United States
Environmental Protection
Agency

Office of
Research and
Development

February 1979

Energy, Minerals and Industry

EPA

DOE Program Transfer

Abstracts of Fossil Fuel Related Health and Environmental Effects Research Projects

EPAX
8905-
0038

EPA

DOE Program Transfer

Abstracts of Fossil Fuel Related Health and Environmental Effects Research Projects

Office of Energy, Minerals and Industry
Office of Research and Development
U.S. Environmental Protection Agency
Washington, D.C. 20460

February, 1979

U.S. Environmental Protection Agency
Library, Room 2404 PM-211-A
401 M Street, S.W.
Washington, DC 20460

Headquarters Library
Mail code 3201
1200 Pennsylvania Avenue NW
Washington DC 20460

FOREWORD

The Interagency Energy/Environment R&D Program was inaugurated in FY 1975 for energy-related environmental research and development. The Interagency Program is planned and coordinated by the Office of Energy, Minerals and Industry but is implemented through interoffice and interagency resource transfers throughout the entire Office of Research and Development and between the EPA and 17 other Federal agencies and departments.

In accordance with the President's FY 1979 budget, there has been a program transfer of approximately $14 million of fossil energy-related environmental and health effects research projects from the Department of Energy (DOE) to the Environmental Protection Agency (EPA). The intent of this transfer, which was concurred with by Congress, is to consolidate and improve the overall Federal effort in determining the health and environmental impacts of energy development.

The research areas and their associated FY 1979 funding that have been transferred to EPA consist of the following:

- Ecological Effects -- $3,984 K
- Health Effects -- $7,208 K
- Atmospheric Transport -- $2,695 K

The purpose of this document is to present a description of the projects and funding involved in the DOE to EPA transfer. To this end, all pertinent project information has been included. The report is organized into three major sections corresponding to the research areas listed above. Project information includes project titles, applicable funding, designated EPA project officer, performing organization, principal investigator and phone number, and abstract.

Of special note is the Atmospheric Transport section which consists of the Multistate Atmospheric Power Production Pollution Study (MAP3S). Due to the uniqueness of this study, a program description is included which gives an overview of the goals and objectives of MAP3S.

For additional information on the entire program, contact:

Clinton W. Hall (Director) or
William Frietsch (Deputy Director)

Energy Coordination Staff
Office of Energy, Minerals and Industry
Washington, D.C. 20460
FTS 426-4567

Following is a list of the performing organizations involved in the transfer and their addresses:

Argonne National Laboratory (ANL)
9700 South Cass Avenue
Argonne, Illinois 60439

Battelle Pacific Northwest Laboratory (PNL)
P.O. Box 999
Richland, Washington 99352

Brookhaven National Laboratory (BNL)
Upton, New York 11973

Lawrence Berkeley Laboratory (LBL)
University of California
Berkeley, California 94720

Lawrence Livermore Laboratory (LLL)
University of California
Livermore, California 94550

Oak Ridge National Laboratory (ORNL)
Oak Ridge, Tennessee 37830

U.S. Department of Agriculture
Plant Stress Laboratory
Agricultural Research Center
Beltsville, Maryland 20705

Boston University
Department of Biology
881 Commonwealth Avenue
Boston, Massachusetts 02215

Boyce Thompson Institute
Environmental Biology
1086 North Broadway
Yonkers, New York 10701

University of California - Davis
Energy Related Health Research Laboratory
Davis, California 95616

University of Georgia
Savannah River Ecology Laboratory
Savannah River Plant
Drawer E
Aiken, South Carolina 29801

University of Rochester
Radiation Biology and Biophysics Department
Rochester, New York 14642

University of Tennessee (UT-CARL)
Comparative Animal Research Laboratory
1299 Bethel Valley Road
Oak Ridge, Tennessee 37830

Lovelace Inhalation Toxicology Research Institute (ITRI)
P.O. Box 5890
Albuquerque, New Mexico 87115

Oak Ridge Associated Universities (ORAU)
Marmoset Research Center
P.O. Box 117
Oak Ridge, Tennessee 37830

New York University
College of Medicine
Department of Environmental Medicine
New York, New York 10016

University of Washington
College of Arts and Sciences
Department of Oceanography
Seattle, Washington 98195

TABLE OF CONTENTS

	FY 1979 Funds	Page
FOREWORD		i
ECOLOGICAL EFFECTS	3,984 K	2
Terrestrial Effects		4
Combustion Pollutant Stress on Terrestrial Ecosystems		4
Marine Effects		7
Petroleum Hydrocarbons in the Marine Environment		7
Marine Effects of Biocides		9
Freshwater Effects		10
Ecosystem Analysis		13
HEALTH EFFECTS	7,208 K	15
Biological Effects of Coal Combustion Pollutants		17
Pulmonary Deposition of Coal Dusts		21
Carcinogenic Polycyclic Hydrocarbons		22
Fundamental Research in Biological Test Systems		23
ATMOSPHERIC TRANSPORT: MAP3S (Multistate Atmospheric Power Production Pollution Study)	2,695 K	34
Program Description		35
GRAND TOTAL	13,887 K	

Ecological Effects

ECOLOGICAL EFFECTS

EPA Project Officer	FY 1979 Funds	Page
Alfred A. Galli FTS 426-4567 OEMI Washington, D.C.		
Terrestrial Effects		4
Combustion Pollutant Stress on Terrestrial Ecosystems		4
Effects of Chronic SO_2 Exposure on Economically Important Crops in Midwest	232 K	4
Effects of Acid Rain on Northeast Forests	258 K	4
Effects of Episodic Fluctuations in SO_2 Concentrations in Presence or Absence of Ozone	131 K	5
Effects of SO_2 and NO_2 on Vegetation in Four Different Areas	176 K	5
Theoretical Approach to Assessment of Pollutant Stress on Plant Function	405 K	6
Agriculture--Absorption by Vegetation	48 K	6
Terrestrial Subtotal	1,250 K	
Marine Effects		7
Petroleum Hydrocarbons in the Marine Environment		7
Effects of Petroleum Hydrocarbons on Behavior of Marine Organisms	90 K	7
Effects of Petroleum Hydrocarbons in Marine Ecosystems --Puget Sound	83 K	7
Long-Term Hydrocarbon Effects on Organisms and Communities in NW Coastal Ecosystems	165 K	8
Fate and Effects of Hydrocarbons in California Coastal Environment	83 K	8
Natural Hydrocarbon Distribution in Puget Sound	170 K	8
Effects of Sublethal Levels of Oil on Behavior and Chemoreception of Aquatic Animals	66 K	9

ECOLOGICAL EFFECTS (Continued)	FY 1979 Funds	Page
Marine Effects of Biocides		9
Toxicant Formation in Condenser Cooling Systems	207 K	9
Marine Subtotal	864 K	
Freshwater Effects		10
Long-term Input of Mortality on Fishery Population and Yield	109 K	10
Nature and Quantity of Pollutants Reaching Aquatic Environment From Coal Combustion	258 K	10
Ecosystem Resilience	186 K	11
Great Lakes Pollutant Transport Processes	431 K	11
Great Lakes Pollutant Transport Processes	179 K	12
Great Lakes Biological Effects of Energy-Related Pollutants	397 K	12
Great Lakes Research Vessel Support	52 K	12
Freshwater Subtotal	1,612 K	
Ecosystem Analysis		13
Methodology for Collecting and Interpreting Ecological Data	258 K	13
Ecosystem Analysis Subtotal	258 K	
ECOLOGICAL EFFECTS GRAND TOTAL	3,984 K	

Terrestrial Effects

Combustion Pollutant Stress on Terrestrial Ecosystems

Title: Effects of Chronic SO_2 Exposure on Economically Important Crops in Midwest (232 K)

Performing Organization: Argonne National Laboratory

Principal Investigator: Joseph Miller, FTS 972-4206

Abstract: Although damage to crop plants in certain industrialized regions is well documented (primarily as the result of acute episodes of SO_2 exposure), much less is known with regard to chronic, long-term exposures at concentrations of the order 1-10 pphm which frequently occur. The primary emphasis of these studies is to determine the effects of such chronic exposure to SO_2 on the growth and yield of economically important crop plants common to the midwest. An open air fumigation system will be utilized to treat uniform plots of soybeans with 0, 2, 5, and 10 PPHM of SO_2 regularly throughout the growing season. Effects of this chronic exposure on crop morphology, development, physiology, and yield, plus the nutrient and elemental composition of individual plants, will be studied. Actual flux rates of SO_2 into the plant canopy will be obtained by measuring SO_2 profiles in both the treated plots and in untreated regions several hundred meters downwind. In addition, growth chamber studies will be carried out to evaluate the relationships between the absorbed dose (uptake) and response under controlled conditions. Stomatal diffusion resistances of test plants and other physiological and environmental variables will be monitored closely as quantitative indicators of stress and in order to make possible objective comparisons of field and chamber results.

