2, fluxes of CO_2 among major reservoirs of the earth (atmosphere, ocean, land), and documentation of CO_2 of ice cores. The effect of CO_2 on climate is investigated with the aid of climate models and paleoclimate data. These approaches make use of geoscience data such as radiation flux, heat capacity and transport, cloud-ice-land albedo, and atmospheric circulation. Research on effects of climate change on the physical environment includes investigations of glaciology, permafrost, and ocean circulation. Integrated studies also include CO_2-induced effects on meteorology, hydrology and water resources.

GEOSCIENCE PROJECTS OF THE CARBON DIOXIDE PROGRAM
(Operating Costs, Thousands)

		FY 80	FY 81	FY 82
Lamont-Doherty Geological Observatory	Coral Growth Rings and the Temporal History of Nuclear $^{14}C/C$ and $^{90}Sr/Sr$ in the Surface Ocean	97	100	100
Geophysical Institute - Univ. of Alaska	Carbon Dioxide in Arctic and Sub-Artic Regions	202	200	200
Lamont-Doherty Geological Observatory Woods Hole Oceanographic Institution Scripps Institution of Oceanography University of Miami	North Atlantic Study of the Transient Tracers in the Ocean Program (NAS/TTO)	1099	2260	544
Argonne National Laboratory	CO_2 Flux Verification Studies	35	75	100
Scripps Institution of Oceanography	A Study of the Abundance of Carbon Dioxide in the Atmosphere and It's Exchange with the Ocean	556	2 yrs	600
University of Bern (Switzerland)	Reconstruction of the History of the Atmospheric CO_2 Content and $^{13}C/^{12}C$ Ratio by Ice Core Analysis	44	44	46
Pacific Northwest Laboratory	Atmospheric CO_2 Abundance - An Archival Study of Spectroscopic Data	242	250	275
University of Washington	Geochemical Determination of Biospheric CO_2 Fluxes to the Atmosphere	141	150	0
Lamont-Doherty Geological Observatory	Investigation of the Surface Water pCO_2 in the Equatorial Pacific Ocean	59	0	60
Lawrence Berkeley Laboratory	Determination of Atmospheric CO_2-O_2/N_2	31	0	0
Scripps Institution of Oceanography	Carbon Dioxide Measurements in the Equatorial Pacific	11	0	0
Oregon State University	Research on the Dynamics of the Climate	166	175	500
Oak Ridge National Laboratory	Global Carbon Cycles and Climatic Risks	210	215	215

		FY 80	FY 81	FY 82
Lawrence Livermore National Laboratory	Carbon Dioxide Effects Research	385	630	600
University of Michigan	A Coupled Carbon Dioxide and Water Vapor Transport Radiation Model	30	30	30
National Center for Atmospheric Research	Enhanced Research Program on the Long-Range Climatic Effects of Increasing Atmospheric CO_2	98	400	200
Brown University	Global Temperature Patterns 6000 Years Ago	212	200	160
University of East Anglia (England)	Geographical Patters of Climatic Change	59	65	65
Oregon State University	On the Increase of Total CO_2 in the World Oceans		35	35
University of Washington	Deep Ocean Tracer Release Experiment, DOTREX		10	0
Argonne National Laboratory	$^{14}CO_2$ Tracer for Fossil Fuel		95	105
New York University	Geochemical and Geophysical Models of the Fossil Fuel Carbon Dioxide Problem		136	136
Scripps Institution of Oceanography Oak Ridge National Laboratory	Development of a Laser Detection System for Argon 39 and Application to Oceanographic Mixing Studies		122	122
Lamont-Doherty Geological Observatory	Variations in Arctic Cloud Cover in Summer		52	52
Lawrence Berkeley Laboratory	The Role of the Carbonaceous Aerosol in Climate Modification		125	125
University of Arizona	Dendrochronology of Bristlecone Pine		45	45
University of Arizona	Accurate Determination of $^{13}C/^{12}C$ in CO_2 of Past Atmospheres from $^{13}C/^{12}C$ in Tree Rings By Removal of Climatic Interferences		56	56
University of Toronto (Canada)	Storage of Non-Living Organic Carbon in Boreal and Arctic Zones		46	46
Weather Service Nuclear Support Office, NOAA	Atmospheric Transport Models	45	50	50

		FY 80	FY 81	FY 82
Massachusetts Institute of Technology	Climate Fluctuations, Volcanic Aerosol and Carbon Dioxide	150	164	150
University of Miami	Climate Effects of Atmospheric Transport and Transformation of Hydrogenous Species	160	110	160
		4010	5840	4777

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH

ECOLOGICAL RESEARCH DIVISION

GEOSCIENCES RESEARCH

The Office of Health and Environmental Research supports geosciences research in the Ecological Research Division. Since 1950, OHER's mission has been to provide a knowledge base in the basic sciences; and particularly long term environmental and ecological research in all energy technologies. In the past several years, geological and hydrological research had been directed to the transformation and effects of nonnuclear pollutants within ecological systems. OHER gives priority to research on intermediate to long term effects of energy technologies on the environment; technical research that directly supports the requirements of environmental laws is conducted by other agencies.

ECOLOGICAL RESEARCH DIVISION

The objectives of geosciences research within the Ecological Research Division are development of scientific information aimed at anticipating the effects of energy technologies in natural environments, and understanding the environmental changes that result from energy development. Geosciences research in the Ecological Research Division, like other basic research in OHER, is aimed at developing a long term base of knowledge about the effects of new and emerging energy technologies and future energy development. The results of scientific research in the geosciences have proven useful to diverse groups within the Department of Energy in the solution of intermediate and long term energy issues; other groups including the Department of Interior, National Academy of Sciences, and numerous State agencies commonly draw upon the Division's geosciences publications in nuclear, coal, and other energy sources.

Division projects are interdisciplinary in content; research projects commonly involve the disciplines of geology, ecology, hydrology, marine sciences, chemistry, and biology. Geosciences research is rarely conducted in isolation from other disciplines. For example, the marine environment is the ultimate receiving system for energy wastes; understanding the assimilative capacity of the marine environment might require research in marine processes and the geochemistry of continental shelf sediments.

This interdisciplinary research approach means that geosciences funds are distributed within multidisciplinary research projects; research funds apportioned to geosciences research are detailed in Table I. Geosciences research that is less than 5% of total funding is not detailed; this additional research commitment to geosciences is estimated to be $100,000.

Approximately 20% of all research in the Ecological Research Division involves physical oceanography, geology, geochemistry, and hydrology. Additional geological and hydrological research related to the effects of energy-solid waste disposal is expected in FY 82 and FY 83. Aerial and satellite remote sensing is a potentially important research method for ecological studies; it will be tested more extensively in the future to predict and evaluate the long term regional effects of energy technologies on terrestrial ecosystems.

Principal areas of geosciences activity include:

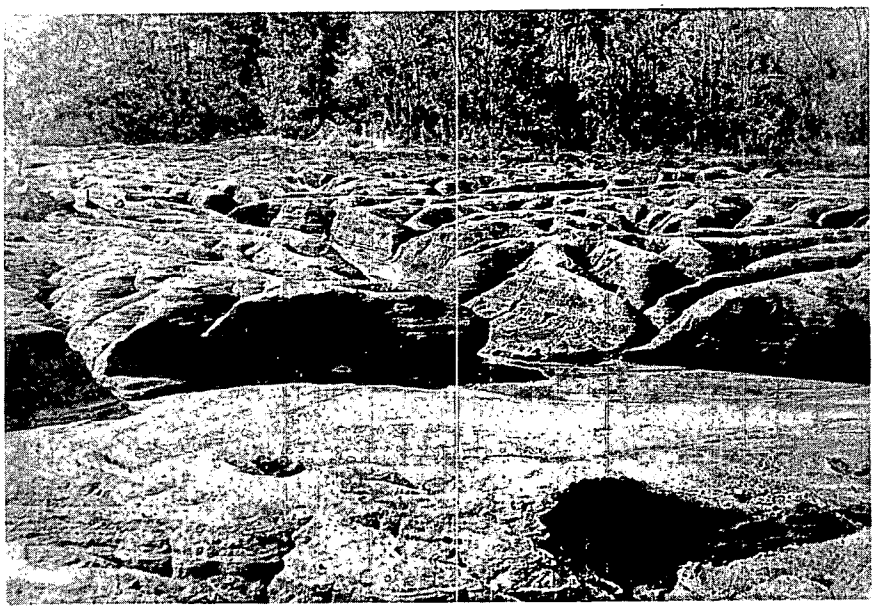
1. Physical Oceanography - including mixing and circulation of water, distribution of radionuclides and other energy contaminants in ocean water and sediments, the assimilative capacity of marine sediments, marine sediment transport and trace metal studies in the marine environment.

2. Cycling of radionuclides - including research in marine geochemistry and freshwater systems and the transport and movement of radionuclides.

3. Ecosystem modelling - including surface and groundwater systems as receptors of energy pollutants; transport of energy residuals in surface waters; stream and estuarine sedimentation and the hydrology of disturbed lands.

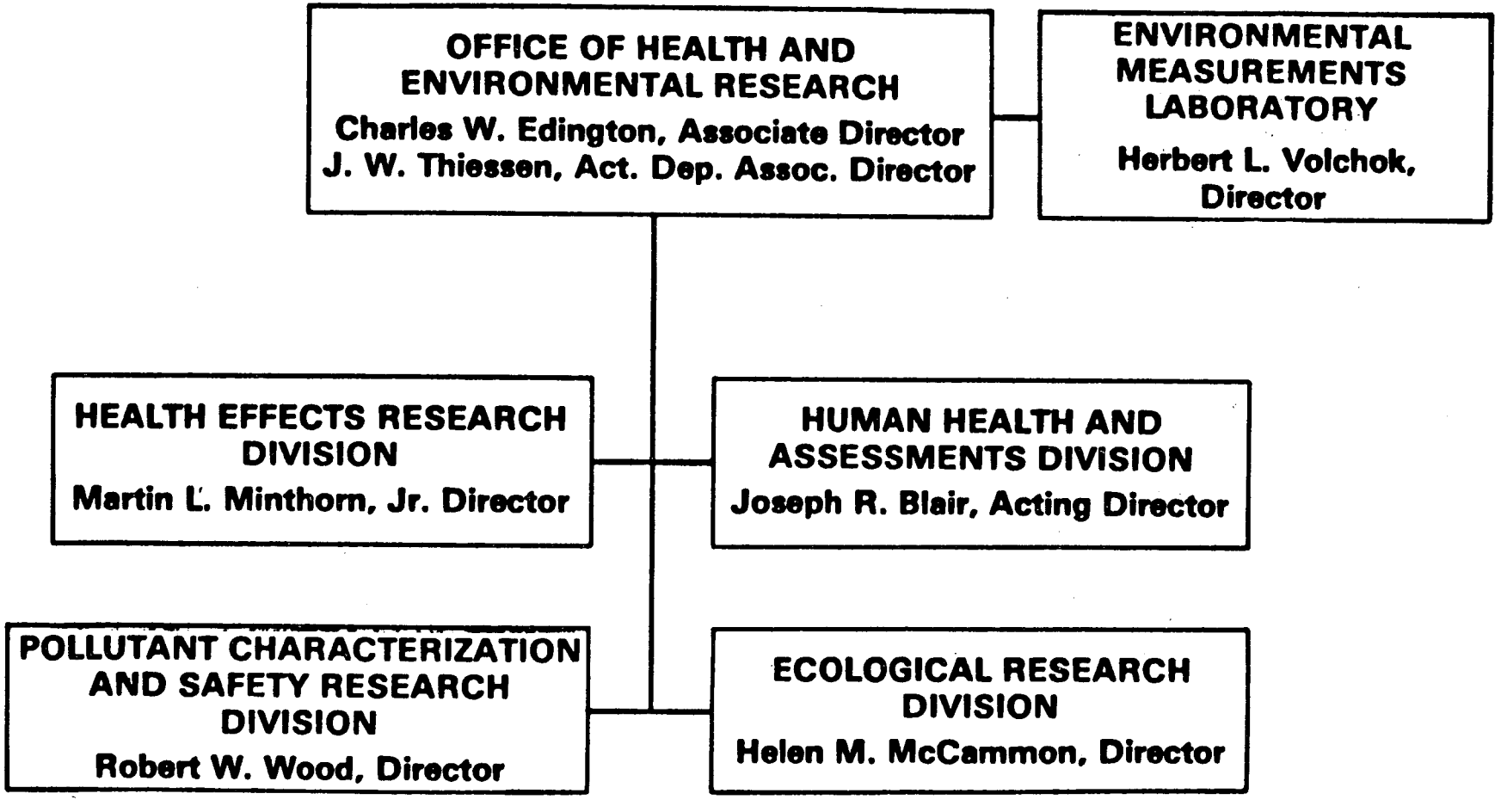
4. Ecological effects of land disturbances, including disposal of energy residuals - the hydrology of disturbed lands, reclamation, soils and sedimentation investigations, geochemistry, and ecological impacts.

Two multidisciplinary research planning activities were completed in FY 80-FY 81; a research plan, Solid Wastes from Energy-Producing Technologies (1980) and Status of Health and Environmental Research Related to Solid Wastes from Coal Conversion (1981).



Coal waste disposal site in southern Indiana. Laboratory and field research are carried out at sites such as this one. Long term research related to regional disposal of energy wastes, stabilization and reclamation of waste sites, the mobilization and transport of leachates into groundwater systems, and sedimentation are among the geosciences questions being examined with OHER.

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH



OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
PROGRAM ORGANIZATION

HUMAN HEALTH AND ASSESSMENTS

HUMAN HEALTH EFFECTS FROM ENERGY GENERATION

OCCUPATIONAL HEALTH AND MEDICAL RESEARCH

BIOMEDICAL APPLICATIONS

ENVIRONMENTAL ASSESSMENTS

HEALTH ASSESSMENTS

HEALTH EFFECTS RESEARCH

CARCINOGENESIS

MUTAGENESIS

SYSTEMS DAMAGE (TOXICOLOGY)

GENERAL LIFE SCIENCES

ECOLOGICAL RESEARCH

TRANSPORT AND CONVERSION OF ENERGY-RELATED POLLUTANTS IN TERRESTRIAL & AQUATIC ECOSYSTEMS

EFFECTS OF ENERGY-RELATED PROCESSES AND POLLUTANTS

FUNDAMENTAL ENVIRONMENTAL PROCESSES

POLLUTANT CHARACTERIZATION AND SAFETY RESEARCH

ANALYTICAL CHARACTERIZATION

ATMOSPHERIC TRANSPORT AND TRANSFORMATION

PHYSICS & CHEMISTRY OF POLLUTANT INTERACTIONS

MEASUREMENT SCIENCE

OCCUPATIONAL HEALTH AND SAFETY

EFFECTS OF CLIMATE VARIATION ON THE ENERGY SYSTEM

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
ECOLOGICAL RESEARCH DIVISION
GEOSCIENCES RELATED RESEARCH

PHYSICAL OCEANOGRAPHY

Laboratory/Contractor	Principal Investigator	FY 1980 ($000) *
Columbia University, Transport and Transfer Rates in the Waters of the Continental Shelf.	P. Biscaye	(364)
U. of Washington, Pollutant Transport and Sediment Dispersal in the Washington-Oregon Coastal Zone.	B. Hickey	(158)
U. of Miami, Shelf Circulation in the South Atlantic Bight.	T. Lee	(163)
Woods Hole Oceanographic Institution, Coastal-Shelf Transport and Diffusion.	G. Csanady	(162)
Skidaway Inst. of Oceanography, Nearshore Transport Processes Affecting the Dilution and Fate of Energy-Related Contaminants.	J. Blanton	(67)
Skidaway Inst. of Oceanography, Continental Shelf Processes Affecting the Oceanography of the South Atlantic Bight.	L. Atkinson	(124)
North Carolina State U., Continental Shelf Processes Effecting the Oceanography of the South Atlantic Bight.	L. Pietrafesa	(138)
Brookhaven National Laboratory, Coastal Transport & Diffusion.	T. Hopkins	(260)
	*Estimated Total	1436

Geosciences research component is listed.

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
ECOLOGICAL RESEARCH DIVISION
GEOSCIENCES RELATED RESEARCH

CYCLING OF RADIONUCLIDES

Laboratory/Contractor	Principal Investigator	FY 1980 ($000)
Lawrence Livermore Laboratory, Hydrogeochemistry of Enewetak Studies on Aquifers.	Buddemeier	(70)
Savannah River Laboratory, Distribution and Movement of Plutonium on Sedimentary Particles in the Savannah River and its Estuary.	Hayes	(280)
Texas A & M, Geochemical Behavior of Uranium and Plutonium in the Mississippi and Rio Grande River Estuaries.	Scott	(90)
Columbia University, Plutonium, Cesium and Uranium Transport and Distribution on Sediments in the Hudson River, its Watershed and Estuary.	Simpson	(70)
Oregon State University, Cycling of Transuranic Radionuclides and Technetium in the Columbia River, its Estuary and the Coastal Shelf.	Beasley	(212)
U. of Wisconsin, Chemical Attenuation of Solutes.	Anderson	(92)
Yale University, The Fate of Nuclides in Natural Water Systems.	K. Turekian	(91)
ORNL, Radionuclide Sources in the Coastal Zone.	Cutshall	(100)
U. of Washington, Chemical and Geochemical Studies off the Coast of Washington.	R. Carpenter	(68)
U. of Alaska, Transport and Reaction of Heavy Metals in Alaskan Fjord estuaries.	D. Burrell	(44)

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
ECOLOGICAL RESEARCH DIVISION
GEOSCIENCES RELATED RESEARCH

CYCLING OF RADIONUCLIDES, continued.