Title: Effects of Acid Rain on Northeast Forests (258 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: George R. Hendrey, FTS 666-3262

Abstract: There is evidence that acid rainfall and acid particulates as by-products of energy-related activities are imposing a considerable stress on ecosystems in the northeastern region of the United States. Forest ecosystems of Long Island are particularly sensitive as they have poorly buffered soils. Acid rain can have effects both on the vegetation and on the soil. Changes in pH of stemflow and through fall can change the nutrient flux from vegetation to the soil and influence the growth of bark-living and leaf-surface organisms. Changes in soil chemistry will result in changes in microbial activities. These changes in turn affect the rates of mineralization and nitrification and of other processes. Decreases in the rates of these processes will have a direct effect on nutrient levels in the soil and therefore upon the productivity of plant and animal life. To begin to understand the effects of acid rain and acid precipitation on plant species of the forest, a laboratory program has been established. Experiments are

focused to (1) measure effects of acid rain and acid precipitation on foilage at acute and protracted dose rates, (2) establish visual and histological responses after exposure to both acid rain and acid precipitation, (3) set threshold limits of acid rain and acid aerosols that plants can withstand with no visual or anatomical malfunctions and no growth inhibition, (4) follow rates of nitrate and sulfate accumulation after exposure to compare with injury responses, and (5) determine effects on leaf surfaces by use of scanning electron microscopy and the leaching of elements through increased cell permeability.

Title: Effects of Episodic Fluctuations in SO_2 Concentrations in Presence or Absence of Ozone (131 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: W.F. Harris, III, FTS 624-7444

Abstract: This project examines the influence of dosage kinetics on plant response to individual and combined exposures with sulfur dioxide, ozone, and acidified precipitation. With gaseous pollutants, emphasis is being placed on determining the role of episodic fluctuations in SO_2 concentrations in the presence or absence of ozone. Both single and multiple exposures are being conducted to explore the role of exposure history on plant response. Concentrations of SO_2 being utilized are at or below the current secondary NAAQS (3-H avg more or less 0.50 ppm). Plant response is being measured in terms of both altered rates of physiological processes (photosynthesis and transpiration) and plant growth and yield. Experiments with simulated acid rain are examining both the range of responses produced by high (pH 3.2) acidity levels and the influence of lower dosage levels, as determined by rainfall acidity and frequency. In addition to gas exchange processes and altered plant growth and yield, effects on root modulation, weathering of leaf surface waxes, leaf wettability and reflectance are being examined. Initial experiments are being conducted with kidney beans (*Phaseolus vulgaris*) with additional species (yellow poplar, white oak, and shortleaf pine) to be included ultimately.

Title: Effects of SO_2 and NO_2 on Vegetation in Four Different Areas (176 K)

Performing Organization: Boyce Thompson Institute

Principal Investigator: Dr. Leonard H. Weinstein, 914-965-0390

Abstract: Research is proposed for a study of the effects of SO_2 and NO_2 on vegetation in four different but integrated areas. These areas of research, which include both basic and applied aspects, are (1) the route and rate of uptake and metabolic transformation of SO_2 in plants, (2) the effect of SO_2 on the plant as it affects its suitability as a host for plant diseases, (3) the effect of SO_2 on secondary products of plant metabolism and the relation of these changes to the susceptibility of the plant to invasion by insects, and (4) the effect of NO_2 on the phytotoxicity of SO_2 with respect to leaf lesions and yield. These investiga-

tions will utilize various cultivars or hybrid lines of plant species of economic importance (conifers, corn, soybeans, wheat). Benefits realized from these studies will include a broad data base on both direct and indirect effects of SO_2 in plants and how they are affected by NO_2. This kind of information will be very useful to assess the impacts of fossil-fueled power generators on agriculture and forestry.

Title: Theoretical Approach to Assessment of Pollutant Stress on Plant Function (405 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Joseph H. Shinn, FTS 532-6806

Abstract: A combination experimental and theoretical approach to the assessment of environmental stress on plant function in the ecosystem is described. The approach ultimately relies on validated theoretical process models supplemented by empirical models where theoretical conceptualization of environment x plant interactions is weak or lacking. Experimental equipment and systems have been developed to provide the necessary data base. These methods are currently being utilized in a study of air pollution stress effects on ponderosa pine in the San Bernardino Mountains of California.

Title: Absorption by Vegetation (48 K)

Performing Organization: U.S. Department of Agriculture

Principal Investigator: Dr. Jesse H. Bennett, 301-344-3143

Abstract: This is a proposal to conduct basic research into physiological effects of SO_2 and NO_2 and various pollutant combinations on crop plants. The primary purpose is to assess the foliar absorption rates and to determine minimum doses that can inhibit photosynthesis and alter plant growth without causing visible injury. Some experiments will be directed toward assessing the possible fertility value of low exposure doses of these pollutants on S/N deficient plants. Use of radioactive tracer techniques is anticipated in the research with sulfur dioxide. Varieties varying in tolerance to SO_2 and NO_2 will be used in some of the studies. Plants will be grown and fumigated in controlled environments which will be monitored with respect to temperature, humidity, light, wind, and carbon dioxide and pollutant content.

Marine Effects

Petroleum Hydrocarbons in the Marine Environment

Title: Effects of Petroleum Hydrocarbons on Behavior of Marine Organisms (90 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: Charles I. Gibson, 206-683-4151

Abstract: The basic aim of the research is to observe and describe patterns of behavior in marine organisms as related to life habits and environmental requirements. Once established, the various strategies possessed by the organism to deal with the total range of selected environmental factors can be identified, including those levels which may be stressful. Such understanding of behavior under natural conditions may be used to design experiments in the laboratory, with the formulation of questions and interpretation of results derived from and related to the field observations of natural behaviors. From these findings the effect of man-induced perturbations may be predicted, with the highest probability of predictive success on those which approximate natural stresses. Based on findings to date, the research will center on defining comprehensively the natural flexibility of behavioral patterns expressed under various environmental regimes.

Title: Effects of Petroleum Hydrocarbons in Marine Ecosystems--Puget Sound (83 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: J.R. Vanderhorst, 206-683-4151

Abstract: Production and transport of petroleum in the coastal and inland waters of the Pacific Northwest is in the process of a dramatic increase due to completion of the Trans-Alaska Pipeline, present and anticipated offshore oil leases in Alaska, and exploration of offshore leasing activities on the Oregon and Washington coasts. These activities will result in a significant increase in the petroleum hydrocarbon content of the marine ecosystems. The objectives in this program are to identify potential population and community response parameters and provide estimates of changes in these parameters in the field. Emphasis is placed on identification of parameters for which statistically valid estimates can be made at specific field sites in proximity to petroleum industry operations. This is being accomplished by field sampling, field manipulative studies, development of procedures for indirect estimation of population vital statistics, and by manipulation of statistical design. Laboratory experiments are being conducted to define the relative magnitude of change which may be expected in parameters from specified inputs of petroleum hydrocarbons. At present, these studies are examining the response of marine intertidal communities and populations of clams to chronic low-concentration contamination by petroleum.

Title: Long-Term Hydrocarbon Effects on Organisms and Communities in NW Coastal Ecosystems (165 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: D.R. Anderson, FTS 444-7511 (ask for 946-2934)

Abstract: This research program has been designed to provide data necessary to access effects of long-term exposure to petroleum hydrocarbons on selected organisms and communities from the northwest U.S. coastal ecosystems. The types of studies in progress include long-term lab exposure of cultures of selected species to sublethal levels of the aqueous phase of Prudhoe Crude Oil (PBC), exposure of organisms in field or laboratory to sediments contaminated with hydrocarbons in varying degrees, and in situ depuration studies on rates of release of hydrocarbons from both sediment and organisms previously contaminated and, at the same time, monitoring of the recruitment rate of benthic organisms in these sediments. The program closely integrates analytical expertise of the environmental chemistry section with experimental approaches of marine biologists in the marine sciences section. While utilizing state-of-the-art techniques, development is taking place to produce better analytical methods and experimental approaches to more closely define the transport of hydrocarbons and their effects under natural conditions.

Title: Fate and Effects of Hydrocarbons in California Coastal Environment (83 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Robert B. Spies, FTS 532-5792

Abstract: This marine science activity investigates the fate and effects of petroleum hydrocarbons on the California coastal environment. It responds to increased offshore oil drilling in southern California, particularly the Santa Barbara Channel. It is designated to complement the B.L.M. study of the entire southern California bight. By focusing attention on ecological phenomena around a natural oil seep, hydrocarbon effects and processes can be realistically studied that would be anticipated by increased oil pollution in the Santa Barbara Channel. For the past 2 years, we have been studying faunal communities living in the well-oiled sediments of the seep and a nearby control area. The new study will answer questions raised by the baseline study. These include possible adaptation of communities to chronic oil pollution; fractionation of hydrocarbons among sediments, water, and organisms; and trophic transfer of hydrocarbons from sediments to organisms. Therefore, this project represents a significant redirection of the former effort supported by EPA passthrough funding.