Laboratory/Contractor	Principal Investigator	FY 1980 ($000)
U. of California, Marine Geochemistry Research.	E. Goldberg	(75)
Woods Hole Oceanographic Institution, The Distribution of Some Chemical Elements Between Dissolved and Particulate Phases in the Ocean.	D. Spencer	(112)
Woods Hole Oceanographic Institution, Radioelement Studies in the Ocean.	V. Bowen	(356)
U. of California, Fluxes of Biogenic and Athropogenic Carbon Compounds in Marine Sediments.	I. Kaplan	(105)
Skidaway Inst. of Oceanography, Trace Element Geochemistry of the South Atlantic Bight.	H. Windom	(103)
Scripps Oceanographic Inst., Marine Geochemistry Research Using Fallout Radionuclides as Tracers.	Goldberg	(80)
	Estimated Total	1950

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
ECOLOGICAL RESEARCH DIVISION
GEOSCIENCES RELATED RESEARCH

ECOSYSTEMS MODELLING

Laboratory/Contractor	Principal Investigator	FY 1980 ($000)
PNL, Terrestrial Effects of Oil Shale.	Wildung	(150)
U. of Colorado, Oil Shale Environmental Program.	Chappell	(100)
PNL, Study of the Movement and Chemical Speciation of Radionuclides in Alluvial Groundwater Flow.	Robertson	(80)
New Mexico Institute of Mining and Technology, Radon Transport Processes in Underground Mines and Soil Matrices.	Wilkening	(56)
Johns Hopkins University, Biogeochemistry of Trace Metals in Chesapeake Bay.	J. Gavis	(48)
Los Alamos Scientific Laboratory, Erosion and Transport of Soil Particles by Intermittent Streams.	Hakonson	(250)
	Estimated Total	700

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
ECOLOGICAL RESEARCH DIVISION
GEOSCIENCES RELATED RESEARCH

ECOLOGICAL EFFECTS OF LAND DISTURBANCES, INCLUDING RECLAMATION AND DISPOSAL OF WASTES FROM ENERGY SOURCES.

Laboratory/Contractor	Principal Investigator	FY 1980 ($000)
University of Notre Dame, Hydrological and Chemical Modeling.	Theis	(85)
PNL, Restoration of Surface Mined Land.	Sauer	(100)
U. of Tennessee, Ecological and hydrological Aspects of Coal Mining.	Minear	(100)
Oak Ridge National Laboratory, Mobilization and Transport of Leachates from Energy Solid Wastes.		(400)
Colorado State University, Rehabilitation Potential of Oil Shale Lands.	Cook	(200)
Argonne National Laboratory, Long Term Reclamation of lands Mined for Coal, and hydrological effects.	Carter	(1200)
	Estimated Total	(2100)

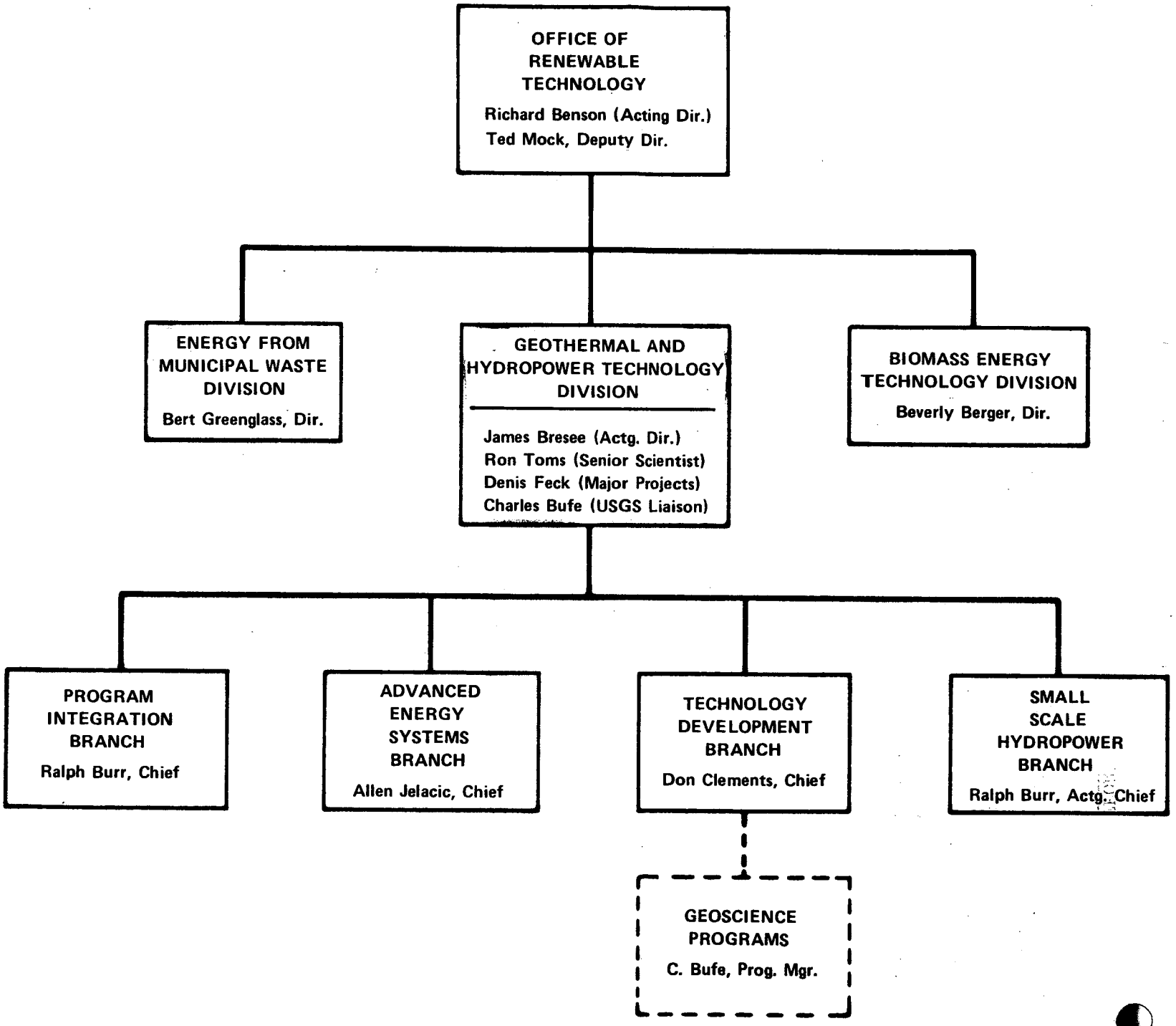
Office of Energy Systems Research
Division of Energy Storage Technology
Geosciences Related Projects
(Operating Costs, Thousands)

Laboratory and Effort	Principal Investigator(s)	FY80
Battelle PNL		
Air/Water/Rock Interactions with Compressed Air	Stottlemeyer	299
Field Studies of Porous Rock Reservoirs	Rudd/Allen	548
Aquifer Storage Program Environmental Assessment	Wukelic	95
Aquifer Thermal Storage Physiochemical Analysis	Stottlemeyer	66
Aquifer Thermal Storage Numerical Simulations	Kincaid	65
Oak Ridge National Laboratory		
Aquifer Storage Program Environmental Assessment	Lee	60
Lawrence Berkeley Laboratory		
Aquifer Mathematical Studies	Tsang	235

Contract Research	Principal Investigator(s)	FY80
Serata Geomechanics, Inc Numerical Modeling of Salt Caverns for Compressed Air	Serata	71
Louisiana State University Laboratory Tests of Salt Specimens for Compressed Air	Thoms	160
RE/SPEC, Inc Numerical Studies of Rock Caverns for Compressed Air	Fossum	138
Auburn Univeristy Field Studies of Aquifer Thermal Storage	Molz/Parr/Melville	500
Century West Engineering Regional Aquifer Assessment Study	Stoffel	38
Oregon State University Coupled Energy and Mass Transportation in Geologic Media	Childs	44

Office of Renewable Technology
Division of Geothermal and Hydropower Technology

The purpose of the Department of Energy's geothermal program is to support the development and utilization of the Nation's geothermal resources as an economical, reliable, operationally safe, and environmentally acceptable energy source. This is accomplished through a comprehensive effort to develop new technologies that will promote more efficient and economical use of hydrothermal, geo-pressured, and hot dry rock resources. The program is carried out by the DOE national laboratories, Federal and State governmental agencies, universities, and private contractors.


OFFICE OF RENEWABLE TECHNOLOGY
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Ted Mock, Deputy Dir.
ENERGY FROM MUNICIPAL WASTE DIVISION
Bert Greenglass, Dir.
GEOTHERMAL AND HYDROPOWER TECHNOLOGY DIVISION
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SMALL SCALE HYDROPOWER BRANCH
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GEOSCIENCE PROGRAMS
C. Bufe, Prog. Mgr.

Division of Geothermal Energy
Geosciences Related Projects
(Operating Costs, Thousands)

LABORATORY AND EFFORT	PRINCIPAL INVESTIGATORS	FY 80
LAWRENCE BERKELEY LABORATORY		
Cerro Prieto Reservoir Case Study	Lippmann	500
Exploration Technology Development	Goldstein	424
Reservoir Engineering Management	Howard	100
Reservoir Engineering	Tsang	525
Controlled Electromagnetic Surveys	Goldstein	100
Resistivity and Magnetic Surveys at Cerro Prieto	Goldstein	71
LAWRENCE LIVERMORE NATIONAL LABORATORY		
Tidal Pressure Response as a Reservoir Engineering Tool	Hanson	140
LOS ALAMOS NATIONAL LABORATORY		
Log Interpretation	Mathews	390
Arizona-New Mexico Low Temperature Resource Assessment	Laughlin	125
SANDIA NATIONAL LABORATORY		
Geothermal Well Logging Development	Veneruso	956

Division of Geothermal Energy
DOE Geosciences Program
(Operating Costs, Thousands)

CONTRACT RESEARCH	PRINCIPAL INVESTIGATOR(s)	FY 80
University of Alaska/State of Alaska, Department of Natural Resources: Geothermal Assessment in Alaska	Turner/Schaff	200
Amax Exploration, Inc: Geothermal Reservoir Assessment	Olsen	423
Amherst College: Survey of the Geothermal Potential of New England	Brophy	65.4
Aminoil USA, Inc: Geothermal Reservoir Case Study	Jenkins	559
State of Arizona, Bureau of Geology and Mineral Technology: Low and Moderate Temperature Geothermal Evaluation	Hahman	300
Barringer Research, Inc: The Application of Soil Geochemistry to Exploration for Concealed Geothermal Fields	Meyers	94.4
State of California, Division of Mines and Geology: Geothermal Assessment and Reservoir Definition in California	Martin	250
University of California, Riverside: Application of Petrology and Geochemistry to the Study of Geothermal Reservoirs	Elders	181
Chevron Resources Co: Geothermal Reservoir Assessment Case Study	Dahlstrom	150
Colorado Geological Survey: Geothermal Assessment and Reservoir Definition in Colorado	Pearl	200
Earth Sciences, Inc: Sulfur Gas Geochemical Detection of Hydrothermal Systems	Rouse	70.5

Electro Magnetic Applications, Inc: A Study of the Characterization and Elimination of Cultural Noise in Active Source EM Surveys	Merewether	39.7
Environmental Research Institute of Michigan: Simultaneous Analysis of Multiple Data Sets	Jackson	94.2
Fenix and Scisson:Geothermal Drilling on Mt. Hood		1,787
Gruy Federal, Inc: Support for DOE's Hydrothermal Resource Program	Renner	185
University of Hawaii: Geothermal Assessment and Reservoir Definition in Hawaii	Helsey	150
Idaho Department of Water Resources: Geothermal Assessment and Reservoir Definition in Idaho	Mitchell	250
International Engineering Co: Geothermal Model Development Database contribution	Zurflueh	75.5
Kansas Geological Survey: Geothermal Assessment and Reservoir Definition in Kansas	Peeples	150
Lutech, Inc: Analysis of Three-Dimensional Inverse Electrical Methods	Tesche	64.5
Montana Bureau of Mines and Geology: Geothermal Assessment and Reservoir Definition in Montana	Sonderegger	225
National Oceanic and Atmospheric Administration: Geothermal Map Preparation	Theberge	284
University of Nebraska: Geothermal Assessment and Reservoir Definition in Nebraska	Carlson/Gosnold	150
Nevada Bureau of Mines and Geology: Geothermal Assessment and Reservoir Definition in Nevada	Trexler	200
New Mexico Energy Institute: Geothermal Assessment and Reservoir Definition in New Mexico	Icerman	300
University of New Mexico: Terrain Effects in Resistivity and Magnetotelluric Surveys	Jiracek	54.9

New York State Energy Research and Development Authority: State-Coupled Geothermal Energy Program	Krakow	376
North Dakota Geological Survey: Geothermal Assessment and Reservoir Definition in North Dakota	Harris	100
Oregon Department of Geology and Mineral Industry: Geothermal Assessment and Reservoir Definition in Oregon and the Cascades	Hull	526
Princeton University: Development of a Geothermal Reservoir Simulator	Pinder	50
University of Southern California: Borehole Measurements of In-Situ Velocity and Attentuation as Related to Rock Fracture Characteristics	Henyey	87.9
Stanford University: Stanford Geothermal Program	Kruger/Ramey/Miller	300
System, Science & Software, Incl: Inversion Modeling of Multiple Geophysical Data Sets for Geophysical Exploration	Savino	89.5
University of Texas at Austin: Geothermal Resource Assessment for the State of Texas	Woodruff	195
Texas Energy and Natural Resources Advisory Council: Geothermal Exploration in Trans-Pecos, Texas/New Mexico	Rao	170
U.S. Geological Survey: Heat Flow Measurements	Sass	74
U.S. Geological Survey: Low Temperature Assessment		11
U.S. Geological Survey: Seismic Profiles in The Geysers-Clear Lake Area	Iyer	47.5
U.S. Geological Survey: Computer Code Comparison	Sorey	9

U.S. Geological Survey: Imperial Valley Seismic Study	Johnson	60
Utah Geological and Mineral Survey: Geothermal Assessment and Reservoir Definition in Utah	Gwynn	200
University of Utah Research Institute: Support of the Industry-Coupled Program	Ross	700
University of Utah Research Institute Support of the State-Coupled Program	Foley	130
Vetter Research: Use of Tracers in Following Fluid Movement in Hydrothermal Reservoir	Vetter	120
Virginia Polytechnical Institute and State University: Evaluation and Targeting of Geothermal Resources in the Southeastern United States	Costain	1,597
Washington Department of Natural Resources: Geothermal Assessment and Reservoir Definition in Washington	Schuster	300
University of Wyoming: Geothermal Assessment and Reservoir Definition in Wyoming	Heasler	150

Fossil Energy
Office of Oil, Gas and Shale
Oil Division
Advanced Process Technology Branch

The goal of the Oil Division research and development program is to increase the production of oil from domestic sources by developing new and improved techniques of recovering oil from existing and potential oil reservoirs as well as non-conventional sources such as tar sand and oil shale. This program is designed to develop and evaluate advanced techniques to increase the rate of production; to recover more oil from existing reservoirs; and to develop the technology base relating to the production and use of petroleum and shale oil.

Currently, in the United States, there are 334 billion barrels of oil in place which are not recoverable through conventional recovery techniques. The research effort in the Enhanced Oil Recovery (EOR) program is designed to assist development of the technology to recover an increasing portion of this oil through new or improved methods.

The Nation's abundant western oil shale resource, equivalent to 1.8 trillion barrels, has the potential of contributing up to 600 billion barrels to our domestic oil supply using surface and in situ technologies that are currently in various stages of development. Additional shale oil may be recoverable from these shales and from the extensive but poorly-quantified eastern organic shales by potential technologies that are now in early stages of development.

The Advanced Process Technology activity supports the overall objectives of: (1) conducting advanced research in upgrading raw shale oil, heavy oil, and tar sands for transportation fuels, (2) producing and testing reference specification fuels to minimize required changes to engine design and costs, (3) investigating innovative technologies for recovering oil, gas, shale, and coal (in situ conversion) resources, (4) conducting fundamental materials and engineering research to overcome major barriers to advancing the state-of-the-art in drilling technologies in areas not pursued by industry, (5) conducting research in advanced drilling technology to include deep water and Arctic frontiers, and (6) providing engineering and advanced development support to the USGS and BLM in support of offshore and Arctic leasing and to the NSF for its OCS and deepsea drilling programs.

For the foreseeable future, the United States must rely upon fossil energy resources to supply the bulk of its energy. Drilling is an integral technology required for exploration and production of all petroleum, natural gas, coal, oil shale, and tar sand resources. Although the bulk of these domestic fuel resources are located onshore, the petroleum industry estimates that 60 to 70 percent of all additional petroleum discoveries will be made offshore on the Outer Continental Shelf (OCS). DOE estimates (1979) that in order to maintain current domestic levels of production at 10 million bbls/day, some 37 percent (20 percent oil

and 17 percent gas) of all production in 1990 must come from the OCS. Estimates of potentially producible reserves in the U.S. OCS areas include 32 billion barrels of oil and 210 trillion cubic feet of natural gas.

Development of efficient, cost-effective drilling and offshore technology can have a pronounced effect upon the pace at which both conventional and unconventional fossil fuels are produced. In some cases (e.g., methane from coal, underground coal conversion and oil/gas production from waters greater than 5,000 feet in depth), the development of new technology may determine whether a resource becomes a commercial reserve.

That part of the Oil Division's research and development related to geoscience research is focused in the Frontier Area Research branch (FAR).