Title: Natural Hydrocarbon Distribution in Puget Sound (170 K)

Performing Organization: University of Washington

Principal Investigator: Dr. Roy Carpenter, 206-543-8535

Abstract: Seasonal samplings of phytoplankton, zooplankton, and neuston are being made in a number of areas within Puget Sound and off the west coast of Washington State north of the Columbia River. The samples are being subjected to solvent

extraction to remove the aliphatic and aromatic hydrocarbons, which are then being characterized by gas chromatography, UV fluorescence spectroscopy, and high pressure liquid chromatography. Selected samples are being analyzed by combined gas chromatography-mass spectrometry and/or by having 14C and 13C/12C ratios determined. The purpose of these measurements is to establish the natural distribution of hydrocarbons in local marine organisms and sediments and to determine the extent to which they may be already contaminated by petroleum hydrocarbons from chronic oil spills. Some of the regions being sampled are in comparatively remote areas which are unlikely to have received significant oil pollution while other samples come from areas near petroleum refineries or along tanker routes where spills are more likely. In addition to the organisms, cores of sediment are being collected and analyzed in a similar manner. With the lead-210 technique, we are also determining sediment accumulation rates in these cores over the last 100 years. We are thus determining profiles of changes in hydrocarbons types and amounts during the last 100 years.

Title: Effects of Sublethal Levels of Oil on Behavior and Chemoreception of Aquatic Animals (66 K)

Performing Organization: Boston University

Principal Investigator: Dr. Jelle Atema, 617-353-2442

Abstract: Studies will be made of the effects of temperature and of petroleum hydrocarbon fractions on the behavioral responses of catfish, lobsters, and marine snails. Heat shock studies on catfish at different acclimation temperatures have led to the hypothesis that temperature affects the fish's hormone level. Elevated hormone levels result in formation of breeding territories which are based on male aggression. Abnormal levels of aggression appear to be the result of both abnormally high temperatures and abnormally crowded conditions. The investigator proposes to separate the two parameters in a naturalistic study where crowding will not be a determining factor. A model is proposed to determine the mechanisms by which petroleum hydrocarbons interfere with marine animal behavior which predicts that specific compounds or classes of compounds will cause specific behavioral changes. Some of these changes will be mediated via chemoreceptors, either as perceived compounds confusing the natural chemical environment or as blocking compounds damaging receptor structures.

Marine Effects of Biocides

Title: Toxicant Formation in Condenser Cooling Systems (207 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: R.W. Brocksen, FTS 624-7399

Abstract: The overall goal of this research is development of the ability to predict the environmental effects of toxicants resulting from efficient operation of condenser cooling systems. The research in progress involves chlorine optimization for which two criteria are important: (1) Determination of the minimum dose requirements needed to control fouling and (2) estimation of the environmental

effects of releases at that level. Steps toward the first goal above have been initiated using data from operating power plants in the Southeast and Michigan. These data will be supplemented as required by research studies both in the laboratory and in situ, using the important fouling communities which are identified. Efforts toward the second goal have begun to identify and quantify the important chlorine reaction products (both residual chlorine and chlorinated organics) produced under various field conditions. Toxicity of these products at realistic dose-time combinations will be estimated using carp eggs, daphnia, and fathead minnows, among others. Acute and chronic toxicity as well as bioaccumulation will all receive some emphasis. Results will be important in making decisions regarding optimum design and operation of power plants.

Freshwater Effects

Title: Long-Term Input of Mortality on Fishery Population and Yield (109 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: R.W. Brocksen, FTS 624-7399

Abstract: The objective of this research program is to develop and apply modeling and statistical methodologies for fish populations that will be of value (a) in evaluating the consequences of manmade stresses, (b) in placing previously qualitative statements into a quantitative framework, and (c) in defining issues where field and laboratory research are essential for more accurate estimates of impacts. The methodologies will be sufficiently flexible so as to be applicable to more than one site and one fish species. Two interrelated approaches are used in our computer simulation modeling of fish populations. First, a population transport model is developed and applied in cases where it is important to consider spatial phenomena in addition to temporal phenomena. Second, an age-dependent, life-cycle population model is developed and applied to estimate the long-term impact of increased mortality on the size and age structure of the total population and, where appropriate, on the yield to the fishery.

Title: Nature and Quantity of Pollutants Reaching Aquatic Environment From Coal Combustion (258 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: D.R. Anderson, FTS 444-7511 (ask for 946-2934)

Abstract: The objective of our present research is to obtain predictive information on potential impacts of coal combustion and coal conversion (i.e., solvent refining) on water quality and aquatic biota. Essentially, we are attempting to identify the byproducts that reach aquatic environments, determine which ones occur in greatest concentrations, assess their potential for adverse impacts, and quantify the direct and indirect effects that can result. Categories of potentially adverse toxicants include heavy metals, polynuclear aromatic hydrocarbons, phenolic compounds, basic hydrocarbons, and various trace elements. Our program consists of

five interrelated projects: (1) assessment of current state-of-the-art, (2) site surveys of western coal-fired plants, (3) laboratory studies of selected effluent constituents, (4) studies of developing technologies (SRC), and (5) sublethal effects (behavioral, physiological) of coal effluents on freshwater biota.

Title: Ecosystem Resilience (186 K)

Performing Organization: University of Georgia at Athens

Principal Investigator: Dr. Michael H. Smith, FTS 239-2959

Abstract: The objective of this program is to address questions related to the response of environment systems to stress. In particular, which characteristics of ecosystems or populatons are most vulnerable, resistant, and have the most rapid recovery rate following ecological disturbance? These questions are of vital importance during the present period of escalating energy demands as all power generating facilities will produce thermal or other environmental stresses. At SREL we have studied long- and short-term effects of thermal stress in both field and laboratory conditions. We will continue to focus on aquatic ecosystems and species populations. The development of a capability to direct and control heated effluent from a thermal canal to a natural creek will expand our field experimentation opportunities. This experiment will concentrate on plant and animal populations normally occurring in the stream. The program will be set up to establish prealteration conditions of selected parameters for later comparison with control and altered portions of the system.

Title: Great Lakes Pollutant Transport Processes (431 K)

Performing Organization: Argonne National Laboratory

Principal Investigator: Paul Frenzen, FTS 972-4143

Abstract: This program examines the role of the principal physical transport processes which combine to define the average pathways followed by energy-related pollutants in the Great Lakes. These mechanisms include (a) wet and dry deposition at the air-water interface, (b) resuspension and redistribution of sediments on the bottom, and (c) large-scale mixing associated with wind-driven upwelling circulations. Field experiments are conducted to obtain data sets sufficient to test available models of these mechanisms, the goal being to develop quantitative information on the average pathways followed by pollutant material as they move from atmospheric or stream inputs, through the water column to the sediments. Dry and wet deposition data are collected at the air-water interface by equipment mounted on spar buoys in the open lake; sediment resuspension studies are conducted in the lower boundary layer by suitable instruments near the bottom. Existing models of these transport and mixing mechanisms will be tested and modified as required to obtain realistic simulations of the average pollutant pathways in the Great Lakes.

Title: Great Lakes Pollutant Transport Processes (179 K)

Performing Organization: Argonne National Laboratory

Principal Investigator: Paul Frenzen, FTS 972-4143

Abstract: This program examines the role of the principal physical transport processes which combine to define the average pathways followed by energy-related pollutants in the Great Lakes. These mechanisms include (a) wet and dry deposition at the air-water interface, (b) resuspension and redistribution of sediments on the bottom, and (c) large-scale mixing associated with wind-driven upwelling circulations. Field experiments are conducted to obtain data sets sufficient to test available models of these mechanisms, the goal being to develop quantitative information on the average pathways followed by pollutant material as they move from atmospheric or stream inputs, through the water column to the sediments. Dry and wet deposition data are collected at the air-water interface by equipment mounted on spar buoys in the open lake; sediment resuspension studies are conducted in the lower boundary layer by suitable instruments near the bottom. Existing models of these transport and mixing mechanisms will be tested and modified as required to obtain realistic simulations of the average pollutant pathways in the Great Lakes.