The FAR research activities address the following program objectives:

- o Improve the productivity of conventional drilling systems to increase average penetration rates and thus increase the total footage drilled per year by the U.S. drilling rig fleet.
- o Develop advanced, more efficient ("revolutionary") drilling concepts for deep ocean and deep onshore applications.
- o Develop required technology to drill and produce fossil fuels from both onshore and offshore "frontier" areas:
  - very deep formations (greater than 30,000 feet)
  - deep offshore waters (greater than 5,000 feet)
  - Arctic environments
- o Reduce or eliminate any adverse health, safety and environmental impact of both new and existing technology applications.
- o Coordinate and/or provide direct research support to the Office of Oil, Gas and Shale research development programs, to related programs within DOE (Geothermal, Energy Research and Environment) and to other Federal agencies (Departments of Interior, Defense, and Commerce).

Although the program research activities are affected by both technical and nontechnical (environmental, legal and socioeconomic) constraints, there are no known technological or physical barriers to development of improved drilling and offshore technology. Definition of specific goals and objectives coupled with the dedication of adequate funds, manpower and research facilities will produce specific improvements in drilling and offshore technology.

The program is separated into these subactivities:

- o Advanced Drilling Technology
- o Offshore and Arctic Technology

The table below summarizes the funding levels by subactivity for the FY 1979 to FY 1981 period.

DRILLING AND OFFSHORE TECHNOLOGY	BUDGET AUTHORITY (DOLLARS IN THOUSANDS)		
SUBACTIVITIES	ACTUAL FY 1979	APPROPRIATION FY 1980	ESTIMATE FY 1981
ADVANCED DRILLING TECHNOLOGY	1,510	1,500	1,120
OFFSHORE & ARCTIC TECHNOLOGY	1,090	1,500	1,250
TOTAL	2,600	3,000	2,370

A transitional organizational chart for the Assistant Secretary for Fossil Energy showing the structure and location of this program is in the following page.

ADVANCED DRILLING TECHNOLOGY

A true understanding of the need to increase the national drilling capability occurs only when the following information is studied. Essentially all the Nation's drilling rig fleet has been drilling at capacity since 1974, yet imports increased from 40 to 50 percent by 1979. It is clearly evident that additional capacity in annual drilled footage is absolutely essential if domestic production rates are to be significantly increased above the normal decline rates.

Some methods to increase the annual drilled footage capacity are listed below.

1. Increase activity in drilling research that will provide increased penetration rates, reduce non-rotating time, and provide basic research for drilling associated problems.

2. Increase or develop additional rig-building capacity.

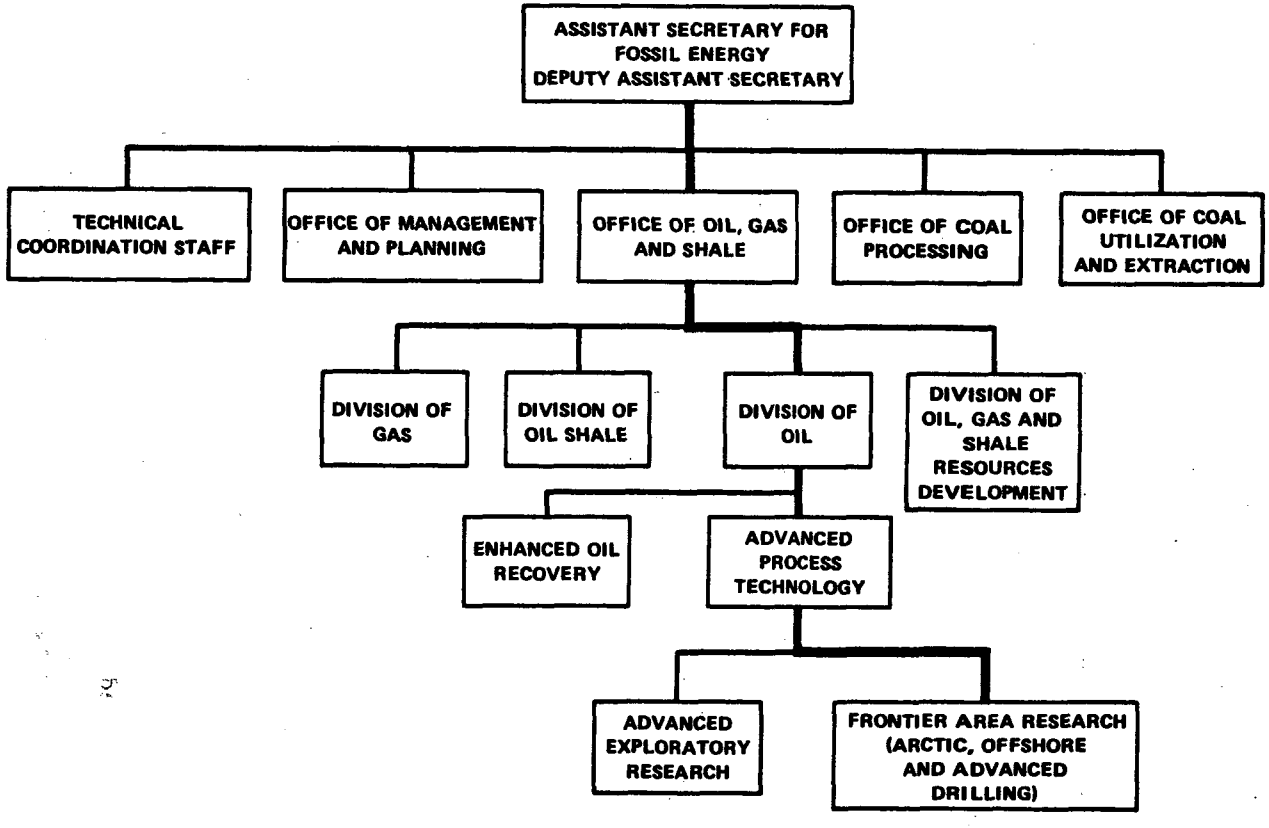
3. Induce U.S. owned rigs which are drilling in foreign countries to be returned for domestic drilling.

A short description and status of each FE FY 1981 drilling initiative follows:

Bartlesville Energy Technology Center; Sandia Laboratories

High Performance Bit Technology: This research activity is directed toward optimizing rock removal techniques and bit hydraulics performance for newly developed polycrystalline diamond compact (PDC) drag bits. This work will investigate and quantify rock removal mechanisms, hydraulic behavior, heat transfer and other dynamic characteristics of drag bits used with high-speed downhole drilling motors.

OFFICE OF THE ASSISTANT SECRETARY FOR FOSSIL ENERGY
(TRANSITIONAL ORGANIZATION)



Fluid System Investigations: This activity will evaluate and quantify cuttings removal capabilities for various drilling fluids employed in very deep (greater than 20,000 feet) and highly deviated (30 degree - 90 degree angle) directionally drilled wells. Laboratory and field experiments will be augmented by computer modeling. Hole stability and particle transport phenomena in aerated fluids also will be experimentally investigated.

Materials Research: New high-temperature, high-pressure, and corrosion resistant alloys and elastomers will be tested to determine whether they are superior and more cost-effective materials for use in coatings, fillers, strengthening agents and fabrication of equipment components.

Instrumentation Development: This activity will provide for the development of downhole and surface sensors to be used in collection and processing of data required to optimize drilling operations.

Water Jet Drilling: Research will continue on the development of high-pressure hydraulic and cavitation jet cutting techniques for drilling small diameter (less than 18-inches) boreholes. A prototype water jet drilling system (see accompanying illustration) will be field tested to assess its application in drilling horizonal holes in coal seams for methane drainage.

Directional Drilling: Inertial guidance systems (an adaptation of a cruise missile guidance system) will be evaluated as a means of controlling downhole motors for precision directional drilling. A complete systems analysis, component testing (destructive and non-destructive) and field testing of the entire guidance assembly will be conducted.

Improved Pressure-Coring System: This system is being developed to provide industry with a reliable method for obtaining a pressurized core with reduced flushing at a reasonable cost. Obtaining an unflushed core will provide more accurate reservoir saturation data which is extremely important for reservoirs being considered for enhanced oil or gas recovery.

OFFSHORE AND ARCTIC TECHNOLOGY

Offshore

This proposed offshore research program can assist industry in providing near-term relief of domestic energy deficiencies. The program can influence the rate of development of offshore oil and gas resources.

It is evident that oil and natural gas will continue to b e the dominant components of the U.S. energy mix for the remainder of this century. Informed estimates indicate that from 50 to 60 percent of our total domestic energy supply will be provided by oil and gas in the year 1990. Offshore oil and gas production provides a significant portion of our currenty domestic production. Currently 13 percent of our domestic oil and 26 percent of our domestic gas are produced from the OCS.

OCS oil and gas production will become even more important in the future. Industry estimates that the OCS will eventually provide 60 to 70 percent of all new petroleum discoveries. In addition, one-half of all domestic production must come from presently undiscovered resources by 1990 if oil production is to be maintained at 8.6 million barrels per day or increased.

Assessing such information regarding the U.S. energy situation, it is clearly evident that:

1. Oil and gas will remain the major energy source for the remainder of this century.

2. The OCS currently provides substantial amounts of oil and gas.

3. The OCS offers one of this Nation's best possibilities for new discoveries.

Therefore, there is a critical need to accelerate the development of this Nation's OCS petroleum resources to, as Secretary Edwards said during his confirmation hearings, ". . . emphasize capturing the enormous production potential of our own resources."

Arctic

There is a great lack of basic knowledge regarding drilling and producing oil and gas wells in the Arctic environment. It is ecologically dangerous to operate in such a harsh, undefined environment without adequate research knowledge. However, oil operators recognize this and operate at the maximum state-of-the-art to achieve safety and efficiency. They build structures extra-strong to compensate for the lack of basic engineering data. The dangers persist, but the benefits and production potential are tremendous and the reserves must be developed. These reserves are the most favorable source of useable "near-term" energy available to the United States.

Seventy percent of America's undiscovered recoverable offshore oil resources are estimated in the 1980 U.S. Geological Survey Circular 725 to lie within the Continental Shelf of Alaska's coast. This consists of 19 billion barrels of oil and compares with a current annual production of about 2.2 billion barrels from the contiguous states and adjacent submerged lands. Sixty percent of the Nation's undiscovered recoverable offshore gas resources also lie off Alaska's coast. These estimates are based on a 50 percent probability level.

The vast majority of Alaska offshore reserves lie beneath the waters (and ice) of the Beaufort, Chukchi, and Bering Seas. These estimated reserves have become a principal focus in this Nation's effort to reduce its dependence on foreign petroleum supplies in favor of domestic production. Commensurate with this goal, the Department of the Interior has scheduled seven initial oil and gas lease sales in these frontier areas during the period 1980 through 1985. Moreover, federal onshore petroleum development is scheduled to occur in the National Petroleum Reserve - Alaska (NPR-A).

Although possessing a significant proportion of estimated U.S. petroleum reserves, these frontier areas present severe physical and climatological conditions and pose some of the most serious technological challenges ever experienced in the field of petroleum exploration and production. It is imperative that the technology employed in the Arctic reflect the most advanced state-of-the-art possible to ensure the safe and timely availability of petroleum products.

It was in recognition of this lack of knowledge and engineering data that the Federal Government scheduled its 1985 oil and gas leasing in the Chukchi Sea . . . "contingent upon a reasonable assumption that technology will be available for exploration and development of the tracts included in the sale." Implementation of this proposed work can assist in obtaining the information needed to develop the technology.

Timely production of the Nation's domestic petroleum resources requires, therefore, that technological research in the Arctic be given high national priority. The achievement of this essential research will require the combined and complementary efforts of both the petroleum industry and those federal agencies whose missions relate to providing petroleum resources for the American public.

A short description and status of each of our FY 1981 offshore technology development initiatives follows:

o SEMS ($175K)

The Seafloor Earthquake Measurement System (SEMS) is a device for measuring the motion of soil on the seafloor during earthquakes. Three SEMS units have been fabricated. They have been installed on the seafloor in the Santa Barbara (California) channel for a one year final test program. There has been intense industry interest in this program. No other devices of this kind are available. It will have important application in the Arctic, west coast, and other earthquake prone areas of the world.

o GISP ($250K DOE; $50K USGS)

The Geotechnically Instrumented Seaflood Probe (GISP) is a pore pressure measurement device. Two prototypes have been fabricated. They were installed in the Gulf of Mexico for testing which was accomplished, after which some modifications were made at Sandia. The USGS has identified an area in the Gulf which has an extremely unstable (shifting) seafloor where the devices will be installed for further field tests. The data obtained will be used in the design and initiation plans for offshore rigs.

o Acoustic Telemetry ($220K)

This FY 1981 budget would be used to extend the range of a DOE previously developed acoustic telemetry system from its 600 ft. transmission range through water capability to a 4000' range, and increase its data transmission rate.

- Shear/Normal Force Gauge ($220K)

  The shear/normal force gauge is a new concept for measuring soil strength in situ - applicable to deep water. The project will include developing and testing a prototype instrument. Ultimately it is planned that this system will measure both pore pressure and shear strength.

- Marine Sediment Penetrometer ($150K)

  Hardware has been developed for measuring shear strength of seafloor soils, and numerous sediment penetration readings have been recorded. Work now underway includes modelling and performing detailed analysis of the data to determine shear measurement correlation data.

- Advanced Studies ($135K)

  This program is designed to conduct advanced theoretical studies and identify key parameters related to research projects that should be done.

- Arctic Technology-Advanced Studies ($68K)

  Due to estimated potential of up to 4 million barrels/day of oil production (vs 1.5 million barrels/day of current production) a program plan is being developed to define the research and development initiatives the DOE/FE must take to support rapid exploration and development of the Arctic Frontier.

UNIVERSITY CONTRACT RESEARCH AND DEVELOPMENT

Three university geoscience-related research projects are funded by this division:

- Stress Induced Fatigue Studies of Drill Pipe Immersed in Drilling Mud; University of Tulsa; 2 year

- Drill Cuttings Transport in Vertical Annuli by air, mist and/or foam; University of Tulsa; 2 year

- Analysis and Priorities for Arctic Offshore Technology Research; University of Alaska; 1 year

Division of Oil Shale

Part of the Oil Shale Program's technology base research at the Laramie Energy Technology Center includes mineralogic and Fischer Assay analysis of selected oil shale cores and drill cuttings to provide improved extrapolation of locations and quantities of oil shales that may be amenable to specific oil shale technologies that are being developed. Gross physical mineralogic description as well as x-ray mineral analysis is included. Samples are generally obtained from industrial drilling projects where available and are selected for their contribution to data gaps in the present knowledge of the resource. A core library is maintained for future reference needs. This effort is presently funded at $400K in FY 1981.

Division of Gas

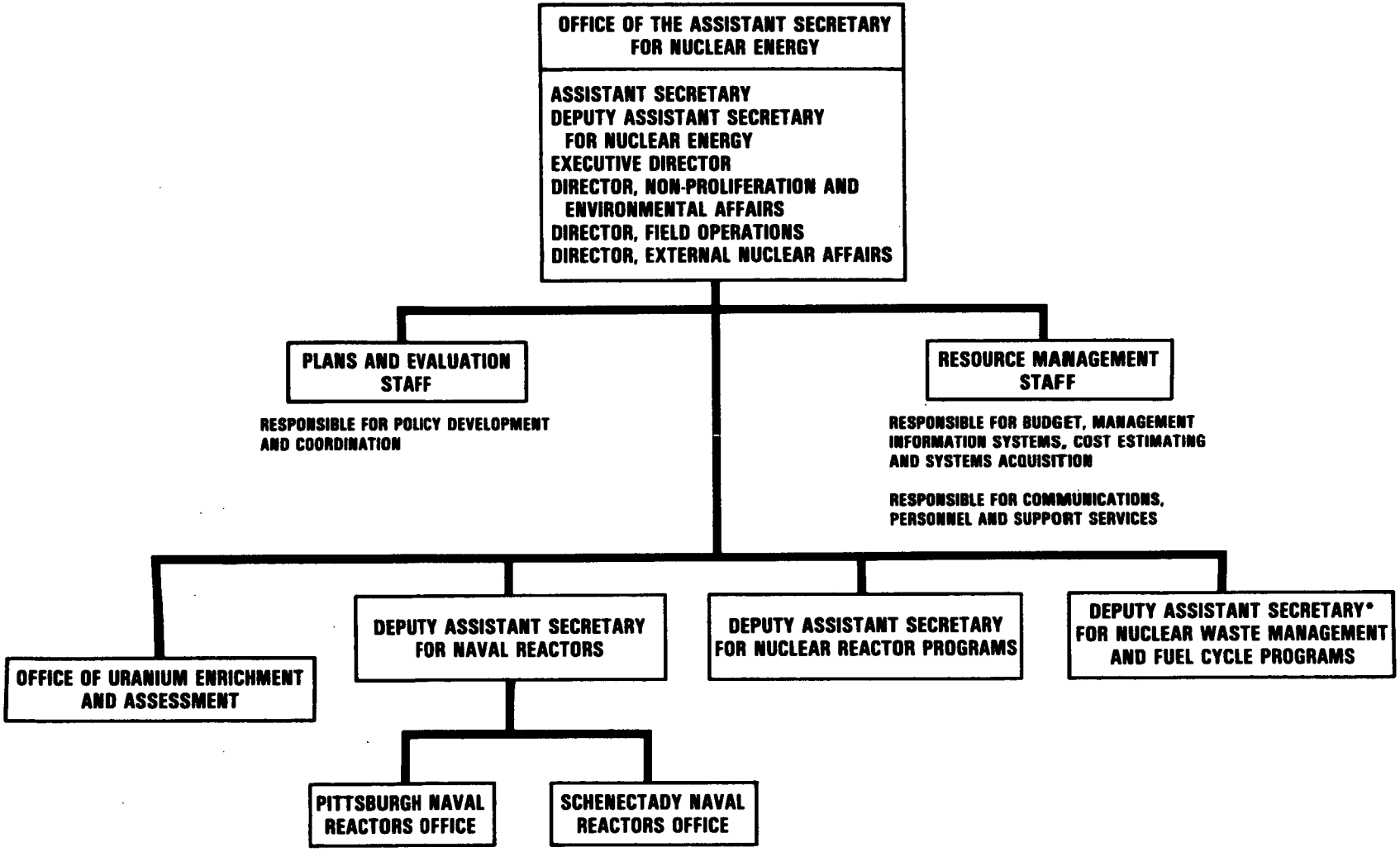
The research projects sponsored by the Office of Gas that are related to Geosciences research are, as follows:

		FY 1981
1.	TRW, Inc.	$1,222,000
	A methane from coalbeds resource delineation effort covering the entire U.S.	
2.	Colorado Geological Survey	50,000
	Evaluation of Colorado coalbed methane potential	
3.	Utah Geological and Mining Survey	50,091
	Evaluation of Utah coalbed methane potential	
4.	Lawrence Livermore Laboratory	250,000
	Fracture containment studies in relation to coalbed methane production from mineable coal seams	
5.	University of New Mexico	90,000
	Resource assessment of coalbed methane from the San Juan Basin	
6.	U.S. Geological Survey	440,000
	Geologic characterization for western tight gas sands project	
7.	CER	132,000
	Provides log analyses and gas production geologic studies for western tight gas sands project	
8.	CER Corporation	660,000
	Acquisition of core and logging data for western gas sands project	
9.	U.S. Geological Survey	660,000
	Resource and reservoir characterization for western tight gas sands	

	FY 1981
10. University of New Mexico	96,000
Development of core analysis techniques for low permeable gas reservoirs	
11. Cliffs Minerals	775,000
Collection, description, and logging of EGSP Devonian shale cores	
12. Terra Tek	600,000
Study of the interactions between fracturing fluid, proppants, and shale mineral components	
13. U.S. Geological Survey	200,000
Geological, geochemical and geophysical appraisal of energy resources of the Devonian shale in the Appalachian Basin	
14. Tetra Tech, Inc.	475,000
Assessment of shale production in dual completed wells	
15. Mound Laboratories	1,100,000
Physical and chemical characterization of Devonian shale gas	
16. Gruy Federal	740,000
. Organization and collection of data from EGSP drilling, coring, and logging operations	
. Gas well testing and analysis service in the Devonian shale	
17. West Virginia University	292,000
. Characterization and evaluation of the Devonian shales in West Virginia	
. Analyses of structural geological parameters that influence gas production from the Devonian shale of the Appalachian Basin	
. In situ stress determination based on fracture responses associated with coring operations	

	FY 1981
18. Donohue, Onstey and Morrill	1,170,000
Testing of a new exploration technique using surface measurements of seismic velocity to locate zones of natural fractures in Devonian shales	
19. Columbia Gas System Service Corporation	1,539,000
. Demonstrate the gas producing potential of the Devonian shale over a wide area in the Appalachian Basin	
. Demonstrate state-of-the-art logging and stimulation techniques in relation to different geologic and stress conditions in the Appalachian Basin	
20. Sandia National Laboratories	11,750,000
Technical and management support for the western tight gas sands multiple well experiment	

U.S. DEPARTMENT OF ENERGY



RESPONSIBLE FOR DIRECTING THE FOLLOWING:
- GASEOUS DIFFUSION ENRICHMENT
- GAS CENTRIFUGE ENRICHMENT
- ADVANCED ISOTOPE SEPARATION TECHNOLOGY DEVELOPMENT
- SALES OF URANIUM ENRICHMENT SERVICES AND RELATED PRODUCTS
- URANIUM RESOURCE ASSESSMENT
- SAFETY OF ASSIGNED NUCLEAR FACILITIES

RESPONSIBLE FOR DIRECTING THE FOLLOWING:
- NAVAL NUCLEAR PROPULSION AND ASSIGNED CIVILIAN NUCLEAR REACTOR PROGRAMS
- RESEARCH, DESIGN, DEVELOPMENT, CONSTRUCTION, OPERATION AND HEALTH AND SAFETY MATTERS PERTAINING TO PROGRAMS UNDER HIS COGNIZANCE

RESPONSIBLE FOR DIRECTING THE FOLLOWING:
- NUCLEAR REACTOR R&D
- BREEDER REACTOR SYSTEMS
- CONVERTER REACTOR SYSTEMS
- LIGHT WATER REACTORS
- SPACE NUCLEAR SYSTEMS
- THREE MILE ISLAND EXAMINATION
- SAFETY OF ASSIGNED NUCLEAR FACILITIES

RESPONSIBLE FOR DIRECTING THE FOLLOWING:
- WASTE ISOLATION ACTIVITIES
- NUCLEAR FUEL CYCLE R&D
- DEFENSE NUCLEAR WASTE
- COMMERCIAL NUCLEAR WASTE
- SAFETY OF ASSIGNED NUCLEAR FACILITIES

*REPORTS TO THE ASSISTANT SECRETARY FOR DEFENSE PROGRAMS ON ALL DEFENSE WASTE MATTERS

Title: Meteorological Studies

Performing Organization: NOAA, Air Resources Laboratory

Funding:

	FY 78	FY 79	FY 80	Planned FY 81
DOE	$250,000	$250,000	$240,000	$200,000
NRC	$220,000	$250,000	$225,000	$220,000

Summary:

This jointly-supported research project consists primarily of field measurements of 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; development of validated dispersion parameters and improved calculational models; and performance of building wake effects studies.

Title: Meteorological Effects of Thermal Energy Releases

Performing Organizations:

ORNL, PNL, ATDL (NOAA), Penn State, Rand, ANL

Funding: (NE share)

FY 78	FY 79	FY 80	Planned FY 81
$648,000	$450,000	$580,000	$400,000

Summary:

This jointly-funded (NE and EV) research project consists of the development of methods and a data base to assess the atmospheric effects of heat and moisture releases from large nuclear and fossil energy generating facilities. The atmospheric effects of interest include precipitation modification, fogging and icing, drift deposition and shadowing. Included in the program are effects from mechanical and natural draft cooling towers as well as cooling ponds. Primary emphasis is given to field studies with related analytical and physical modeling studies conducted as well. Oak Ridge National Laboratory has been carrying out a precipitation study over a several year period at the 3160 MWe Bowen Power Plant in Georgia utilizing a dense raingage network around the plant to determine to what extent normal rainfall patterns are affected by thermal emissions from natural draft cooling towers. A report of six months of storm data was published in June 1979. Battelle Pacific Northwest Laboratories are assisting Oak Ridge in field testing and in data analysis. Other efforts include: (1) an analysis of drift deposition and transport from mechanical draft cooling towers; (2) airborne measurements of velocity, temperature, and humidity in cooling tower plumes; (3) mathematical modeling to predict the occurrence of snowfall from natural draft cooling tower plumes; and (4) physical modeling of multiple plume interactions between adjacent cooling towers.

NUCLEAR WASTE ISOLATION

The National Waste Terminal Storage (NWTS) Program was established in 1976 by the Department of Energy's (DOE) predecessor agency, the Energy Research and Development Administration. The purpose of the Program is to develop the technology and provide the facilities for the safe, environmentally acceptable, permanent disposal of high-level and transuranic nuclear wastes for which the Federal Government is responsible. Although alternative concepts are being investigated (e.g., subseabed disposal), principal emphasis is directed to waste disposal by emplacement in mined repositories in deep, stable geologic formations.

The NWTS Program will be carried out in four phases: Technology Development, Engineering Development, Operations, and Decommissioning. The first phase, Technology Development, is active and includes most of the geoscience-related research. The work of this phase is being accomplished by four separate, but coordinated, projects: 1) the Office of Nuclear Waste Isolation (ONWI), 2) the Basalt Waste Isolation Project (BWIP), 3) the Nevada Nuclear Waste Storage Investigations (NNWSI) Project, and 4) the Subseabed Disposal Program. The first three projects are concerned with mined geologic disposal and are conducting work in the general areas of site evaluation and technology development, facility design, and field testing. In addition, ONWI, the lead contractor in the NWTS geologic repository development effort, has program coordination responsibilities and responsibilities for developing the criteria and technology that are generic to the design and safety assessment of mined geologic disposal systems.

With respect to evaluations of potential sites, BWIP is investigating basalt formations underlying DOE's Hanford Site in Washington State, NNWSI is investigating several different rock types underlying DOE's Nevada Test Site, and ONWI is evaluating geohydrologic systems within the contiguous United States. The ONWI siting investigations, which have historically focused on the potential of areas containing domed and bedded salt, have been expanded to include other rocks as well. The Subseabed Disposal Program is studying the technical and environmental feasibility of emplacing wastes in the sediments below the ocean floor.

Titles, objectives, and principal investigators for all NWTS geoscience research tasks are given in the following pages. The contract amounts are for the year FY 1980. The contract list covers a three year period, and hence the FY 80 amount may be different from those in FY 79 or FY 81. An FY 80 amount of 0 means that the project was funded in one of these other years.

LIST OF RESEARCH AND DEVELOPMENT CONTRACTORS PARTICIPATING IN THE EARTH SCIENCES WORK OF THE NATIONAL WASTE TERMINAL STORAGE PROGRAM (AND ABBREVIATIONS)

Agapito and Associates
Argonaut Enterprises
Argonne National Laboratory (ANL)
Battelle Columbus Laboratories (BCL)
BDM Corporation (BDM)
Boyles Brothers Drilling Co.
BSC Richland, Inc.
Bechtel
Birdwell
Brookhaven National Laboratory (BNL)
Brown, R. E.
Colorado School of Mines (CSM)
Columbia University
Corps of Engineers
Dames and Moore
D'Appolonia
Esca-Tech
Exploration Data Consultants
Falcon Corporation
Fiber Materials, Inc. (FMI)
Fugro, Incorporated
Geochron
Georesults
Georgia Institute of Technology
Gonzales, S.
Hanford Engineering Development Laboratory
Hatch Drilling Co.
INTERA Environmental Consultants (INTERA)
IRT Corporation (IRT)
J. A. Jones Construction Company
Johnson, K. S.
Law Engineering and Testing Company (LETCO)
Los Alamos Scientific Laboratories (LASL)
Los Alamos Technical Associates (LATA)
Lawrence Berkeley Laboratories (LLL)
Lehigh University
Louisiana State University (LSU)
National Bureau of Standards (NBS)
Nevada Bureau of Mines
Nevada Operation's Engineering and Drilling Contractors (NVO Support Contractors)
New Mexico Institute of Mining and Technology (NMIMT)
New York University (NYU)

Oak Ridge National Laboratory (ORNL)
Office of Nuclear Waste Isolation (ONWI)
Ohio State University (OSU)
Pacific Northwest Laboratories (PNL)
Pennsylvania State University (PSU)
Research Management Associates
RE/SPEC Incorporated (RE/SPEC)
Rockwell Hanford Operations (RHO)
Sandia Laboratories, Albuquerque (SLA)
Savannah River Laboratories (SRL)
Science Applications Incorporated (SAI)
Seismograph Service Corporation
Shannon and Wilson
South Dakota School of Mines (SDSM)
State of Idaho, Bureau of Mines and Geology
State of Oregon, Department of Geology and Mineral Industries
State of Washington, Department of Ecology and Department of Natural Resources
Stone and Webster
Terra Tek
Texas A&M University
Texas Bureau of Economic Geology (TBEG)
U.S. Geological Survey (USGS)
University of Arizona
University of California, Berkeley (UCB)
University of New Mexico (UNM)
University of Minnesota
University of Miami
University of Southern Mississippi (USM)
University of Texas, El Paso (UTEP)
University of Washington
Utah Geologic and Mineral Survey (UGMS)
Vitro Engineering Corporation
Washington State University
Waterways Experiment Station (WES)
Westinghouse Advanced Engineering Systems Division (Westinghouse AESD)
Westinghouse Electric Corporation (WEC)
Woodward-Clyde
Yale University

A. IDENTIFICATION AND EVALUATION OF POTENTIAL GEOLOGIC ENVIRONMENTS

			FY 1980 ($ 000's)
1.	TITLE:	National Screening of Geologic Environments	$ 500
	OBJECTIVE:	To identify portions of the conterminous United States with potential for waste isolation, based on a comprehensive integrated literature search of geologic and environmental data.	
	PARTICIPANT:	To be determined	
2.	TITLE:	Geologic Evaluation of the Southeastern United States	$ 40
	OBJECTIVE:	To evaluate the potential of geologic formations in the southeastern United States, especially the crystalline rocks of the Piedmont Province and argillaccous rocks of the Southeastern Coastal Plain, for the disposal of radioactive waste.	
	PARTICIPANT:	SRL; I. Wendell Marine	
3.	TITLE:	Evaluation of West Texas Bedded Salt	$ 2,500
	OBJECTIVE:	To evaluate the regional geologic and hydrologic environments of the Palo Duro and Dalhart Basins of West Texas where extensive bedded salt occurs; to assist in selecting study areas for detailed characterization; and to inventory the natural resources of the basins.	
	PARTICIPANT:	TBEG; C. R. Hanford	
4.	TITLE:	Evaluation of the Salina Salt Basin	$ 0
	OBJECTIVE:	To evaluate the regional geologic and hydrologic environment of the Salina Salt Basin, New York and Ohio, where extensive bedded salt occurs; to select study areas for detailed characterization; and to inventory the natural resources of the Salina Basin.	
	PARTICIPANTS:	J. H. Peck (Stone & Webster), S. E. Norris (USGS)	

5. TITLE: Geologic Evaluation of the Paradox Basin $ 9,600

OBJECTIVE: To conduct, in sequence, regional, area, and site investigations for purposes of identifying, characterizing, and licensing a repository in bedded salt.

PARTICIPANTS: Donald McMillan (UGMS),
Robert Hite (USGS),
Fred Conwell (Woodward-Clyde)

6. TITLE: Survey of Crystalline Rocks $ 0

OBJECTIVE: To perform a reconnaissance survey of occurrences of crystalline rocks in the United States with potential for radioactive waste isolation.

PARTICIPANT: Dames and Moore; R. M. Winar

7. TITLE: Regional Evaluation of Crystalline Intrusive Rocks $ 1,000

OBJECTIVE: To undertake a detailed literature search and analysis of a region within the contiguous 48 states to evaluate the potential for future work in areas within the study region.

PARTICIPANT: To be determined

8. TITLE: Regional Geology of the Columbia Plateau $ 1,281

OBJECTIVE: To provide support for site selection and evaluation as well as input for the Site Characterization Report, the Environmental Report, and the Draft Environmental Impact Statement. The knowledge obtained from this effort will be used to characterize the surrounding regional geology and the natural geologic events that have occurred or may occur in the future.

PARTICIPANTS: RHO; States of Oregon, Idaho, Washington; USGS; and others

9. TITLE: Repository Support Geophysics for BWIP $ 1,667

OBJECTIVE: To provide geophysical support to the development of a detailed structural and stratigraphic model of the proposed repository site. The support will include various types of geophysical surveys that will provide subsurface information at the repository site and surrounding areas.

PARTICIPANTS: RHO; Argonaut Enterprises; Seismograph Service Corporation

10. TITLE: Tectonic Studies of the Columbia Plateau $ 985

OBJECTIVE: To provide the data required for an assessment of the tectonic stability of the repository area. As part of this study, the capability of specific structures will be determined, per the NRC definitions, which could affect repository integrity.

PARTICIPANTS: RHO; Shannon and Wilson

11. TITLE: Develop Baseline Seismic Monitoring Plan for BWIP $ 88

OBJECTIVE: To develop a plan for preconstruction baseline monitoring of any possible microseismic activity in the vicinity of the repository. In addition, valuable data will be obtained for use in developing seismic design criteria.

PARTICIPANTS: RHO; Woodward-Clyde

12. TITLE: Operations of Initial Seismic Network at BWIP $ 489

OBJECTIVE: To continue operation of the eastern Washington seismic network to provide continuing information on seismic events and travel times.

PARTICIPANTS: RHO; University of Washington

13. TITLE: Regional Hydrology Studies of the Columbia Plateau $ 413

OBJECTIVE: To provide hydrologic data on the ground-water flow system of the basalts of the Columbia Plateau and how this flow system impacts the Pasco Sub-Basin flow system and to provide hydrological guidelines for selecting suitable candidate sites for a nuclear waste repository within the Pasco Sub-Basin portion of the Columbia River basalts.

PARTICIPANTS: RHO; State of Washington, Department of Ecology; Washington State University; PNL; R. E. Brown

14. TITLE: Integrated System Description of Basalt Hydrologic Regime, Preliminary Model Adaptations, and Modeling of Potential Credible Scenarios $ 956

OBJECTIVE: To provide numerical analysis techniques for evaluation of radionuclide movement within the hydrologic system at the candidate site and within the Pasco Basin.

PARTICIPANTS: RHO; USGS; State of Washington, Department of Ecology; Georesults; BCS Richland, Inc.; Research Management Associates

15. TITLE: Characterization of Yucca Mountain Area, Nevada Test Site $ 3,000

OBJECTIVE: To assess the geologic, geophysical, and hydrologic characteristics of the Yucca Mountain portion of the southwestern NTS in sufficient detail to permit a judgement about the suitability of contained site(s).

PARTICIPANTS: G. L. Dixon (USGS); B. M. Crowe (LASL)

16. TITLE: Evaluation of Candidate Areas, Southern Nevada $ 150

OBJECTIVE: To identify the most promising localities for waste isolation in southern Nevada, with special emphasis on the southwest quadrant of the Nevada Test Site (NTS).