Title: Great Lakes Biological Effects of Energy-Related Pollutants (397 K)

Performing Organization: Argonne National Laboratory

Principal Investigator: Paul Frenzen, FTS 972-4143

Abstract: Field investigations which represent a major portion of the Great Lakes research program require the periodic use of research vessels for sampling and other *in situ* experimental activities. These vessels are required to be equipped for deep-water limnological studies and must be capable of operating in the open lakes. Up to now, ship-time has been leased from other midwestern research groups. This situation will be changed in FY 1978 since ANL will have used FY 1977 equipment funds to purchase a 50-foot fast work boat equipped for lakewide research activities. The vessel will be based relatively near ANL, will be operated in all seasons of the year, and will be able to accommodate most of the activities in progress or planned for the Great Lakes research program. The total costs of operating, maintaining, and staffing this vessel will not be unlike those incurred in chartering larger vessels from other organizations. However, since the use-factor of a vessel based near ANL and available on short notice year-around will be greater, daily costs will be correspondingly lower.

Title: Great Lakes Research Vessel Support (52 K)

Performing Organization: Argonne National Laboratory

Principal Investigator: Paul Frenzen, FTS 972-4143

Abstract: Field investigations which represent a major portion of the Great Lakes research program require the periodic use of research vessels for sampling and other *in situ* experimental activities. These vessels are required to be equipped for deep-water limnological studies and must be capable of operating in the open

lakes. Since up to now ANL has not owned such a vessel, ship-time has been leased from other midwestern research groups who are so equipped. This situation will be changed in FY 1978 since ANL will have used FY 1977 equipment funds to purchase a 50-foot fast work boat equipped for lakewide research activities. The vessel will be based relatively near to ANL, will be operated in all seasons of the year, and will be able to accommodate most of the activities in progress or planned for the Great Lakes research program. The total costs of operating, maintaining, and staffing this vessel will not be unlike those incurred in chartering larger vessels from other organizations. However, since the use-factor of a vessel based near to ANL and available on short notice year-around will be greater, daily costs will be correspondingly lower.

Ecosystem Analysis

Title: Methodology for Collecting and Interpreting Ecological Data (258 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: L.L. Eberhart, FTS 942-3251

Abstract: The purpose of this study is to provide improved quantitative methodology for the description and interpretation of ecological data and to provide a suitable analytical framework for field and laboratory research activities. The problems dealt with include (1) design of sampling programs, (2) experimental design, (3) structuring of computer simulation models, (4) formulation of methods of estimation, (5) hypothesis testing, and (6) analyses of relevant data. Justification for the project rests on the crucial need for improved quantitative methods in ecology. To be truly effective, such methodology must encompass sampling, statistical methods, modeling, and real data without undue emphasis on any one aspect. The increased scope of impact evaluation problems which need to be addressed has led us to include questions having to do with the assessment of abundance of natural populations in the vicinity or region of energy related activities as a part of this project.

Health Effects

HEALTH EFFECTS

EPA Project Officer	FY 1979 Funds	Page
Gerald J. Rausa FTS 426-4567 OEMI Washington, D.C.		
Biological Effects of Coal Combustion Pollutants		17
Pathology of Respiratory Epithelium	94 K	17
Cocarcinogenesis in Hamsters	104 K	17
Cocarcinogenesis in Mice	94 K	17
Respiratory Toxicology	139 K	18
Carcinogenesis Screening-Respiratory Toxicology	248 K	18
Cellular (*in vivo*) and Biochemical Changes	62 K	19
Lung Clearance Mechanisms	62 K	19
Acute-Chronic Loss of Lung Function	104 K	20
Interspecies Transport and Fate as Function of Age	465 K	20
Multispecies Metabolic Transport Models	310 K	21
Subtotal	1,682 K	
Pulmonary Deposition of Coal Dusts		21
Deposition, Transposition, and Fate of Associated Components	237 K	21
Lung Deposition and Transport Modeling	124 K	21
Subtotal	361 K	
Carcinogenic Polycyclic Hydrocarbons		22
Ultrastructural Changes - Lung Epithelium	108 K	22
Effects on Tracheal Implant Cultures	94 K	22
Carcinogenesis and Cocarcinogenesis Dose/Effect	380 K	23
Subtotal	582 K	

HEALTH EFFECTS (Continued)

	FY 1979 Funds	Page
Fundamental Research in Biological Test Systems		23
Chemical Activation of Tumor Virus	221 K	23
Chemical Activation of Tumor Virus	116 K	23
Develop Mutagenesis Marker	139 K	24
Develop Mutagenesis Marker	77 K	24
Develop Carcinogenesis Biochemical Markers	206 K	25
Develop Carcinogenesis Biochemical Markers	94 K	25
Develop Markers Reproductive--Teratological Damage	67 K	25
Develop Markers Reproductive Damage	289 K	26
Develop Organ-Cell Cultures-Lung	94 K	26
Develop Organ-Cell Cultures-Lung and Skin	155 K	27
Develop Markers for Damage to Immune System	310 K	27
Baseline Studies to Support Carcinogenesis	496 K	27
Baseline Studies to Support Carcinogenesis	57 K	28
Baseline Studies to Support Hematological Effects	622 K	28
Baseline Studies to Support Metabolism	176 K	29
Baseline Studies to Support Metabolism	174 K	29
Baseline Studies to Support Metabolism	102 K	30
Baseline Studies to Support Metabolism	140 K	30
Baseline Studies to Support Mutagenesis	434 K	30
Baseline Studies to Support Mutagenesis	253 K	31
Chemical Carcinogenic Cells *In Vitro*	211 K	31
Methylated Metals Mutagenesis	150 K	31
Subtotal	4,583 K	
HEALTH EFFECTS GRAND TOTAL	7,208 K	

Biological Effects of Coal Combustion Pollutants

Title: Pathology of Respiratory Epithelium (94 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: John B. Storer, FTS 624-0212

Abstract: The purpose of the investigation is to determine (1) the role of several highly suspect gaseous and particulate fossil fuel combustion products in the induction of chronic obstructive pulmonary disease and emphysema in particular, (2) the effect of residual injury due to exposure to one toxic air contaminant on the susceptibility to another in induction of emphysema, and (3) to examine the progression of the disease processes leading to emphysema production after the exposure to the main etiological agents has ceased. The main air contaminants which will be studied singly and in combination are cadmium, sulfuric acid, and nitrogen dioxide.

Title: Cocarcinogenesis in Hamsters (104 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: A. Marchok, FTS 624-3966

Abstract: The studies have two major objectives: (1) to investigate the cocarcinogenic activity of irritant gases derived from combustion of fossil fuels and (2) to study biochemical changes in the lungs following exposure to such air contaminants. In the first group of studies, the effects of nitrogen dioxide and formaldehyde on the tumor response induced by the systemic carcinogen diethylnitrosamine (DEN) in hamsters are being investigated. Animals are exposed at different time intervals before and after a single injection of DEN, which causes tumors in all major segments of the respiratory tract. The use of this tumor model is being explored for testing air contaminants for cocarcinogenic activity. The second group of studies is concerned with the effects of NO_2 on lung surfactant synthesis and catabolism. Particular attention is given to the biosynthetic activity in the lungs of NO_2 tolerant animals. This work is carried out in collaboration with the lipid biochemistry group at ORAU.

Title: Cocarcinogenesis in Mice (94 K)

Performing Organization: Lawrence Berkeley Laboratory

Principal Investigator: Margaret R. White, FTS 451-5811

Abstract: In the development of energy sources, airborne contamination arises from mining, combustion, and industrial processing. Some of these contaminants are potentially carcinogenic. A major problem in cancer research has been the evaluation of risks from carcinogens at very low levels. In recent studies (1-4), we have reported on an apparently general dependence of the latent period in carcinogenesis on an inverse power of the dose of carcinogen. It follows that there may

be dose levels below which the latent period is longer than the life expectancy of the affected population. If this tentative conclusion can be verified for a given carcinogen, a level of negligible hazard can be established. To test very low levels of carcinogens in the laboratory, many thousands of animals are required. By superimposing the action of air pollutants on tumor induction by other carcinogens and studying the effects on latent periods as well as the possibility of multiplicative effects on the total tumor incidence, we hope to evaluate the risks of potentially carcinogenic agents found in the human environment at levels too low for direct experimental testing. This may lead to better ways of evaluating the hazards of environmental pollutants and protecting the public while at the same time now unnecessarily restricting the development of energy sources.

Title: Respiratory Toxicology (139 K)

Performing Organization: Inhalation Toxicology Research

Principal Investigator: Dr. Raymond C. Pfleger, FTS 475-9139

Abstract: One of the environmental pollutants associated with combustion of coal is NO_x which is known to induce lung injury. Particulate materials from coal combustion contain a variety of potentially toxic agents including heavy metals. This study is designed to examine the toxicity of NO_x and particles following inhalation by experimental animals. Particles to be used include those typical of emissions from conventional combustion of coal and from fluidized-bed combustion of coal so that comparisons can be made. Emphasis in this study is being placed on determining effects of these materials on pulmonary surfactant and pulmonary surfactant synthesis and their effect on lung collagen and elastin synthesis breakdown and quantity. It is anticipated that initial studies will be conducted on animals exposed to these materials over relatively short time periods. Later they will be extended to animals exposed to lower levels for longer periods of time. Correlations will be made between biochemical, morphological, and physiological measurements conducted on the exposed animals. Information obtained will be used to determine the relative hazards of NO_x, SO_x, particles and hydrocarbons from FBC and conventional combustion and the appropriate control technologies.

Title: Carcinogenesis Screening-Respiratory Toxicology (248 K)

Performing Organization: University of California at Davis

Principal Investigator: Dr. Marvin Goldman, FTS 453-1340

Abstract: This study addresses the biological effects of inhaling power plant fly ash by itself and in combination with selected sulfur compounds including sulfur dioxide and sulfuric acid. The main objectives and related methods include the following:

- Determination of the functional and morphological consequences of injury to the respiratory system of rodents and monkeys by inhalation of effluents from coal-burning power sources. Sulfuric acid and particulates will be used as models of injury.

- Evaluation of the site and sequence of biochemical, immunological, and cellular mechanisms responsible for the injury.

- Determination of cellular and subcellular mechanisms of adaptation and repair according to intensity and duration of injury, and to plot the extent to which recovery is possible as a function of exposure concentration and time.

- Examination of the relationships between the factors involved in the balance between injury and adaptation/repair, and assessment of their relative roles in the development of chronic bronchitis, emphysema, instertitial fibrosis, and proliferative states capable of increasing the risk of carcinogenesis.

Title: Cellular (*in vivo*) and Biochemical Changes (62 K)

Performing Organization: Inhalation Toxicology Research

Principal Investigator: Dr. David Brownstein, FTS 475-1005

Abstract: These studies are directed at determining the response of the mammalian lung to inhaled particulate acid sulfates. Morphologic, intracellular, and extracellular enzymatic alterations resulting from acute, repeated and chronic exposures are being evaluated and correlated with physiological changes. Methodologies to provide acute, repeated and chronic exposures of animals at various concentrations of acid sulfates with concomitant variations in humidity have been completed. Investigations have been initiated to elucidate the respiratory anatomic site at risk, the population of cells predominantly affected, and their response to various acid sulfates. These sites at risk are being examined for morphologic alteration at the light microscope and ultrastructural level. They are also being investigated for intracellular enzymatic alterations and changes in alveolar fluid and its constituents due to insult by these environmental pollutants. The sequential observations being made provide insight into the mechanisms responsible for pulmonary disease following inhalation of sulfates.

Title: Lung Clearance Mechanisms (62 K)

Performing Organization: Inhalation Toxicology Research

Principal Investigator: Dr. Fletcher F. Hahn, FTS 475-4040

Abstract: Epidemiological studies have indicated an increased incidence of mortality from respiratory disease during periods of elevated sulfur oxide levels. Since laboratory studies have not shown SO_2 alone to significantly affect pulmonary clearance, this project is examining the effect of oxidation products of SO_2 on pulmonary clearance mechanisms. Specifically, acid sulfates such as zinc sulfate or zinc ammonium sulfate and sulfuric acid aerosols are being evaluated. Mice are being chronically exposed by inhalation to graded levels of sulfates ranging from ambient air concentrations to high concentrations. Pulmonary clearance mechanisms are being examined including the removal of particles from the deep lung, and the ability to survive respiratory infections such as influenza or mycoplasma. The results will indicate whether or not acid sulfates reduce the susceptibility of animals to pulmonary infections and thus whether existing health protection standards and control technology are adequate. In addition, their role in reducing

clearance of particles from the deep lung may be an additive factor in assessing hazards from toxic particulates.

Title: Acute-Chronic Loss of Lung Function (104 K)

Performing Organization: Inhalation Toxicology Research

Principal Investigator: Dr. Joe L. Mauderly, FTS 475-1169

Abstract: Estimates of health effects of inhaled sulfates have been derived from data on respiratory changes during acute exposures of guinea pigs. These data are difficult to interpret because of disagreement as to uniformity of response, outdated aerosol technology, and inadequate monitoring of temperature and relative humidity. This project involves use of animal models of acute exposure to compare aerosols used at ITRI with those used by others and to determine the response of the guinea pig and other species using state-of-the-art aerosol generation and characterization techniques. Guinea pigs exposed to 1.0 mg/m^3 H_2SO_4 at 40% relative humidity were unaffected, in contrast to marked changes reported by AMDUR. Guinea pigs are now being exposed to 1.0 mg/m^3 H_2SO_4 at 80% relative humidity, using graded concentrations of histamine aerosol as a positive control and to grade individual reactivity. Guinea pigs will be exposed to other sulfate and sulfite species to rank responses. Rats and dogs will be similarly exposed as a species comparison. Initial results indicate average guinea pig sensitivity to be lower than previously reported, with a few highly reactive individuals among the population. Results of acute studies will be evaluated to determine if long-term exposure studies are required.

Title: Interspecies Transport and Fate as Function of Age (465 K)

Performing Organization: UT-DOE Comparative Animal Research

Principal Investigator: Dr. Robert J. Chertok, FTS 626-4043

Abstract: The broad objective of this program is to investigate in a systematic manner the interactions of specific energy-related pollutants with essential nutrients under a variety of nutritional and physiological stresses at several levels of biological organization in an effort to understand these interactions and their mechanisms of control. To accomplish this broad objective, experiments are being conducted to examine the absorption of toxic agents from the gastro intestinal tract of several species; clarify the interrelationships of toxic agents with essential nutrients (Ca, P, Fe, Vitamin D, etc.) and physiological stresses (anemia, pregnancy) in absorption, metabolism, and subcellular deposition; identify metabolic alterations caused by specific toxic agents; and study the prenatal metabolism of pollutants and their interaction with essential nutrients. In addition, studies at a fundamental level are being conducted to contribute to the elucidation of the subcellular and molecular biology underlying the multistep processes of metal absorption. Special emphasis is placed on the protein-mediated and membrane-associated steps of transport in the intestinal brush border and influence of toxic agents on the absorption of amino acids into isolated renal vesicles.

Title: Multispecies Metabolic Transport Models (310 K)

Performing Organization: UT-DOE Comparative Animal Research Laboratory (CARL)

Principal Investigator: Dr. Gary E. Spalding, FTS 626-4077

Abstract: CARL has a major program directed toward ascertaining the uptake, transport, and distribution of important energy-related environmental pollutants. This program involves strong interaction between data collection and data analysis, with the objective of developing whole-body transport models of various pollutants in several animal species and for several developmental stages. Ultimately, we wish to fit man into the modeling process by interspecies comparisons of model structure and model parameters. Current studies include gastrointestinal uptake and metabolism of 95NB, 239PU, and 115MCD in sheep, swine, guinea pigs, rats, and mice as fetuses, neonates, weanlings, and adults.

Pulmonary Deposition of Coal Dusts

Title: Deposition, Transportation, and Fate of Associated Components (237 K)

Performing Organization: University of Rochester

Principal Investigator: Dr. Paul E. Morrow, FTS 430-3861

Abstract: The principal objective of this research project is the procurement of basic information on the deposition, clearance, and fate of inhaled materials. Of special relevance are specific materials which are major toxicologic concerns in various energy-related technologies and those substances which, by virtue of their special physiochemical properties, serve as investigative probes or prototypes for the pursuit of mechanistic information generally applicable to inhalation toxicology. The success of this dual approach depends considerably upon the preparation of well-controlled and fully-characterized aerosols, their administration to laboratory animals or human subjects by the respiratory route under circumstances which allow quantification, and the subsequent evaluation of the retention, translocation, and elimination processes. The last-mentioned effort is concerned with every level of biological organization which is amenable to investigation, i.e., the organism, organ, cellular, and subcellular, and it seeks to elucidate functional, cytologic, biochemical, and pathogeneic mechanisms and interactions. These kinds of information contribute directly to the quantification and understanding of dose-effect relationships. They are fundamental to the development of toxicologic and radiologic protection standards and the establishment of practices for both occupational and public health protection.

Title: Lung Deposition and Transport Modeling (124 K)

Performing Organization: University of Rochester

Principal Investigator: Dr. Juraj Ferin, FTS 430-3726

Abstract: The increased prevalence of chronic, nonspecific pulmonary disease has expanded interest regarding pathogenic mechanisms and biologic characteristics of

the lung. Realizing the vast number of potentially-damaging agents, researchers have begun to focus attention on the defense mechanisms of the respiratory tract. The organism's defense against environmental factors involves efficient pulmonary clearance mechanisms whereby the deep parts of the lungs are kept clear and sterile. Since the cells of the alveolar membrane and the internal environment of the alveolar are directly exposed to the external environment by inhalation, the protection of these structures and the maintenance of alveolar integrity are of great concern. Different lung pathologies, including lung cancer, have been related, mostly in a hypothetical way, to inefficient clearance function.