PARTICIPANT: R. Byers (USGS); Nevada Bureau of Mines

17. TITLE: Evaluation of the Hydrologic Flow System, Nevada Test Site (NTS) and Vicinity — $ 750

OBJECTIVE: To assess and digitally model in two dimensions the hydrologic flow system of the NTS and surrounding areas.

PARTICIPANT: D. I. Leap (USGS)

18. TITLE: Evaluation of Gulf Coast Salt Domes (Texas, Louisiana, Mississippi) — $ 16,600

OBJECTIVE: To evaluate the regional geologic and hydrologic environment of the Gulf Interior Region where numerous salt domes occur; to select study areas for detailed characterization; and to inventory the natural resources of the basin.

PARTICIPANTS: D. E. Pauls (LETCO);
C. W. Kreitler (TBEG);
J. D. Martinez (LSU);
C. A. Spiers (USGS);
G. Ryals (USGS);
Oscar Paulson (USM)

19. TITLE: Characterization of Regional Ground-water system at WIPP — $ 30

OBJECTIVE: To determine revised and refined potentio-metric and flow relationships between Capitan Reef and adjacent rocks for use in radionuclide migration and dissolution modeling.

PARTICIPANTS: D. D. Gonzales (SLA), hydrology
S. J. Lambert (SLA) geochemistry

20. TITLE: Repository Geology at BWIP — $ 382

OBJECTIVE: To define, with as high a degree of certainty as possible, the geologic conditions which will be encountered in the repository.

PARTICIPANTS: RHO

21. TITLE: Laboratory Evaluation of Argillaceous Rocks for Nuclear Waste Containment $ 430

OBJECTIVE: To perform a fundamental investigation of physico-chemical properties of argillaceous rocks; and to identify and document their suitability as waste repository hosts.

PARTICIPANT: ORNL; G. Brunton

22. TITLE: Survey of Argillaceous Rocks $ 31

OBJECTIVE: To perform reconnaissance survey of occurrences of argillaceous rocks in the United States with potential for radioactive waste isolation.

PARTICIPANTS: K. S. Johnson; S. Gonzales

23. TITLE: High-Frequency Electromagnetic Borehole Techniques $ 0

OBJECTIVE: To determine capabilities and limitations of high frequency techniques for exploration of evaporites and crystalline rocks, to develop borehole equipment for radar and point-to-point transmission measurements, and to test this equipment at several sites to guide further development.

PARTICIPANT: USGS; Frank Frischknecht

B. SITE CHARACTERIZATION

1. TITLE: Economic Geology Study at BWIP $ 239

OBJECTIVE: To assess the potential for significant valuable resources that may be attractive to present or future generations.

PARTICIPANTS: RHO; Esca-Tech

2. TITLE: Large-Hole Drilling and Boring Equipment Capability Trade Study at BWIP $ 0

OBJECTIVE: To determine the capability of existing large-hole drilling and boring equipment for shaft and/or drift construction in support of repository development in the Columbia Plateau basalts.

PARTICIPANT: RHO

3. TITLE: Verification Studies of Specific Geologic Structures of the Columbia Plateau $ 300

OBJECTIVE: To provide geophysical support to the investigations carried out to determine capability of specific structures which could effect the repository.

PARTICIPANT: RHO

4. TITLE: Shale Structure Studies $ 65

OBJECTIVE: To determine the effect of elevated temperature on the chemical/physical structure of shales.

PARTICIPANT: Georgia Institute of Technology, Charles Weaver

5. TITLE: Seismic Effects of Weapons Tests at the Nevada Test Site $ 275

OBJECTIVE: To statistically determine the surface and subsurface ground motion effects of underground nuclear explosions at potential repository areas on the Nevada Test Site.

PARTICIPANT: SLA; L. J. Vortman

6. TITLE: Salt Permeability $ 40

OBJECTIVE: To assess the permeability of southeastern New Mexico rock salt for gas and liquid migration studies.

PARTICIPANT: SLA; J. R. Wayland

7. TITLE: Characterization of Local Ground-water System at WIPP $ 30

OBJECTIVE: To obtain description of hydrologic system for radionuclide migration modeling at WIPP.

PARTICIPANTS: D. D. Gonzales (SLA); J. W. Mercer (USGS)

8. TITLE: Evaporite Origins and Phase Relations in the WIPP Area $ 60

OBJECTIVE: To determine, empirically and theoretically, the conditions of stability and phase relations of evaporite minerals for evaluating the effects of physiochemical perturbations of heating experiments and hole plugging experiments.

PARTICIPANT: S. J. Lambert (SLA)

9. TITLE: Development of a Single Hole Electromagnetic Probe $ 100

OBJECTIVE: To develop and test an electromagnetic borehole probe that is capable of locating anomalies in the vicinity of a deep borehole (size, distance from the hole, and direction).

PARTICIPANT: R. J. Lytle (LLL)

C. EARTH SCIENCE ASPECTS OF FACILITY DESIGN AND OPERATIONAL RISK

1. TITLE: Near-Field Waste-Rock Interactions $ 211

   OBJECTIVE: To investigate the consolidation (compaction) behavior of crushed salt and to study brine.

   PARTICIPANTS: PSU; Della M. Roy

2. TITLE: Salt-Brine-Waste-Canister Interactions $ 230

   OBJECTIVE: To determine the likely interactions among salt, brine, canisters, and waste at a range of temperatures and pressures that may be considered in disposal of high-level radioactive waste or spent fuel, and to determine the properties of the resultant reaction products at temperatures up to 300°C.

   PARTICIPANT: USGS; Rob Potter

3. TITLE: High-Level-Waste-Container Interactions with Rock Salt and Brine $ 693

   OBJECTIVE: To provide data and assess impacts of the interaction potentials of high-level waste forms and containers with the WIPP geologic, near-field environment.

   PARTICIPANT: SLA; M. A. Molecke

4. TITLE: Brine Migration $ 650

   OBJECTIVE: To determine the physiochemical properties of fluid inclusions in native rock and in artificially imposed heat fields. To evaluate the potential of fluid inclusions for waste-form degradation and radionuclide migration by performing laboratory, bench-scale, and in situ experiments for assessment of brine migration phenomena.

   PARTICIPANTS: H. C. Shefelbine (SLA)
   S. J. Lambert (SLA)
   A. R. Sattler (SLA)
   E. Roedder (USGS)

5. TITLE: Effect of Water on Salt Repository $ 260

OBJECTIVE: To gain information sufficient to predict credibly the consequences of any plausible form of water breeching a salt repository that might compromise the integrity of that repository.

PARTICIPANT: ORNL; Charles Baes

6. TITLE: Radiolysis of Brine $ 150

OBJECTIVE: To provide experimental information on the effects on brines under conditions appropriate to the very near-field environment of a repository in salt.

PARTICIPANT: ORNL; Glen Jenks

7. TITLE: Expected Repository Environments $ 300

OBJECTIVE: To identify reference conditions in salt, shale, and granite repositories to serve as a guide for:
(a) scientists conducting material performance tests,
(b) engineers preparing the design of repositories,
(c) the technically conservative conditions to be used as a basis for DOE application for a license, and
(d) scientists and engineers developing waste forms.

PARTICIPANTS: RHO (BASALT); H. C. Claiborne (ORNL)
L. D. Rickertsen (SAI)
G. D. Callahan (RE/SPEC)

8. TITLE: Transient Creep in Rock Salt $ 62

OBJECTIVE: To develop and test a transient creep constitutive relationship for salt.

PARTICIPANT: Texas A&M University; David Parrish

9. TITLE: Bench Scale Creep Tests on Rock Salt $ 35

OBJECTIVE: To perform creep tests on large natural blocks of salt.

PARTICIPANTS: SDSM; William Grams, Charles Gessner

10. TITLE: Thermomechanical and Brine Migration In Situ Tests in Dome Salt at Avery Island $ 400

OBJECTIVE: To provide field engineering support to in situ tests at the Avery Island Mine examining thermomechanical effects and brine migration in dome salt.

PARTICIPANT: Wayne Krause (RE/SPE)

11. TITLE: U.S./Federal Republic of Germany (FRG) Cooperative Efforts in Asse $ 200

OBJECTIVE: To develop and perform field tests, initially involving brine and gas migration and waste/rock interaction, at the Asse Salt Mine, FRG, which has capabilities currently unavailable in the U.S.

PARTICIPANT: Westinghouse AESD; Don Newby

12. TITLE: Operation and Design Support Tests for WIPP $ 507

OBJECTIVE: To provide in situ evaluation of facility design parameters and operational procedures as inputs to the WIPP engineering design and operational safety procedures.

PARTICIPANT: WEC; Bechtel, A. R. Sattler (SLA)

13. TITLE: Thermomechanical Testing in Stripa Granite $ 1,565

OBJECTIVE: To provide data on the effects on the integrity of granite in a deep geologic formation that is subjected to long-term high heat loads.

PARTICIPANT: LBL; Paul Witherspoon

14. TITLE: Material Properties of Stripa Granite $ 130

OBJECTIVE: To measure the material properties of carefully selected rock samples from the granite rock mass at the Stripa mine that are needed to understand the hydraulic, thermal, and rock mechanic behavior of the fracture rock mass.

PARTICIPANTS: LBL; Paul Witherspoon

15. TITLE: Directional Permeability of Stripa Granite $ 259

OBJECTIVE: To define the surface and subsurface hydrological conditions of the fractured granite rock mass as a function of time and temperature.

PARTICIPANT: LBL; Paul Witherspoon

16. TITLE: Macroscopic Permeability of Stripa Granite $ 100

OBJECTIVE: To determine the gross seepage rate in a mined drift at Stripa and to correlate this rate with hydraulic pressure to determine the global permeability of the fractured rock mass.

PARTICIPANT: LBL; Paul Witherspoon

17. TITLE: U.S./Swedish Cooperative Efforts at Stripa, Sweden $ 0

OBJECTIVE: To carry out tests dealing primarily with buffer material and sealing, and hydrogeological aspects in fractured granite at depth in the Stripa mine.

PARTICIPANT: ONWI; R. A. Robinson

18. TITLE: Evaluation of Geophysical Techniques in Fractured Crystalline Rock $ 40

OBJECTIVE: To determine the applicability of different surface, subsurface, and borehole geophysical techniques in delineating and characterizing the fracture systems, in the granite body at Stripa.

PARTICIPANT: LBL; Paul Witherspoon

19. TITLE: Near-Surface Test Facility Design, Construction, and Operation $ 16,716

OBJECTIVE: The design and construction of a multipurpose Near-Surface Test Facility for the in situ testing of basalt.

PARTICIPANTS: RHO; J. A. Jones Construction Company; Vitro Engineering Corporation

20. TITLE: In Situ Stress Measurement Techniques $ 0

OBJECTIVE: To determine the in situ state of stress in the fractured granite rock mass in the Stripa mine.

PARTICIPANT: LBL; Paul Witherspoon

21. TITLE: Support of Geotechnical Test Facility at the Colorado School of Mines (CSM) Experimental Mine $ 210

OBJECTIVE: To provide an experimental facility in crystalline rock to conduct in situ tests, and to develop hard rock mining methods to aid in crystalline rock repository development.

PARTICIPANT: CSM; William Hustrulid

22. TITLE: Heated Block Flatjack Test $ 250

OBJECTIVE: To provide an in situ data base of thermomechanical rock properties for development and evaluation of mathematical models, and to provide a test for the in situ calibration of rock instrumentation.

PARTICIPANTS: Terra Tek; Howard Pratt

23. TITLE: Climax Spent Fuel Test $ 5,000

OBJECTIVE: To evaluate the feasibility of safe and reliable emplacement, short-term storage, and retrieval of spent reactor fuel assemblies and plausible repository depth in a typical granite rock; to obtain technical data about the suitability of granite as a medium for deep geological disposal of high-level reactor waste; and to obtain information about the design of a repository in granite.

PARTICIPANT: NVO Support Contractors; L. D. Ramspott (LLL)

24. TITLE: Granite Heater and Rock Mechanics Tests, Climax Stock $ 0

OBJECTIVE: To analyze and document the results of granite heater test No. 1, and plan subsequent in situ granitic thermal and rock mechanic experiments.

PARTICIPANT: LLL; L. D. Ramspott

25. TITLE: Nuclide Migration Studies in Fractured Granite: Climax, NTS $ 250

OBJECTIVE: (1) To study radionuclide migration in fractured granite; (2) to compare in situ retardation factors with laboratory values; and (3) to model fracture flow in granite and calibrate the model using in situ values.

PARTICIPANT: LLL; David Coles

26. TITLE: Waste/Barrier/Rock Interractions in Basalt $ 1,492

OBJECTIVE: To determine the hydrothermal interactions which will occur following a worst circumstance breach of the engineered barrier system.

PARTICIPANTS: RHO; PSU; PNL

27. TITLE: Characterization of Waste Form and Geologic Environment for BWIP $ 1,020

OBJECTIVE: To obtain physical, chemical, and structural data from analyses of candidate waste forms, natural ground waters, and potential geologic barriers.

PARTICIPANTS: RHO; LBL; Hanford Engineering Development Laboratory; PNL

28. TITLE: Advanced Rock Testing of Basalt $ 464

OBJECTIVE: To determine rock properties for basalt at the Near-Surface Test Facility and for deep basalt flows under the Hanford Site.

PARTICIPANTS: RHO; CSM

29. TITLE: Heater Test Data Analysis and Repository Design for BWIP $ 645

OBJECTIVE: To assess the suitability of basalt as a repository medium from a thermomechanical viewpoint and to develop the computer modeling capability needed to procede with design, construction, and licensing of a basalt repository.

PARTICIPANTS: RHO; University of Maryland

30. TITLE: Borehole Plugging in Basalt $ 2,014

OBJECTIVE: To develop and demonstrate the technology needed to effectively seal all man-made openings to a nuclear waste repository within the basalts of the Columbia Plateau.

PARTICIPANTS: RHO; Woodward-Clyde

31. TITLE: Ground-water Monitoring System Criteria for Basalt $ 49

OBJECTIVE: To prepare criteria and requirements (if any) for monitoring ground-water movement in the immediate vicinity of the repository.

PARTICIPANT: RHO

32. TITLE: Argillite Study $ 90

OBJECTIVE: To characterize the near-field response of argillite to simulated thermal, mechanical, and chemical conditions created by emplacement of high-level radioactive wastes.

PARTICIPANTS: L. D. Tyler (SLA)
K. Wolfsberg (LASL)

33. TITLE: In Situ Test--Conasauga Shale $ 0

OBJECTIVE: To measure the thermomechanical response and mineralogical changes that occur near a heat source in the Conasauga shale.

PARTICIPANT: SLA; L. D. Tyler

34. TITLE: Nuclide Migration Studies in Tuff: G-Tunnel, NTS $ 250

OBJECTIVE: To develop the techniques for and to conduct controlled field experiments to define radionuclide migration through tuffs.

PARTICIPANT: Keith Johnstone (LASL)

35. TITLE: Tuff Study $ 2,500

OBJECTIVE: To develop and apply means to characterize the near-field response of selected tuff units to simulated thermal, mechanical, chemical, and fluid conditions created by emplacement of high-level radioactive waste.

PARTICIPANTS: L. D. Tyler (SLA)
K. Wolfsberg (LASL)

36. TITLE: Engineered Barrier Optimization $ 408

OBJECTIVE: To assess the capabilities of individual engineered barriers, evaluate the mutual compatibility of various components of the waste package, and specify acceptable barrier assemblages.

PARTICIPANTS: RHO; PNL

37. TITLE: Waste Rock-Interaction Technology: Leaching $ 1,800

OBJECTIVE: To determine waste form release rates and help provide source terms for consequence analysis. More specifically: to characterize candidate waste forms; to measure leach rates with solutions and under conditions simulating expected repository conditions; and to determine the effects of physical and chemical factors on release mechanisms.

PARTICIPANT: PNL; Donald Bradley

38. TITLE: Transuranic Waste Characterization Studies Under Conditions of Geologic Isolation $ 333

OBJECTIVE: To obtain data and predictive analytical models on the interaction and degradation behavior of existing and development TRU wastes in a bedded salt repository environment.

PARTICIPANTS: LASL; SRL; UNM; M. A. Molecke (SLA)

39. TITLE: Analysis of Thermomechanical Response of Rock $ 178

OBJECTIVE: To develop the capability for detailed simulation of demonstration tests as well as laboratory tests and the capability necessary for simulation of repository behavior.

PARTICIPANT: SAI; Ronald Hofmann

40. TITLE: Modeling of Thermal-Structural Interactions in Salt $ 562

OBJECTIVE: To provide the analytical modeling for prediction of near-field and far-field response of salt and associated overlying media.

PARTICIPANT: SLA; J. R. Wayland

41. TITLE: Salt Model Pillar Studies $ 100

OBJECTIVE: To understand long-term creep behavior of salt as a function of temperature, stress, and time.

PARTICIPANT: ORNL; Tom Lomenick

42. TITLE: Spent Fuel Canister and Room/Pillar Convective Heat Transfer $ 157

OBJECTIVE: To investigate experimentally and analytically the convective heat transfer aspects related to near-field thermal performance.

PARTICIPANTS: OSU; F. A. Kulacki, R. N. Christensen

43. TITLE: Independent Measurement Laboratory and Rock Properties Handbook $ 600

OBJECTIVE: To develop and operate an independent measurement laboratory as a part of the Energy Technology organization for materials characterization, and to determine the feasibility of authoritative documentation of the physical property data of basalts, granites, and shales and to perform pilot evaluations of typical data.

PARTICIPANTS: NBS; H. Thomas Yoklen (Independent Measurement Laboratory)
L. H. Gevantman (Rock Properties Handbook)

44. TITLE: Fracture Permeability of Rocks Under Pressure $ 270

OBJECTIVE: To measure the fracture permeability in rock (core samples) as a function of pressure and relate it to the acoustic and electrical properties of the rocks.

PARTICIPANT: LLL; H. C. Heard

45. TITLE: Permeability Studies $ 95

OBJECTIVE: To determine very low permeability characteristics in the laboratory of several potential repository host rocks under various conditions of temperature and confining pressure.

PARTICIPANT: LLL; H. C. Heard

46. TITLE: Determination of Elastic Constants $ 45

OBJECTIVE: To determine the effects of pressure and/or temperature on the rock elastic constants.

PARTICIPANT: LLL; H. C. Heard

47. TITLE: Mechanical Behavior of Rocks Under Pressure $ 190

OBJECTIVE: To test rock samples to determine thermal conductivity, thermal diffusivity, heat capacity, and linear thermal expansion coefficient as a function of combined pressure, temperature, and pore water pressure, and to gain an understanding of the interrelationship between thermal properties and sample composition, fabric, and degree of fracturing.

PARTICIPANT: LLL; Albert Abey

48. TITLE: Experimental Study of Opening Mode Crack Growth in Rock NA

OBJECTIVE: To study crack growth mechanisms in rock.

PARTICIPANT: Yale University; R. B. Gordon

49. TITLE: Laboratory Measurements--Mechanical Properties $ 50

OBJECTIVE: To perform materials properties tests on rock specimens.

PARTICIPANT: Terra Tek

50. TITLE: Thermal Properties Measurements $ 89

OBJECTIVE: To provide measurements of thermal properties of a large number of samples on a routine basis as various sites are explored and geologic and other data obtained.

PARTICIPANTS: M. T. Morgan (ORNL)
J. F. Lagedrost (FMI)

51. TITLE: Thermal-Structural Interaction in Salt--Laboratory Experiments $ 352

OBJECTIVE: To provide thermophysical properties of WIPP rock salt and surrounding media and to obtain data on elastic and creep behavior to support development of appropriate constitutive models.

PARTICIPANTS: SLA; J. R. Wayland, W. Wawerski

52. TITLE: Tectonic Stability--ERDA 6 Test Borehole $ 0

OBJECTIVE: To conduct adequate tests of reservoir size (large brine pocket) and adjustment during testing and to obtain additional samples of brine for study of genesis of structure and fluid.

PARTICIPANTS: SLA; D. W. Powers, S. J. Lambert, R. D. Statler

53. TITLE: Feasibility of an In Situ Test Facility $ 0

OBJECTIVE: To perform a feasibility study on the possibility of developing an underground test facility (UTF) in hard rock.

PARTICIPANT: LBL; Paul Witherspoon

54. TITLE: Ultra-Large Rock Core Tests $ 240

OBJECTIVE: To perform laboratory testing to: (1) investigate effects of scale, state of stress, fluid pressure, and temperature on measured properties of rocks and rock fissures; (2) conduct site-specific core testing (i.e., Stripa, BWIP, NTS); and (3) investigate the relationship between fissure permeability and dilatency due to shear loading.

PARTICIPANT: LBL; Paul Witherspoon

55. TITLE: Repository Instrumentation Development $ 150

OBJECTIVE: Initial procurement of instrumentation R&D to satisfy needs for in situ experiments (short-term) and repository monitoring functional requirements (long-term).

PARTICIPANT: To be determined.

56. TITLE: Application of Acoustic Methods $ 140

OBJECTIVE: To determine whether acoustic methods can be used in the near-field environment to monitor fracture development and/or slip along fractures during the thermal pulse.

PARTICIPANT: LBL; Thomas McEvilly

57. TITLE: Data Transmission Alternatives $ 150

OBJECTIVE: To conceptually develop and analyze techniques to transmit data from subsurface instrumentation in or at the repository to the biosphere without breaching repository geologic integrity. These concepts will apply generically to all candidate repository media.

PARTICIPANT: To be determined.

58. TITLE: Borehole Instrumentation $ 99

OBJECTIVE: To develop an underground telemetry system capable of measuring an in situ physical property and transmitting the data to the surface.

PARTICIPANT: IRT; Rod Galloway

59. TITLE: Instrumentation Development for In Situ Testing $ 430

OBJECTIVE: To develop thermomechanical and thermochemical instrumentation for application to pre-WIPP in situ experiments, for measurements for which commercially available instrumentation is inadequate or not available.

PARTICIPANT: SLA; A. R. Sattler

60. TITLE: Instrumentation Needs for In Situ Experiments $ 37

OBJECTIVE: To determine instrumentation requirements for all current and planned NWTS in situ tests and define corresponding developmental needs.

PARTICIPANT: OSU; Don Miller

61. TITLE: State-of-the-Art Review of Measurement Techniques for Nuclear Waste Disposal $ 50

OBJECTIVE: To assess the value of various types of instrumentation which will be used during the site evaluation phase, the site construction phase, and the long-term monitoring phase.

PARTICIPANT: Terra Tek; Howard Pratt

62. TITLE: Short-Term Hydraulic Effects $ 0

OBJECTIVE: To simulate with a digital model the fluid-pressure response measured near an electrical heater source in the granite of the Climax Stock.

PARTICIPANT: USGS; D. D. Gonzales

63. TITLE: Thermal Structural Interaction--Bench Scale and In Situ $ 206

OBJECTIVE: To conduct bench-scale and in situ tests which serve to assess and demonstrate the validity of predictive models.

PARTICIPANTS: SLA; J. R. Wayland, A. R. Sattler

64. TITLE: Release Rates of Reactor Products $ 175

OBJECTIVE: To identify and quantify the release of radionuclides from irradiated UO_2 fuel elements and synthetic and natural uraninite minerals under conditions of geologic disposal.

PARTICIPANT: LASL; Edward Norris

65. TITLE: Thermodynamic Properties of Actinides $ 250

OBJECTIVE: To provide thermodynamic data on the species, oxidation states, and concentrations of radionuclides in solution under geologic repository conditions.

PARTICIPANT: LBL; Norman Edelstein

66. TITLE: Strain Related Radiation Damage $ 190

OBJECTIVE: To determine the combined effects of strain and irradiation over a range of temperatures in candidate host rock materials.

PARTICIPANT: BNL; Paul Levy

67. TITLE: Repository Concepts Analysis $ 490

OBJECTIVE: To provide laboratory testing capability for characterizing salt and other rocks in a repository environment and numerical support on generic conceptual repository design.

PARTICIPANTS: G. D. Callahan; P. F. Gnirk, RE/SPEC

68. TITLE: Development of Displacement-Discontinuity Models $ 125

OBJECTIVE: To develop displacement-discontinuity models for analysis of conceptual repository designs.

PARTICIPANTS: University of Minnesota; Steve Crouch, Christopher St. John

69. TITLE: Borehole Plugging--Cement and Geochemical Studies $ 600

OBJECTIVE: To develop a better basic understanding of the parameters that relate to placement and long-term stability of cementitious composites, to evaluate the geochemistry of cement-based materials, and to help determine the longevity and durability of cementitious composites in the repository environment.

PARTICIPANTS: Katherine Mather (WES)
Della M. Roy (PSU)

70. TITLE: Geotechnical Design Studies for Repository Sealing $ 500

OBJECTIVE: To establish repository sealing design criteria that will become the basis for determining the needs of all related laboratory, field testing, analytical, and licensing efforts in the NWTS program.

PARTICIPANT: D'Appolonia; Dick Ellison

71. TITLE: Borehole Plugging--Cement Technology Studies $ 0

OBJECTIVE: To investigate methods for improving the precision of physical testing of cementitious solids.

PARTICIPANT: ORNL; John Moore

72. TITLE: Borehole Plugging Field Tests $ 1,600

OBJECTIVE: To demonstrate borehole plugging technology using the best available current methods, materials, and instrumentation.

PARTICIPANTS: SLA; C. L. Christensen

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D. EARTH SCIENCE ASPECTS OF LONG-TERM RISK ANALYSIS

1. TITLE: Effect of Surficial Processes on the Columbia Plateau — $ 96

   OBJECTIVE: To analyze those surficial processes with potential for affecting a repository. As part of this activity, quantitative measurements of denudation rates will be determined and coupled with maximum possible rates of uplift to examine any possible effect on a repository.

   PARTICIPANTS: RHO; Woodward-Clyde

2. TITLE: Evaluation of Dissolution of Evaporities near WIPP Area — $ 100

   OBJECTIVE: To determine amount, extent, and nature of dissolution of evaporites due to effects of superjacent water-bearing rocks.

   PARTICIPANTS: G. O. Bachman (USGS); S. J. Lambert (SLA); J. W. Mercer (USGS); D. G. Brookins (UNM)

3. TITLE: Subsidence Over Mines in Evaporites — $ 50

   OBJECTIVE: To determine effects of evaporite removal on overburden subsidence and disruption of overlying water-bearing units, for implications regarding mine-induced dissolution.

   PARTICIPANTS: J. W. Mercer (USGS); D. W. Powers (SLA)

4. TITLE: Characterization of Consolidated Rubble Chimney — $ 750

   OBJECTIVE: To determine nature and origin of consolidated rubble chimney (breccia pipe) and to evaluate magnitude of threat of such features for contributing toward dissolution of evaporites.

   PARTICIPANTS: C. L. Jones (USGS); J. W. Mercer (USGS); S. J. Lambert (SLA); D. G. Brookins (UNM)

5. TITLE: Effect of Depth on Ground Motion — $ 0

   OBJECTIVE: To analytically predict subsurface ground motions necessary for the seismic design of underground repository

facilities and compare these predictions with field measurements.

PARTICIPANTS: D. M. Ellett, L. J. Vortman, SLA

6. TITLE: Subsurface Earthquake Damage $ 80

OBJECTIVE: To determine whether damage from an earthquake is less at depth than it is on the surface and to develop mathematical models.

PARTICIPANT: I. Wendell Marine, SRL

7. TITLE: Assessment of Geothermal and Volcanic Activity of the Columbia Plateau $ 244

OBJECTIVE: To assess the possibility of future volcanic activity in the respository area which could affect the repository. As part of this study, determine the geothermal gradient in the repository area and determine the relationship between past volcanic activity and tectonic structures.

PARTICIPANTS: RHO; Fugro, Incorporated

8. TITLE: Evaluation of Tectonic, Seismic, and Volcanic Hazards, Nevada Test Site and Vicinity $ 800

OBJECTIVE: To assess the potentials for volcanic eruptions, fault movements, regional uplift, erosion, and natural seismicity in the vicinity of the Nevada Test Site.

PARTICIPANTS: W. J. Carr, A. M. Rogers (USGS); B. M. Crowe (LASL)

9. TITLE: Tectonic Stability--Magnetic Anomaly $ 0

OBJECTIVE: To determine the presence/absence of magnetic anomalies in the WIPP site area normally associated with igneous intrusions about 9 miles northwest of the WIPP site; and to determine empirically the magnetic signature, if any, associated with so-called breccia pipes.

PARTICIPANTS: SLA; Undetermined

10. TITLE: Tectonic Stability--Remote Sensing $ 0

OBJECTIVE: To detect and evaluate large, but perhaps subtle, tectonic features that may affect tectonic stability of the WIPP.

PARTICIPANTS: SLA; Undetermined

11. TITLE: Tectonic Stability--Quaternary Fault Mapping $ 0

OBJECTIVE: To provide field evidence on existing faults or areas of interest for mechanism, ages, and magnitudes of movement for assessment of tectonic stability of the Delaware Basin.

PARTICIPANTS: G. O. Bachman (USGS), SLA

12. TITLE: Tectonic Stability--Earthquake Activity $ 175

OBJECTIVE: To provide reliable estimates of present earthquake activity around the WIPP site for facility design and assessment of long-term tectonic stability.

PARTICIPANTS: A. M. Rogers (USGS); G. R. Keller (UTEP); A. R. Sanford (NMIMT)

13. TITLE: Tectonic Stability--In Situ Stress, Delaware Basin $ 0

OBJECTIVE: To measure in situ stress to determine whether stress is consistent with the tectonic situation in the northern Delaware Basin; and to determine in situ stress in deformed evaporite sequence.

PARTICIPANTS: SLA; D. W. Powers; R. D. Statler

14. TITLE: Climatic Stability/Tectonic Stability-- West Texas Salt Flats Graben $ 25

OBJECTIVE: To obtain supplementary time/climatic relationships for southeastern New Mexico; and to obtain structural/age relationships for the tilting of the Delaware Basin.

PARTICIPANTS: SLA; D. W. Powers, S. J. Lambert

15. TITLE: Climatic Stability--Pecos River History $ 0

OBJECTIVE: To determine climatic history of the area during the Quaternary including rates, chronology, and limits of effects.

PARTICIPANT: USGS; G. O. Bachman

16. TITLE: Climatic Stability--San Simon Sink $ 0

OBJECTIVE: To obtain climatic/age information related to periods of dissolution by study of a core of fill material in the San Simon Sink.

PARTICIPANT: SLA; Roger Y. Anderson

17. TITLE: Effects of Far-Field Inhomogeneities $ 64

OBJECTIVE: To investigate by use of scaled laboratory models and by analytical techniques the effects of far-field inhomogeneities on heat transfer.

PARTICIPANT: OSU; F. A. Kulacki

18. TITLE: Large-Scale Ground Movements $ 100

OBJECTIVE: To test long-term far-field models.

PARTICIPANT: To be determined

19. TITLE: Natural Fission Reactor Program, Oklo $ 350

OBJECTIVE: To identify the migration paths of some of the mobile fission products and reconstruct the paleohydrology and transport history.

PARTICIPANT: LASL; George Cowan

20. TITLE: Study of the Morro do Ferro Thorium Deposit $ 100

OBJECTIVE: To measure the initial dissolution, subsequent transport, and dispersion of thorium from the Morro do Ferro deposit in the Pocos de Caldas plateau in Minas Gerais, Brazil.

PARTICIPANT: NYU; Merril Eisenbud

21. TITLE: Field Investigations to Determine In Situ Geologic, Hydrologic, and Engineering Parameters $ 6,845

OBJECTIVE: To provide field services as required to obtain subsurface geologic, hydrologic, and engineering data in support of candidate site selection and evaluation for construction of a nuclear waste repository in Columbia River basalts.

PARTICIPANTS: RHO; PNL; Boyles Brothers Drilling Company; Exploration Data Consultants; SAI; LBL; Hatch Drilling Co.; Birdwell; Geochron; University of Miami; and J. A. Jones Construction Company

22. TITLE: Waste Rock Interaction Technology: Geochemistry $ 2,000

OBJECTIVE: To determine radionuclide sorption processes under conditions of all candidate repository geologies.

PARTICIPANT: PNL; R. J. Serne

23. TITLE: Geochemical Studies for Nuclide Migration (WIPP) $ 476

OBJECTIVE: To determine sorptive capacities for radionuclides in rock/solution systems of southeastern New Mexico and perform assessment of radionuclide migration modeling.

PARTICIPANTS: SLA; D. R. Fortney; R. G. Dosch

24. TITLE: Organic Compounds in Ground Water $ 100

OBJECTIVE: To evaluate the structure and extent of natural organics that may be present in repository environments and analyze potential effects on radionuclide migration.

PARTICIPANT: BCL; J. L. Means

25. TITLE: Ground-water Dating $ 225

OBJECTIVE: To develop methods of dating ground water that is older than 50,000 years. This capability would provide information on past rates of ground-water flow in the vicinity of a repository and aid in verification of predictive models used for determining future rates of ground-water flow.

PARTICIPANTS: I. Wendell Marine (SRL); Stan Davis (University of Arizona); John Apps (LBL)

26. TITLE: Characterization of Southeastern New Mexico Rocks and Waters $ 50

OBJECTIVE: To obtain basic geochemical data on subsurface materials in southeastern New Mexico for brine migration, radionuclide sorption, and borehole plugging studies and to determine the history of rock/solution interaction.

PARTICIPANT: SLA; S. J. Lambert

27. TITLE: Chemical Environment Modeling $ 266

OBJECTIVE: To characterize the chemical environment in the vicinity of the buried waste packages as a function of time.

PARTICIPANTS: RHO; LBL

28. TITLE: Development of Fracture Flow and Thermal-Hydraulic Flow Models $ 111

OBJECTIVE: To review the state of the art of ground-water flow modeling in fractured media; and to determine where emphasis should be placed on future model development; to develop, in parallel, techniques for determining global parameters from borehole data in fractured media and the effects of fracture continuity on these parameters; and to develop and verify fracture flow models that include the effects of temperature on the flow.

PARTICIPANT: Paul Witherspoon (LBL)

29. TITLE: Development of Analytical Transport Models $ 150

OBJECTIVE: To provide an analytical standards capability for the calculation of radionuclide transport in porous media and apply it in support of the performance assessment activities of the NWTS Program.

PARTICIPANT: Thomas Pigford (LBL)

30. TITLE: Brine Migration Modeling $ 115

OBJECTIVE: To develop a comprehensive model of brine migration in natural rock salt.

PARTICIPANTS: Don Olander (UCB); others to be determined

31. TITLE: Tracer Tests of Overlying Strata $ 50

OBJECTIVE: To determine permeability and dispersion coefficients of water-bearing rocks overlying evaporites for input of numerical results to radionuclide migration modeling.

PARTICIPANT: D. D. Gonzales (SLA)

32. TITLE: Osmotic Effects of Clay Minerals $ 175

OBJECTIVE: To determine the effects that natural clay membranes can have on pressure.