Carcinogenic Polycyclic Hydrocarbons

Title: Ultrastructural Changes--Lung Epithelium (108 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: C.A. Heckman, FTS 624-0830

Abstract: The main objective of this effort is to study changes occurring during the early development of polycyclic hydrocarbon-induced carcinomas of the conducting airways. The studies are an integral part of our efforts (1) to identify early markers of respiratory tract neoplasia and (2) to develop *in vitro* models for respiratory carcinogenesis. As part of this effort, we are investigating the characteristics of normal, preneoplastic, and neoplastic epithelial cells *in vivo* and *in vitro*. The biological basis of decreased intercellular adhesiveness and its importance in carcinogenesis will be studied. In particular, cell surface and cytoskeletal features will be investigated by transmission and scanning electron microscopy. Efforts will be made to study the mechanism of invasion using *in vitro* systems.

Title: Effects of Trachael Implant Cultures (94 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: B.C. Pal, FTS 624-0813

Abstract: The purpose of the studies is to develop a simplified model for the investigation of the etiology and pathogenesis of bronchogenic carcinoma. Heterotopic tracheal transplants are used as targets for carcinogenic polycyclic hydrocarbons and other fossil-fuel related carcinogens. The system has already proven to be extremely useful to study the evolution of preneoplastic and early neoplastic lesions. However, a better carcinogen delivery system needs to be developed which will release the carcinogen from either a solid pellet or a capsule into the tracheal lumen at a constant rate, for protracted periods of time. Various approaches are tested in an *in vitro* system as well as in the tracheal transplants. Silastic, polystirene, cellulose acetate, and other polymers are being tested as either matrix for incorporation of carcinogen or as "coat" to encapsulate carcinogen pellets. Studies with cocarcinogenic substances have also been initiated.

Title: Carcinogenesis and Cocarcinogenesis Dose/Effect (380 K)

Performing Organization: New York University Medical Center

Principal Investigator: Dr. Roy E. Albert, 914-351-2396

Abstract: The temporal kinetics of tumor induction when two or more carcinogens are present simultaneously or sequentially are studied in mouse and rat skin and hamster lung. Experimental tumor induction curves are being analyzed in terms of mathematical models that relate the probability of tumor development to carcinogen dose and time of exposure.

Fundamental Research in Biological Test Systems

Title: Chemical Activation of Tumor Virus (221 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: R.W. Tennant, FTS 624-0823

Abstract: Cancer is the major long-term health-related consequence of energy generation and utilization and can result from the interaction between multiple gene loci and various environmental factors. In rodents this interaction involves loci which are endogenous RNA tumor viruses and other loci which control expression of the virus, both of which can be affected by several, defined environmental factors. Therefore, it is important to determine the mechanisms of environmental carcinogen-endogenous virus interactions in model systems and this pursuit continues to form the basis of our proposal. Specifically, we are attempting to determine if various chemicals and radiation act as carcinogens primarily through interaction with endogenous RNA tumor viruses and other cellular genes, using three complementary approaches: (1) the mechanisms of radiation and chemical induction of endogenous tumor viruses in cell cultures, (2) the potential role of endogenous RNA tumor virus induction by chemical carcinogens in cell culture transformation, and (3) the mechanisms of cellular control over RNA tumor virus expression tumorigenesis.

Title: Chemical Activation of Tumor Virus (116 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Maria T. Pavlova, FTS 666-3634

Abstract: In order to define the dose-effect relationship for a variety of acute and late effects, including carcinogenic effects, it is necessary to understand the interaction of manmade pollutants with living organisms and ecosystems. The purpose of this research is to determine whether energy-related pollutants, such as polycyclic hydrocarbons, metals and metallic compounds, ozone, and nitrogen and sulfur oxides, (1) enhance viral transformation of cells *in vitro*, and/or (2) enhance viral tumor formation *in vivo*. If so, quantitative information directly applicable to estimation of health risks from these pollutants will be obtained. The objectives are to develop reliable methods for rapid *in vitro* screening for

carcinogenic and mutagenic potential of chemical agents associated with all facets of fossil energy technologies. The studies will also provide information about the molecular mechanisms of carcinogenesis and mutagenesis.

Title: Develop Mutagenesis Marker (139 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Barton L. Gledhill, FTS 532-6299

Abstract: Sperm can be used to indicate the presence of mutagens, carcinogens, and teratogens in the mouse and hamster. They also may be useful as part of a protocol that monitors humans for occupational, accidental, or therapeutic exposure to noxious agents. In this project we are determining if changes in sperm morphology and variability in DNA content are sufficiently sensitive indicators to signal such hazards. Particular attention will be focused toward monitoring humans involved in fossil-fuel production. The genetic implications of abnormally shaped sperm in the mouse as a mammalian model are being defined, and some of the genotypic differences in metabolism of hydrocarbons are under study. Automated methods for the recognition, counting, and separation of abnormal sperm must be developed for the practical implementation of a screening protocol for human exposure to hazardous agents. Since flow systems are the most appropriate means for automation, we are engaged in the development and application of improved flow instruments for this task.

Title: Develop Mutagenesis Marker (77 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Elbert W. Branscomb, FTS 532-5681

Abstract: The purpose of this project is to develop and apply automated cytological methods for monitoring the rate of somatic point mutation in humans. Initial efforts will be directed towards measuring the frequency of mutant erythrocytes in samples of peripheral blood. In this approach fluorescent antibodies will be used to label rare red cells that contain certain mutant forms of hemoglobin, and flow microfluorometry will be used to count the frequencies of such rare cells in normal blood samples. The project has three primary objectives: (1) to develop and purify specific antisera capable of distinguishing hemoglobins containing any one of a number of specific amino acid substitutions and to confirm the applicability of these red blood cell markers for detection by automated flow cytometry, (2) to apply these methods in testing blood samples from several occupationally exposed worker populations, particularly those involved in coal gasification, and (3) to develop corresponding immunologic markers for detecting mutant hemoglobins in rabbit or mouse erythrocytes and to use these markers to perform the arrival studies needed to validate and interpret the human data.

Title: Develop Carcinogenesis Biochemical Markers (206 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Martin Vanderlaan 532-5721

Abstract: These studies will further our understanding of the early cellular events in chemical carcinogenesis by developing analytical cytochemical methods and applying them to the study of tumor induction by complete carcinogens and tumor-promoting agents. We will measure enzymatic activity, DNA, and other cellular markers by fluorescent cytochemical methods, using light and electron microscopy and flow cytology. Early cellular changes and preneoplastic cell markers will be identified in rat livers, mouse skin, and cultured cells after exposure of the animals and cultures to carcinogens. The generality of the observed cytological changes will be explored in these varied biological systems, using representative chemicals from several classes of carcinogens and promoting agents. Emphasis, however, will be on polycyclic hydrocarbon carcinogens and on tumor promoters because of the likely role of these agents in human carcinogenesis and their possible introduction into the environment by the use of fossil fuels. Ultimately, these studies may provide (1) sensitive inexpensive assays for both complete carcinogens and for promoting agents, (2) a basis for identification of tumor cells in diagnostic cytology and in monitoring of high risk human populations, and (3) insight into the mechanism of carcinogenesis and tumor promotion.

Title: Develop Carcinogenesis Biochemical Markers (94 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: M. Uziel, FTS 624-0838

Abstract: Broad study of interaction of cellular macromolecules with carcinogens with the goal of determining irregular events in nucleic acid metabolism. Monitoring modified nucleosides after treatment of resistant and susceptible tissues and cells will elucidate early biochemical alterations that may be critical to malignant transformation. Existing techniques in our lab will monitor uridine, methionine, inosine, adenine, and quanine to fully map perturbations in RNA metabolism. Separation of RNA populations by gel electrophoresis will facilitate examining intracellular variance in systems both resistant and susceptible to malignant transformation.

Title: Develop Markers Reproductive--Teratological Damage (67 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: A.P. Pfuderer, FTS 624-1200

Abstract: Phenol is the major single toxicant from coal conversion process water. We studied the action of phenol and substituted phenols on the goldfish as a model system. Above 10 ppm phenol, the goldfish darken in color. Higher concentrations intensify this, causing the fish to swim erratically and to die. The melanophore in teleost fish is an alpha-adrenergic nerve cell. Severing the nerve causes it to darken; stimulating it causes it to lighten. Phenol appears to act as a toxin on

the adrenergic system in the goldfish. A sample of purified acetylcholinesterase was found unchanged in activity in phenol concentrations up to 200 ppm. Synthoil #4, fraction #3 (weak acids) behaved much like the other phenols, causing an initial darkening at 10 ppm, and maximum darkening at 50 ppm. We believe we have a good model system to study neurological effects of coal conversion products. These effects are not confined to fish, but have been observed in man also. We also have found an active analog to a natural neurotoxic growth inhibitor in *Xenopus laevis*. We intend to simulate aging by inhibiting growth and following the incidence of tumors and other indicators of age.

Title: Develop Markers Reproductive Damage (289 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: R.A. Wallace, FTS 624-1207

Abstract: A major thrust of our previous work has been the demonstration that macromolecular yolk precursors as well as heterologous materials present in the maternal serum are incorporated by the growing oocyte, stored in compartmentalized membrane-bound inclusions and utilized during embryogenesis. Thus, it appears likely that environmental materials present at subthreshold levels of toxicity in the adult female will be acquired, concentrated, and stored by growing oocytes and made available to the embryo when the yolk compartment is utilized. Studies designed to test this possibility have begun with an attempt to understand the normal process of yolk utilization during embryogenesis. We have also developed a model system, which uses the ciliate *Tetrahymena pyriformis*, to test potentially dangerous environmental products. The system is inexpensive, rapid, and monitors behavior, cytology, respiration and growth. We have begun to examine coal-conversion effluents and some of the dissolved organics (phenol, cresol, halogenated and substituted phenols) which they contain. We are also extending our studies to other aquatic organisms (daphnia, amphibian embryos) in order to acquire comparative data. Finally, our group supervises the operation of two transmission and one scanning electron microscope; use of these instruments by other research groups at the laboratory is extensive.

Title: Develop Organ-Cell Cultures--Lung (94 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: A. Marchok, FTS 624-3966

Abstract: The respiratory system is continuously exposed to pollutants in the environment which are potentially carcinogens or cocarcinogens. A major source of these pollutants can be byproducts generated during processing and burning fossil fuels. Therefore, it is of great practical importance to determine the capacity of respiratory tract epithelium to recover from such toxic and carcinogenic insults and to define conditions favoring recovery. The proposed studies utilize and will further develop three *in vitro* model systems: (1) organ culture of lesions induced by exposure of tracheal transplants to carcinogens *in vivo*, (2) an epithelial outgrowth-cell culture system of these lesions, and (3) an organ culture-cell culture system in which carcinogen exposure takes place *in vitro* in order to identify epithelial cell populations that have acquired altered growth characteristics

and functional changes due to contact with carcinogens. Such investigations will aid in developing diagnostic tools for identification of preneoplastic lesions and individuals with an increased cancer risk due to previous exposure to toxic agents.

Title: Develop Organ-Cell Cultures--Lung and Skin (155 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Eugene P. Cronkite, FTS 666-3568

Abstract: The incidence of chronic pulmonary disease is increasing. Toxic agents in the environment, cigarettes, and industrial dusts are suspected as the primary causes. Evaluation of suspected hazards by exposure of animals in closed, monitored environments would take decades and be extremely costly in manpower as well as dollars. Using special tissue culture systems, it is proposed to study the interactions of suspected, toxic agents with pulmonary macrophages and neutrophils and to detect those pollutants producing deleterious effects on human pulmonary epithelium. In particular, agents producing necrosis and transformation in tissue culture will be identified. In addition, the effects of noxious particulate and gaseous pollutants will be studied in classical tissue culture systems. The toxic agents shown to have deleterious effects in culture will be evaluated in animals when exposure chambers are available for handling pollutants from generation of electricity.

Title: Develop Markers for Damage to Immune Systems (310 K)

Performing Organization: Oak Ridge Associated Universities

Principal Investigator: Dr. N. Grengozian, FTS 626-3118

Abstract: The objective of this program is to evaluate the effects of environmental hazards such as radiation chemical pollutants on the homeostatic control mechanisms of immunologic cell populations. The coexistence of two different genetic cell types in the marmoset, a natural blood chimera, and the allogeneic radiation chimera created in the laboratory, depend on immunologic deficits similar to that of host-tumor relationships in man. Identification of the cellular and humoral factors mediating these tolerant relationships should ultimately permit us to regulate and eliminate cell populations escaping from homeostatic control such as may occur following exposure to environmental carcinogens.

Title: Baseline Studies to Support Carcinogenesis (496 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: John B. Storer, FTS 624-0212

Abstract: When an individual is exposed to a carcinogen, numerous intrinsic and environmental factors will determine whether a cell becomes neoplastic and whether the cell subsequently develops into a tumor. A central objective of this project is to examine the role of physiologic and environmental factors in carcinogenesis. Individuals respond variably to exposures to carcinogens. If we are to reliably

evaluate risks for tumors from experimental models, it is important to identify those intrinsic factors that determine sensitivity. That hormones are factors which influence the development of neoplasms is well known. Whether hormones act as promoters, cocarcinogens, antagonists, or as physiological modulators is unknown. Therefore, one aspect of this project has been a study of the influence of hormones on carcinogenesis. Environmental factors appear to play a major role in carcinogenesis. This involves the interaction of various agents at low dose levels. Most experimental work has studied single carcinogens, but little effort has been directed towards synergistic and competitive effects between carcinogenic and noncarcinogenic compounds found in the environment. These latter compounds may modify the biological activity and effect of carcinogens and serve either as cocarcinogens or antagonists. Experiments undertaken in this group have been examining these potential interactions.

Title: Baseline Studies to Support Carcinogenesis (57 K)

Performing Organization: Lawrence Berkeley Laboratory

Principal Investigator: E.L. Alpen, FTS 451-5206

Abstract: The objectives of this project are to (1) evaluate carcinogenic influences that can be revealed by data such as dose versus yield of tumors, dose versus time of appearance of tumors, calendar time since exposure or chronological age versus incidence of tumors and (2) study the influence of health factors on the frequency of cancer, since such factors, though not intrinsically carcinogenic or anticarcinogenic, may alter the end results expressed as observed cancers. Our previously reported work produced a model of carcinogenesis that has stood up under test in various carcinogenic systems. If this model can be further supported by extension of our studies to a much larger base of experimental data, it should permit determination of dosage levels of environmental carcinogens that can be regarded as reasonably safe. We plan to develop this model more fully and to relate it to as much of the data in the literature on carcinogenesis as possible.

Title: Baseline Studies to Support Hematological Effects (622 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Eugene P. Cronkite, FTS 666-3568

Abstract: Chemical pollutants, e.g., benzene and many polycyclic hydrocarbons, are capable of producing leukemic hypoplastic to aplastic bone marrow, and hemopoietic dysplasias frequently preceding the appearance of leukemia. Chemical moieties in pollutants produced by combustion of fossile fuels contain carcinogens and substances related to materials that have produced hemopoietic dysplasia (HD). Target cells for leukemogenesis and HD are the hemopoietic stem cells, probably the pluripotent but possibly also the committed stem cells.

A new method is developed for determining the route of absorption, cellular location, and concentration of radiolabeled pollutants by freezing cell suspensions and allowing target cells, e.g., the gemopoietic stem cell, to accumulate radiation injury. The procedure can be utilized in several target tissues.

A system is developed for separating pure stem cells and culturing them in vitro or in peritoneally implanted diffusion chambers, in the presence of candidate leukemogens from pollutants. The leukemogenic, HD, and hypoplastic potential will be tested by transplantation of the treated stem cells into syngeneic mice. Study is made of the cell-to-cell interactions in bone marrow, definition of feedback loops controlling cell differentiation, and description of mechanisms which determine rates of hemlopoietic cell proliferation.

Title: Baseline Studies to Support Metabolism (176 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Darrel D. Joel, FTS 666-3603

Abstract: Particulate materials, including known carcinogens and sulfates, constitute a major proportion of pollutants in the biosphere. Particulates enter the gastrointestinal tract not only by ingestion of contaminated food and water but also by the swallowing of inhaled particles subsequently cleared from the lung. Consequently, the mucosal surface of the intestine is a major site of contact with the environment, yet little is known about the penetration of particulates through the intestinal mucosa or their deposition and effect on the gut wall. The broad objectives of this budget activity are to study quantitatively in animals the uptake, distribution, and fate of tagged, nonviable particles of various sizes administered into the gut, and then to establish a practical threshold of no detectable effect by observing the biological effects of carcinogens, suspended sulfates, and other hazardous particulate pollutants on DNA turnover rates, hematopoietic stem cells, dominant lethal mutations, immunological responses, and carcinogenesis. By providing a valid estimate of the hazard to animals, an approximation of the hazard to man can be established. These studies could also provide useful information on antigen entry and immunologic responsiveness of the intestine to pollutant haptenes in the environment.