PARTICIPANTS: I. Wendell Marine (SRL)

33. TITLE: Systematic Comprehensive Evaluation of Performance and Total Effectiveness of Repositories $ 1,000

OBJECTIVE: To develop, integrate and apply modeling technology to evaluate nuclear waste isolation system performance (both near- and far-field).

PARTICIPANT: R. B. Lantz (INTERA)

34. TITLE: Advanced Evaluation of Geologic Isolation Systems $ 1,908

OBJECTIVE: To develop and apply release scenario and consequence analysis methodology for assessment of repository performance.

PARTICIPANT: Mark Harwell (PNL)

35. TITLE: Nuclear Waste Repository Safety Assessment $ 500

OBJECTIVE: To provide a WIPP site-specific assessment of the long-range consequences of the emplacement of nuclear wastes in the Salado salt formation. The assessment will be dependent on repository design, WIPP site geology and hydrology, waste form, and waste mixes.

PARTICIPANTS: J. P. Brannen (SLA); M. S. Tierney (SLA)

36. TITLE: Systems Study of Engineered Barriers $ 450

OBJECTIVE: To provide a technical basis for decisions regarding the development of engineered barriers for the geologic disposal of spent fuel.

PARTICIPANTS: M. O. Cloninger (PNL); D. H. Lester (SAI)

37. TITLE: Radionuclide Transport $ 0

OBJECTIVE: To couple source-term assumptions into models for radionuclide movement in the WIPP environment.

PARTICIPANT: J. P. Brannen (SLA)

38. TITLE: Software Support $ 0

OBJECTIVE: To quantify consequences of various source-term assumptions for radionuclide release.

PARTICIPANT: J. P. Brannen (SLA)

39. TITLE: Source Term--Direct Access $ 0

OBJECTIVE: To characterize radionuclide source terms for hypothetical direct-access scenarios.

PARTICIPANT: J. P. Brannen (SLA)

E. COORDINATION AND REVIEW

1. TITLE: Coordination and Consultation $ 60

   OBJECTIVE: To provide coordination of USGS projects and to provide geological assistance to DOE in lieu of staffing.

   PARTICIPANT: G. D. DeBuchananne (USGS)

2. TITLE: Technical Integration and Support $ 295

   OBJECTIVE: To provide technical support to ONWI in a broad range of areas relating to geologic disposal and to coordinate all ONWI work at ORNL.

   PARTICIPANT: A. L. Lotts (ORNL)

3. TITLE: Nevada Nuclear Waste Storage Investigations (NNWSI) Technical Project Coordination $ 1,010

   OBJECTIVE: To provide coordination and integration of NNWSI technical investigations; to assure appropriate exchange of information among NNWSI contractors; to exchange information with other aspects of the NWTS Program; and to advise DOE on the technical merits of investigative activities in terms of progress toward a capability for repository construction.

   PARTICIPANTS: R. C. Lincoln, L. D. Tyler (SLA); W. S. Twenjofel, G. L. Dixon (USGS); K. Wolfsberg, B. M. Crowe (LASL); L. D. Ramspott (LLL)

NUCLEAR ENERGY
OFFICE OF URANIUM ENRICHMENT AND ASSESSMENT

Estimates of U.S. uranium ore reserves and uranium supply have been made by the Atomic Energy Commission (AEC) and its successors, ERDA, and DOE, since 1952. In response to concerns regarding the adequacy and availability of domestic resources to support extended development of nuclear power in the U.S., and to ensure a sound information base on which federal planning and policy decisions could be based, an expanded effort to systematically assess the nation's potential uranium resources was initiated in 1974.

The goals of the Uranium Resource Assessment program have been to assess and expand the nuclear fuel resource base of the United States; reduce uncertainties regarding economics and availability of domestic and foreign nuclear fuel resources; and make available to industry resource information and technology for use in the discovery and production of uranium resources.

In October 1980 "An Assessment Report on Uranium in the United States" was published covering the highest priority areas containing all of the known reserves and most of the probable potential resources. An improving resource situation, as indicated in this report, and reduced demand projections have mitigated the perceived need for completion of the comprehensive, systematic, nationwide assessment. Consequently, activities designed to increase the data base for resource estimation or to develop advanced technologies for resource identification and assessment are being phased out. Reserve estimation and supply analysis efforts based largely on data furnished by industry will continue much as it has since 1952. Total budget authority is expected to decrease from $61.5 million in FY 1980 to $10.0 million in FY 1982. The table of Operating Costs provides an indication of the categories of and expenditures for geoscience related research conducted in FY 1980.

The data base and technology developed by this program over the past five years should serve the nation well for many years, providing a sound factual basis for future exploration and evaluation of uranium as well as other mineral resources. Of particular significance are the multi-element analyses of hydrologic and stream sediment samples covering some 67 percent of the conterminous U.S. and 82 percent of Alaska, as well as the airborne radiometric and magnetic surveys covering virtually the entire conterminous U.S. and 75 percent of Alaska. Discussions have been held with the U.S. Department of Interior and seminars are being presented to industry and the public to increase awareness of the available data base, clarify what remains to be done and how it may be accomplished. The table of Selected Projects provides a brief description of topical and technology based projects that were conducted in FY 1980.

OFFICE OF URANIUM ENRICHMENT AND ASSESSMENT
GEOSCIENCE RELATED RESEARCH
FY 1980 OPERATING COSTS

($ in Millions)

Project Category	Subcontracts	National Labs	BFEC[1/]	USGS	Total
o Geologic and Related Investigations					
o Surface	$ 4.8	$ 0.6	$10.8	$ 2.2	$18.4
o Aerial					
Survey	7.9	-	-	-	7.9
Technology	0.5	-	0.2	-	0.7
o Hydrogeochemical	0.1	10.0	0.2	-	10.3
o Subsurface					
Drilling and Logging	2.8	-	1.1	0.1	4.0
Logging only	3.5	-	1.3	-	4.8
o Technology Applications					
o Technology Development and Evaluation	0.4	1.0	2.0	-	3.4
o Technology Integration	0.3	-	0.5	-	0.8
	$20.3	$11.6	$16.1	$2.3	$50.3

[1/] Bendix Field Engineering Corporation, Prime Contractor, Grand Junction, CO.

OFFICE OF URANIUM ENRICHMENT AND ASSESSMENT
GEOSCIENCE RELATED RESEARCH
SELECTED PROJECTS - FY 1980

Topical Studies

1. Title: Uranium Distribution in Fluorine-enriched Volcanic Rocks

   Authorized Expenditure: $79,000
   Contractor: Arizona State University
   Principal Investigator: Dr. D. M. Burt
   Project Summary: The dynamics of the uranium-fluorine relationship during magmatic differentiation; eruption, welding, secondary crystallization and diagenesis of tuff sheets; and hydrothermal fluid migration were studied. The primary study area was the Spor Mountain-Thomas Range area of western Utah.

2. Title: Study of Uranium and Thorium Potential in Red Muds

   Authorized Expenditure: $55,000
   Contractor: Zellars-Williams
   Principal Investigator: Michael E. Zellars
   Project Summary: The red mud residues from aluminum production were analyzed for uranium content. The results indicate that the residues are a potential low- to intermediate-grade uranium resource.

3. Title: NURE Geostatistical Evaluation Study-Phase I

   Authorized Expenditure: $70,000
   Contractor: Terradata
   Principal Investigator: C. Kendall
   Project Summary: The current resource assessment methodology was examined from a statistical viewpoint and an in-depth study of control-area parameters to provide a population data set for control areas was made.

4. Title: Uranium in Carbonatites in the United States

   Authorized Expenditure: $93,000
   Contractor: Powell and Associates
   Principal Investigator: J. D. Powell
   Project Summary: Genetic models for uranium in carbonatites using world-wide geologic, geochemical, and geophysical data from carbonatites and associated alkaline rocks were prepared. These models were used in evaluating uranium potential of selected carbonatites in the United States.

5. Title: Basin and Range Volcanic Census

Authorized Expenditure: $80,000
Contractor: U.S. Geological Survey
Principal Investigator: Karen Wenrich-Verbeek
Project Summary: A compilation and an analysis of past and current USGS geochemical sampling of volcanic rocks in the Basin and Range relating geochemistry to volcanic environments are being made.

Aerial Technology

1. Title: Spectrum Enhancement-Phase III

Authorized Expenditure: $320,000
Contractor: Science Applications, Inc.
Principal Investigator: Dr. John Reed
Project Summary: This is the third phase of a study to demonstrate the applicability of the spectrum-enhancement technique (MAZE) to data acquired with sodium iodide detector systems currently used in aerial radiometric surveys.

2. Title: Reconnaissance Magnetics Interpretation Survey

Authorized Expenditure: $58,000
Contractor: QEB, Inc.
Principal Investigator: D. P. O'Brien
Project Summary: The usefulness of combining magnetic data from the NURE surveys with available gravimetric data to provide a more complete regional subsurface interpretation for possible use in evaluating uranium resource potential was studied.

3. Title: Dynamic Test Range-I, Follow-on

Authorized Expenditure: $110,000
Contractor: LKB Resources, Inc.
Principal Investigator: R. L. Summerfelt
Project Summary: Detailed radiometric and aeromagnetic data were obtained. Contour maps were prepared which allowed users to find both altitude - and location-dependent concentration variations and apply this information to improve airborne calibration coefficients.

4. Title: Vertical Radon Propagation

Authorized Expenditure: $169,000
Contractor: Radiation Research Associates, Inc.
Principal Investigator: M. B. Wells
Project Summary: This project furnished much needed information for developing more accurate techniques to account for the distribution of radon daughters and for improving subsequent model calculations.

5. Title: Phoswich Detector

Authorized Expenditure: $170,000
Contractor: Grumman Aerospace Corporation
Principal Investigator: Dr. E. Schneid
Project Summary: Grumman Aerospace fabricated a hybrid Phoswich detector having a greater sensitivity for uranium than a sodium iodide detector by about 50 percent for equal volume or weight systems.

6. Title: Solid State Photomultiplier Tube Applications

Authorized Expenditure: $70,000
Contractor: Science Applications, Inc.
Principal Investigator: Raulf Polichar
Project Summary: Conventional spectral-scintillation-type uranium exploration systems are limited to a large extent by undesirable characteristics inherent to the use of the photomultiplier tube. Four tubes were fabricated, and the energy resolution of the prototypes was equal to conventional tubes and the performance of the tubes was potentially superior in use in terms of temperature, voltage, and power consumption.

7. Title: Science Applications, Inc., MAZE Code

Authorized Expenditure: $223,000
Contractor: Science Applications, Inc.
Principal Investigator: Dr. Glen Reynolds
Project Summary: The MAZE code study included: the final development and demonstration of a temporal filtering technique conceptually developed under the Spectrum Enhancement Phase II project, and the assembling of computer codes for determining detector response functions of typical aerial radiometric detectors into a user's-oriented package.

8. Title: Airborne EM Evaluation

Authorized Expenditure: $76,000
Contractor: Geoterrex Ltd.
Principal Investigator: John Devalk
Project Summary: A study to evaluate the effectiveness of the Barringer INPUT System to map resistivity of the sedimentary environments of the Red Desert, Wyoming, Technology Integration site and the Powder River Basin, Wyoming, study areas was undertaken. Results from both study areas indicate that the INPUT system was able to map gross variations of the subsurface resistivity structure but was not sufficiently detailed to map stream channels.

Technology Development and Evaluation

1. Title: Optical Fiber Logging Cable Development

   Authorized Expenditure: $90,000
   Contractor: Optelecom, Inc.
   Principal Investigator: Gordon Gould
   Project Summary: An optical fiber logging cable to increase the data transmission capabilities of logging systems many times over industry's standard four-conductor logging cable was studied. The fabricated prototype cable was tested and proved to be feasible for borehole logging.

2. Title: Uranium Borehole Logging with PFN

   Authorized Expenditure: $316,000
   Contractor: Sandia Laboratories
   Principal Investigator: Hugh Bivens
   Project Summary: Two major areas were investigated: commercialization of the neutron generating tube technology and prompt fission neutron system refinement. Field work was conducted in Texas, New Mexico, and Washington.

3. Title: ^{252}Cf-based Direct Uranium Logging System-Phase II

   Authorized Expenditure: $531,000
   Contractor: IRT Corporation
   Principal Investigator: Dr. D. K. Steinman
   Project Summary: Phase II work was to complete the upgrading of the ^{252}Cf-based delayed fission neutron probe built for DOE and certain components of the computer-based system within a logging vehicle. Field work was conducted in Texas, Wyoming, and Washington.

4. Title: Associated Uranium Minerals Logging

   Authorized Expenditure: $361,000
   Contractor: Sandia Laboratories
   Principal Investigator: Hugh Bivens
   Project Summary: This study is investigating the development of a gamma-ray spectroanalysis probe that assays for elements which are associated with uranium deposits. It is envisaged that this probe, when developed, will be used with other prospecting techniques in a systems approach for the identification of U mineralization.

5. Title: Borehole Neutron Correlation-Phase II

   Authorized Expenditure: $69,000
   Contractor: Consolidated Controls Corporation
   Principal Investigator: C. W. Peters
   Project Summary: Experiments were conducted to test the associated particle technique for uranium exploration with probes containing neutron generators. The results were used to test theoretical calculations from Phase I of the project.

6. Title: Gamma-gamma Transport Calculations-Phase I and Phase II

Authorized Expenditure: $120,000
Contractor: Science Applications, Inc.
Principal Investigator: W. A. Woolsen
Project Summary: This study investigated the gamma-ray back-scatter principle as a direct uranium logging method. The study also determined the sensitivity of formation density measurements to variations in borehole diameter, fluid, rugosity, and mud cake conditions, and determined probe design parameters.

7. Title: Computation and Non-destructive Assay Methods

Authorized Expenditure: $270,000
Contractor: Los Alamos Scientific Laboratory
Principal Investigator: Michael Evans
Project Summary: Gamma-ray flux calculations for infinite homogeneous rock media were developed.

8. Title: Borehole Data Acquisition and Transportation System (BDATS)

Authorized Expenditure: $100,000
Contractor: Science Applications, Inc.
Principal Investigator: Robert Hancock
Project Summary: This contract provided for the construction of a prototype BDATS that utilized digital data transmission and acquisition techniques.

9. Title: He^4/Ar^{36} Ratio and ^{222}Rn Measurements

Authorized Expenditure: $143,000
Contractor: Teledyne Isotopes
Principal Investigator: Dr. Don Shultz
Project Summary: The project included sampling areas of known mineralization in Red Desert, Wyoming; Copper Mountain, Wyoming; and Spokane Mountain, Washington. Results indicated that the He^4/Ar^{36} ratio did eliminate the problem of local variation in soil-gas values.

10. Title: Uranium Isotopes Studies-Phase II

Authorized Expenditure: $62,000
Contractor: Florida State University
Principal Investigator: J. K. Osmond
Project Summary: Phase II involved an in-depth evaluation with ground-water samples from deep holes in the Grants mineral belt, New Mexico.

11. Title: Lead Isotopes in Ground Water

Authorized Expenditure: $52,000
Contractor: California State University at Los Angeles
Principal Investigator: Dr. T. E. Davis
Project Summary: This project studied the U/Pb variations in and around known mineralization for uranium deposit halo-identification studies. Ground water samples were collected at different levels from seven BFEC/DOE holes and from leaching the core samples collected at the same site.

12. Title: Uranium and Radon Daughters by Nuclear Emulsions

Authorized Expenditure: $51,000
Contractor: Stieff Research and Development Co., Inc.
Principal Investigator: Lorin Stieff
Project Summary: The major objective of the study was to obtain data on the systematic distribution and concentration of ^{238}U and its daughter products ^{226}Ra, ^{210}Pb, and ^{234}U from drill-hole and geochemical samples collected over or near known ore-bodies via nuclear emulsion techniques and to determine whether leachable ^{210}Pb values represent an enhanced ^{222}Rn signal.

13. Title: Delayed Neutron Logging Demonstration

Authorized Expenditure: $120,000
Contractor: IRT Corporation
Principal Investigator: Dr. D. K. Steinman
Project Summary: The objective of the project is to evaluate the ^{252}Cf logging probe (DFN).

Technology Integration

1. Title: Stable Isotope Ratios

Authorized Expenditure: $94,000
Contractor: Global Geochemistry Corporation
Principal Investigator: Dr. I. R. Kaplan
Project Summary: These studies delineated halos around known uranium deposits, and exploration models will be prepared.

2. Title: Seismic Reflection Applications

Authorized Expenditure: $118,000
Contractor: Geophysical Services, Inc.
Principal Investigator: Richard Maxwell
Project Summary: This work will investigate the subsurface lithology and structure of the Westwater Canyon Member of the Jurassic Morrison Formation in the San Juan Basin near Crown Point, New Mexico.

Defense Programs

The role of the Department of Energy in defense activities is to provide for national security requirements in support of the Department of Defense and includes a wide range of programs. The Assistant Secretary for Defense Programs directs the Nation's nuclear weapons research, development, testing, production, and stockpile surveillance program. In addition, the Assistant Secretary coordinates a safeguards and security program related to facilities and to the provision of accountability and physical protection of special nuclear materials. Further responsibilities include management of the inertial fusion development and nuclear materials production programs, classification and declassification of nuclear weapons information, and analysis and coordination of international activities related to nuclear technology and materials.

Office of Military Application

The Office of Military Application (OMA), under the Assistant Secretary for Defense Programs, directs the research, development, engineering, testing, and production of all U.S. nuclear weapons; maintenance of reliable weapons for their stockpile life; and retirement and disposal of nuclear weapons from the stockpile. Weapon research and development is conducted primarily at the Department of Energy's three nuclear weapon laboratories: Lawrence Livermore National Laboratory (LLNL), Livermore, California, Los Alamos National Laboratory (LANL), Los Alamos, New Mexico; and Sandia National Laboratories at Albuquerque, New Mexico (SNLA), and Livermore, California (SNLL). Underground nuclear testing is conducted at the Nevada Test Site (NTS). Weapons production is conducted at seven government-owned, contractor-operated plants.

A major objective of the geosciences research and development efforts is to assure that the U.S. nuclear test program is conducted safely with respect to effects on man, structures, and the environment. Much of this work is performed by a variety of specialized contractors under the auspices of the Department of Energy's (DOE) Nevada Operations Office. The weapons laboratories also perform geosciences research in selected disciplines. Principal areas of interest include:

1. Geology/Hydrology--studies of rock formations and properties; distribution and circulation of water in the soil and underlying rocks in proposed underground test areas;

2. Seismology--development of reliable ground motion prediction techniques; measurement and evaluation of ground motion during NTS events; measurements of the response of structures to ground motion produced by underground nuclear tests; and investigations to improve U.S. capability to detect, locate, and identify nuclear explosions;

3. Radionuclide Migration Studies--study movement of explosive-produced radionuclides in the subsurface away from test sites;

4. Atmospheric Sciences--studies of fallout models, radiation models, trajectory predictions, and long-range diffusion studies; studies of airglow, aurora, cosmic rays, atmospheric aerosols, and dynamic interaction of plasmas with the upper atmosphere; pollutant transport theory; climate modeling; and composition of the atmosphere.

The total OMA program in environmental sciences which includes all geosciences activities was estimated at $6.6M in FY 1980.

SANDIA NATIONAL LABORATORIES-ALBUQUERQUE

Title: Rock Deformation and Failure
Budget: 200K
Principal Investigator: B. M. Butcher (SNL)

Summary: Experimental studies are supporting model development for computer codes describing the static and dynamic deformation and failure of competent rock, deformation of joint systems and rock fragmentation.

Title: Containment Studies
Budget: 450K
Principal Investigator: C. W. Smith (SNL)

Summary: Examination of phenomenology of residual stressfields by measurements on nuclear and high explosive events. In G-tunnel at NTS, fractures are being driven into tuff with air and water. Air fracture measurements pertain to the propagation of steam hydrofracs; water fracture measurements, plus analysis, yield estimates of in-situ stress fields.

Title: On-Site Ground Motion from Underground Weapons Tests
Budget: 70K
Principal Investigator: L. J. Vortman (SNL)

Summary: Prediction, measurement, and evaluation of ground motion during Nevada Test Site events, with special emphases on the compatibility between weapon testing and Nevada Nuclear Waste Storage investigations and on containment diagnostics. Some comparisons with earthquake motion are included.

Title: Sandia Seismic Net
Budget: 270K
Principal Investigator: H. D. Garbin and L. R. Hill (SNL)

Summary: Seismic stations placed around the Nevada Test Site are used to determine yields of underground nuclear tests and obtain earthquake/explosion discrimination data.

Title: Terradynamic Soil and Rock Penetration Program
Budget: 1900K
Principal Investigator: C. E. Dalton (SNL)

Summary: Studies of soil and rock penetration by instrumented projectiles. The structural response of the penetrator and target are being investigated both analytically and experimentally at velocities up to 1000 m/s into natural targets. Laboratory and modeling efforts involve characterizing the soil and rock physical properties and their contributions to penetration.

GEOLOGICAL SURVEY

Title: NV Geology Support

Budget: $214K

Principal Investigator: A. T. Fernald, USGS
(303)234-2391

Summary:

1. To provide a senior geology consultant and an alternate member to attend meetings of the Containment Evaluation Panel to evaluate the containment of each nuclear test.

2. To manage a facility at Mercury, Nevada, for the collection of drill cores and cuttings for nuclear weapons programs and radioactive waste management programs.

Title: Technical Support to LANL

Budget: $115K

Principal Investigator: E. C. Jenkins, USGS
(303)234-2391

Summary: To provide the Laboratory with advice on (1) site selection for nuclear tests; (2) lithology and geologic structure; (3) depth to Paleozoic rocks by gravity methods; and (4) presentations by the Laboratory at CEP meetings.

Title: Technical Support to LLNL

Budget: $115K

Principal Investigator: E. C. Jenkins, USGS
(303)234-2391

Summary: To provide the Laboratory with advice on (1) site selection for nuclear tests; (2) lithology and geologic structure; (3) depth to Paleozoic rocks by gravity methods; and (4) presentations by the Laboratory at CEP meetings.

LOS ALAMOS NATIONAL LABORATORY

Title : Low Altitude Nuclear Weapons Effects
Budget : 60K
Principal Investigators: R. W. Whitaker, E. M. Jones, M. T. Sandford, H. G. Horak

Summary: We model optical signatures from low altitude nuclear weapons using one and two dimensional radiation-hydrodynamic computer codes. We also define the dusty nuclear environment by making significant additions to our two dimensional KFIX and developed a two phase two dimensional radiation version of YAQUI. This enables us to respond to important questions raised by gaps in our understanding of the importance of dust on nuclear effects.

Title : Improved Geologic Interpretation at NTS Using Electric Logs
Budget : 20K
Principal Invesgigators: N. Marusak, R. Batra

Summary: We use electric logs, a geophysical tool measuring the resistivity of a rock formation, for detailed geologic interpretation at the Nevada Test Site. Electric logs have successfully been used to identify a missing rock sequence (geologic fault), enhance stratigraphic interpretation and aid in accurate definition of new site selections for future emplacement holes. Objectives are: to aid in the interpretation of seismic data at NTS; use electric log interpretation in new areas considered for underground testing and storage of radioactive waste; and graphically represent this refined geologic data to give a more accurate regional interpretation which would aid both the geologist and nongeologist who is required to understand geologic problems.

Title : Electrical Conductivity and Permeability of Tuff
Budget : 40.5K
Principal Investigator : T. Dey

Summary: Porosity, permeability, and electrical resistivity of zeolitized and other tuffs are measured and correlated under both hydrostatic and triaxial stress conditions. Archie's law will be tested for its applicability to tuffs. Measurements of these properties, together with stress and strain information for samples loaded to failure, are made simultaneously. The observed phenomena will be used to indicate similarities and differences in failure processes in tuffs compared to sandstones and granites

Title : Regional Seismological Research
Budget : 631K
Principal Investigators: K. H. Olsen, J. N. Stewart, E. F. Homuth, C. A. Newton, D. J. Cash

Summary: We analyze short-period and broadband seismic recordings and infer from them detailed models of crust and upper mantle structure beneath areas of New Mexico, Nevada, Arizona, Midwestern United States, and the U.S.S.R.

We seek improved diagnostic indicators for discriminating between possibly clandestine low-yield underground nuclear explosions and small earthquakes as observed at regional distance ranges (200-2000 km). A major analytic procedure is detailed waveform modeling by sophisticated computer programs; extensions and improvement of these synthetic seismogram codes is a major component of the research. Our long-range goal is to obtain important new basic understanding of short-period wave propagation in laterally complex earth structure and improve knowledge of seismogram character at regional distances.

NEVADA OPERATIONS OFFICE

Title: Analysis of Ground Motions Recorded fron Underground Nuclear Explosions

Budget: $70K

Principal Investigator: J. A. Lahoud (Adaptronics, Inc.)
(703) 893-6650
FTS 8-202-893-6650

Summary: A 14-month program to complete the postshot analysis of ground motion data collected during the accelerated high-yield test program at the Nevada Test Site and to update ground motion prediction technology.

Title: Structural Response Studies

Budget: $561K

Principal Investigator: K. K. Honda, John A. Blume & Associates Engineers, Inc., (415) 397-2525
FTS 8-415-397-2525

Summary: A three-year study consisting of four research tasks which deal with these on-going research programs are required to develop and improve these technical methods for prediction of on- and off-site structural damage potential resulting from proposed underground nuclear tests. Tasks include: Structural response analysis (highrise damage criteria), environmental effects studies, low-rise damage analysis, new structural and architectural systems.

Title: Radionuclide Migration

Budget: $28K

Principal Investigator: Paul R. Fenske (DRI)
(702) 673-7371

Summary: The Radionuclide Migration Program is a program to investigate radionuclide distribution in rubble chimneys created by underground nuclear tests and the transport of those radionuclides from the rubble chimney by moving groundwater. Field operations involve monitoring and pumping of drill-back holes within and external to rubble chimneys.

Title: NTS Cultural Resources Management Program

Budget: $26K

Principal Investigator: Lonnie Pippin (DRI)
(702) 673-7306

Summary: This program includes two overlapping research activities: (1) the immediate on-call reconnaissance of areas proposed for land disturbing activities by the Department of Energy or its contractors, and (2) the long range, systematic inventory and analyses of archeological records of the Nevada Test Site.

The first activity, required by several federal acts is oriented toward protecting significant archeological resources from adverse and inadvertent impact by the Department of Energy.

The Inventory of Cultural Resources also required by federal legislation is designed to provide information on cultural history, paleoenvironmental variability, prehistoric and historic settlement patterns in relation to land forms and economic resources and ecological and cultural processes which influence these adaptive systems through time.

Title: Saturated Zone Programs

Budget: $70K

Principal Investigator: Stephen Wheatcraft (DRI)
(702) 673-7393

Summary: In areas where underground nuclear tests are conducted, knowledge of the groundwater resources is required for the containment, design, assessment of radionuclide transport and development of water supplies. Groundwater resource studies will identify areas of serious data deficiencies and provide a basis for planning supplemental data collection programs.

The first and most easily accomplished task in analyzing the groundwater resources is the construction of a map showing the probable configuration of the water table. The second, and the more difficult step, is the construction of a three dimensional model flow system. Two saturated zone programs are currently underway, an empirical water table mapping program and a numerical analyses program of the three-dimensional aspects at the NTS hydrological system. In addition, the geochemistry of Nevada Test Site waters in wells and springs is being investigated to define the flow systems.

Title: Unsaturated Zone Program

Budget: $117K

Principal Investigators: Roger Jacobson (DRI) (702) 673-7373
Clinton M. Case (702) 673-7375

Summary: The regional unsaturated zone programs involve field effort as well as laboratory and theoretical studies on the movement of water and the transport of radionuclides through the unsaturated zone to the water table on the Nevada Test Site. An important part of the field effort has been delineation and study of recharge areas in a desert environment. This study involves a field program that investigates the movement of groundwater through the unsaturated zone both in areas of infiltration and through the thick unsaturated zone above the tunnel complex at Rainier Mesa. The groundwater recharge program currently involves: (1) a study of washes and their importance to recharge in the unsaturated and saturated zones, and (2) a study to address the fundamental recharge on bedrock areas and an attempt to correlate this with water quality changes in the Rainier Mesa tunnels.

Associated with this will be the monitoring of springs primarily at the base of Rainier Mesa. By determining the quantity and quality of the spring water it is possible to separate base flow from more direct storm waters.

Title: Containment Evaluation Panel

Budget: $73K

Principal Investigators: Paul R. Fenski (DRI) (702) 673-7371
Clinton M. Case (702) 673-7375

Summary: The principal investigators on this project are member and alternate member of the containment evaluation panel for the Department of Energy. Their main task is to review all containment designs for underground nuclear tests and to provide their judgment along with the other panel members on the likelihood of possible venting of radioactivity into the atmosphere. In addition to serving on the panel, a duplicate nuclear event data file is kept in the DOE computer and the DRI members on the containment evaluation panel carry out studies in hydrology and geology as related to containment as necessary.

Title: Radionuclide Transport Assessment at the NTS

Budget: $70K

Principal Investigator: Clinton M. Case (DRI)
(702) 673-7375

Summary: This program investigates the possible migration of radionuclides away from proposed and currently used disposal locations on the Nevada Test Site. A number of specific activities are required: (1) flash flood investigations, (2) climatic investigations, (3) measurements of existing soil saturation, (4) measurement of soil suction, (5) measurements of the saturated hydrologic conductivity as a function of saturation, (6) measurements of soil water temperatures, and (7) studies of chemical interactions of specific ions with relevant soils. These studies are carried out as field efforts, laboratory efforts and theoretical efforts.

Title: NV Geology Support

Budget: $214K

Principal Investigator: A. T. Fernald (USGS)
(303) 234-2391

Summary: (1) To provide a senior geology consultant and an alternate member to attend meetings of the Containment Evaluation Panel to evaluate the containment of each underground nuclear test. (2) To manage a facility at Mercury, Nevada, for the collection of drill cores and cuttings for nuclear weapons programs, which provides data on a continuing basis on the geology of NTS and other locales.

Title: Radiation Prediction Techniques for Nuclear Test Support

Budget: $41K

Principal Investigator: H. F. Mueller (WSNSO)
(702) 734-3513

Summary: To provide radiation exposure/dose prediction capabilities in support of DOE nuclear test activities. This support function requires continuing development and implementation of radiological prediction methodologies unique to varying test configurations, release modes, and radionuclide inventories. Prediction techniques development involves meteorological and radiological interdisciplinary studies related to the transport, dispersion, and deposition of radioactivity released into the atmosphere and resulting exposures or absorbed doses. Digital computer codes and electronic calculator programs are formulated for some of the prediction techniques employed.

Title: Meteorology for Ecological Studies

Budget: $18K

Principal Investigator: H. F. Mueller (WSNSO)
(702) 734-3513

Summary: Measurement of physical parameters in environmental and ecological studies usually includes the measurement of meteorological variables such as temperature of the air; humidity and solar radiation; measures of air motion or ventilation such as mean wind direction and wind speeds at varying heights above the surface; soil and vegetative surface temperatures; and soil moisture. These types of measurements are made to help in identifying and understanding the routes whereby radioactive materials are redistributed. Currently, the major effort is concentrated on the study of plutonium and certain other radionuclide contamination in the environs of the Nevada Test Site with special emphasis on the resuspension and transport of radioactive material by the wind. A special meteorological measurement network is operated in connection with radiological measurements being made by the Lawrence Livermore Laboratory. Activities are coordinated by the Nevada Applied Ecology Group.

Title: Studies to Improve Weather, Wind, Trajectory, and Transport Prediction for Nuclear Tests

Budget: $110K

Principal Investigator: H. F. Mueller (WSNSO)
(702) 734-3513

Summary: Provide the continuing meteorological services required in the safety and technical programs associated with all forms of nuclear and non-nuclear experiments conducted by the DOE Nevada Operations at the Nevada Test Site and other places. Studies are conducted to improve the equipment and procedures for measuring, analyzing, and predicting the atmospheric processes involved in the transport of any radioactive effluents from nuclear tests. The potential effects of radioactivity on the bioenvironment justifies continuing efforts to understand transport phenomena and predict the areas to be subject to potential exposure. A variety of approaches are used, including statistical relationships, case studies, and dynamical modeling to improve predictions; development of automated telemetered sensors to measure input atmospheric parameters; and development of computer programs to process data, perform calculations, and display results. The

meteorological studies are based primarily on weather and wind data collected in the process of supporting nuclear tests, but National Weather Service network data and local measurements are also used. The effluents from past nuclear rocket engine tests, cratering tests, and atmospheric experiments are used to provide large scale transport data.

Lawrence Livermore National Laboratory

1. Title : NTS Groundwater Hydrology
   Budget : 220K
   Principal Investigator : R. W. Buddemeier (LLNL) 532-8159

   Summary: Determination of hydrologic source terms for the migration of radionuclides from the sites of nuclear detonations and modeling.

2. Title : Geologic and Geophysical Studies at the Nevada Test Site (NTS)
   Budget : 200K
   Principal Investigator : H. Lawrence McKague (LLNL) 532-6491

   Summary: Various geologic projects such as alluvium correlation studies and age dating of carbonate from faults and stratigraphic horizons lead to a better understanding of NTS geology, and concomitantly, the safe and effective use of the NTS.

3. Title : Geologic and Geophysical Characterization of Nuclear Test Sites
   Budget : 500K
   Principal Investigator : N. Howard (LLNL) 532-6491

   Summary: Geologic and geophysical descriptions allow site evaluation of containment for proposed underground nuclear tests.

4. Title : Geologic and Nuclear Test Effects Data Base
   Budget : 150K
   Principal Investigator : N. Howard (LLNL) 532-6491

   Summary: All geologic and nuclear test effects data are entered in a computerized data base so that new sites may be compared and evaluated to previous tests.

5. Title : Seismic Surveys at the Nevada Test Site
   Budget : 250K
   Principal Investigator : N. Burkhard (LLNL) 532-6483

   Summary: Knowledge of the subsurface geology is needed for siting of NTS experiments. Because of the seismic characteristics of the alluvium, conventional seismic surveys have not been effective in defining the subsurface geology. This work has developed successful seismic techniques.

6. Title : Improved Geophysical Logging
   Budget : $50K
   Principal Investigator : J. Hearst (LLNL) 532-6490

   Summary: Conventional well logging methods are not satisfactory for determining water and carbonate content at NTS. Special logs and calibration techniques are being developed to solve these and similar problems.

7. Title : Containment Studies for Nuclear Weapons Testing
   Budget : 200K
   Principal Investigator : R. Terhune (LLNL) 532-3964

   Summary Computer modeling of explosion phenomenology and earth media behavior characteristics to develop containment risk analysis procedure for Nuclear Weapons Test Program.

8. Title : Stratospheric Effects of Atmospheric Nuclear Explosives
   Budget : 60K
   Principal Investigator : F. M. Luther (LLNL) 532-1825
   J. S. Chang (LLNL) 532-4081

   Summary: To understand and assess the potential impact of atmospheric nuclear explosives on the stratosphere, ultraviolet radiation flux and surface climate by use of numerical models of the chemistry and physics of the atmosphere.

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