Title: Baseline Studies to Support Metabolism (174 K)

Performing Organization: University of Rochester

Principal Investigator: Dr. Thomas T. Mercer, FTS 430-5997

Abstract: The ultimate goal of this program is to explain quantitatively the part played by the physical and chemical properties of airborne particles in the chain of events between exposure to a toxic aerosol and the production of biological damage. Its scope includes (1) routine measurement of particulate properties for all aerosols needed for animal exposures, (2) development of methods for generating aerosols designed to meet specific requirements for studies of clearance mechanisms, (3) investigation of fundamental mechanisms of sampling processes to provide a basis for the development of improved instrumentation and more accurate methods of data interpretation, (4) investigation of mechanisms related to the stability of aerosols and to aerosol-vapor (-gas) interactions, (5) solubility rate measurements on selected toxic materials with which to improve the interpretation of data now available in the literature, and (6) investigation of the effect of particulate properties on the physiological clearance of intact particles from nonciliated regions of the lung.

Title: Baseline Studies to Support Metabolism (102 K)

Performing Organization: University of Rochester

Principal Investigator: Undesignated

Abstract: The overall aim of the project is directed toward exploring the precise morphological and biochemical events that take place during transcellular transport of calcium (and possibly other divalent cations), a process which we consider to be distinctly different from transport associated with intracellular calcium ion regulation. The long-term goal is to achieve a better understanding of the intracellular processes involved in the transfer of absorbed materials, physiological or toxic, through the cytosol and into the recipient organism.

Title: Baseline Studies to Support Metabolism (140 K)

Performing Organization: Lawrence Berkeley Laboratory

Principal Investigator: Frank T. Lindgren, 415-642-3637

Abstract: This proposal involves studies of plasma lipoproteins as interaction sites for, and transporters of, environmental pollutants. Human plasma lipoproteins, *in vitro*, and animal model systems, *in vivo*, will be used to study dose-response effects of such pollutants as ozone and heavy metals (namely, lead and mercury). Changes in distribution and physicochemical properties of lipoproteins will be studied as a function of exposure to pollutants, using analytic ultracentrifugation, agarose and polyacrylamide gel electrophoresis, and electron microscopy. Methodology for the measurement of small amounts of lipoproteins and plasma proteins will be developed to facilitate screening for abnormalities of these constituents in animal model systems exposed to pollutants. Effects of heavy metals (lead and mercury in both their organic and inorganic forms) on tissues, cells, and enzyme systems associated with lipoprotein metabolism will be investigated. The overall aim and goal of these studies is to describe (1) the mechanism of pollutant transport in the bloodstream, (2) the initiation of membrane and cellular damage by pollutants, and (3) correlation of degree or pollutant damage with concentrations of serum lipoproteins and/or proteins.

Title: Baseline Studies to Support Mutagenesis (434 K)

Performing Organization: UT-DOE Comparative Animal Research Laboratory

Principal Investigator: Dr. B.H. Erickson, FTS 626-4036

Abstract: Studies of irradiation effects conducted at our laboratory have shown that in the mammal, with the exception of the rodent oocyte, the primitive stem germ cell (gonocyte, male, and oogonium, female) is the cell type affected most adversely. The gonocyte and oogonium are at risk for protracted periods in the development of the long-lived mammal (months to years, depending on species and sex); thus we have chosen to study interspecific variability in their kinetics and response to chronically administered toxicants emitted by the energy-producing industry. Mitotic delay, cellular survival, chromosomal abnormalities, sperm number and morphology, follicular number and quality, ovulation rate, growth, and

reproductive performance are assayed. Trials are being conducted in cooperation with ORNL to establish the cytogenetic sensitivity of swine oocytes since they are closely comparable to those of humans; interspecies comparisons of chromosomal response to known mutagens will provide a basis for examining mechanisms of induction and will generate a broadened data base for extrapolation to man.

Title: Baseline Studies to Support Mutagenesis (253 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Michael A. Bender, FTS 666-3570

Abstract: Genetic effects of energy-related pollutants represent a major consequence in terms of human ill health and societal cost. This is especially true of the nuclear technologies and of coal conversion and combustion. Genetic effects are impossible to measure directly under the low-level exposure conditions relevant to energy production and use. Consequently, human genetic hazard estimates must rest on downward extrapolation over orders of magnitude from data on acute, high-level exposures, and from animal and *in vitro* human cell exposures to human population exposures. Chromosomal aberrations not only constitute a class of genetic effect of considerable importance in human populations, but are conveniently detected as well. This program has two major objectives. One is the development and verification of sensitive model test systems using chromosome aberration and sister chromatid exchange production to detect and evaluate the mutagenic potential of energy-related agents administered to rodents via inhalation or ingestion, as well as to monitor actual human populations. The other is investigation of the molecular mechanisms involved in the production of these cytogenetic phenomena in order to facilitate more confident human genetic hazard evaluation based upon model test system results.

Title: Chemical Carcinogenic Cells *In Vitro* (211 K)

Performing Organization: Oak Ridge National Laboratory

Principal Investigator: E. Huberman, FTS 624-0833

Abstract: Induction of somatic cell mutations and malignant cell transformation will be studied in rodent and human cells *in vitro*. These studies are performed in order to develop systems for screening for potential hazardous chemicals reliably, quickly, and cheaply relative to current animal exposure techniques. In addition, our studies will be concerned with the relationship between carcinogenesis and mutagenesis induced by polycyclic hydrocarbons and other classes of chemical carcinogens as well as the involvement of mammalian DNA polymerases in these events.

Title: Methylated Metals Mutagenesis (150 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Robert T. Taylor, FTS 532-5652

Abstract: Methylation can be an important determination of metal toxicity in man, the striking example being methyl-Hg-1+ versus inorganic Hg-2+. The major purpose of this project is to determine the relative toxicities and mutagenicities of six energy-relation metals (As, Hg, Sn Cr, Ti, and Pt), comparing the inorganic metal ions with their methylated forms. A secondary goal is to determine whether combinations of metal ions and their methyl derivatives have synergistic mutagenic effects. Biochemical reactivity with methylcobalamin (MEB-12) will be used as a biomethylation index. Use of ME-labeled MEG-12 will permit us to ascertain which other metals can yield stable ME-metal reaction products. Cultured mammalian cells, primarily Chinese hamster ovary lines, will be used for acute toxicity and mutagenesis-assay systems. Toxicity experiments will measure metal-compound-concentration effects on cell growth, cell viability, and the incorporation of radioactive precursors into macromolecules. Metagenesis assays will involve the induced resistance to two drugs (8-azaguanine and ouabain), markers which reflect changes in specific enzymes. Trace metals are significant components of the pollution from most of the energy technologies, but especially coal processing and coal combustion. It is important to evaluate the influence of the valence state and the chemical form of some of these metals on their *in vitro* mutagenicity in mammalian cells.

Atmospheric Transport

MAP3S

Multistate Atmospheric Power Production Pollution Study

ATMOSPHERIC TRANSPORT:
MAP3S (Multistate Atmospheric Power Production Pollution Study)

EPA Project Officer	FY 1979 Funds	Page
Daniel Golomb FTS 426-4567 OEMI Washington, D.C.		
Program Description		35
Transport and Transformation	415 K	37
Modeling and Analysis--Development	165 K	37
Data Management	155 K	37
MAP3S Aircraft Operation	191 K	38
Modeling Studies--Computer	165 K	38
Precipitation Scavenging	520 K	39
Boundary Layer Investigation	413 K	39
Aerosol and Trace Gas Transport	227 K	39
Research Aircraft Operations	186 K	40
Field Studies--Mobile Laboratory	52 K	40
Aerosol Characterization	88 K	40
Program Coordination--MAP3S	118 K	41
ATMOSPHERIC TRANSPORT GRAND TOTAL	2,695 K	

Program Description

The Multistate Atmospheric Power Production Pollution Study (MAP3S), coordinated among the DOE national laboratories, has as its goal the development of an improved capability for the regional assessment of the effects of pollutants emitted during the conversion and combustion of fossil fuels. The program centers on the emission effects from coal-fired power plants in relation to interacting emissions from all other sources.

These sources include:

- Sulfur oxides sulfites and sulfates.
- Nitrogen oxides and their secondary reaction products (including oxidants).
- Hydrocarbons (including polycyclic organic matter).
- Trace inorganic elements
- Particulates (which may contain any or all of the above substances and elemental carbon or soot).

The primary objective is to develop and demonstrate an improved, verified capability of numerically simulating the present atmospheric conditions and potential changes that result from pollutants released by coal-fired power production processes.

MAP3S-supported research emphasizes:

- Field experiments, aimed at improving the understanding of atmospheric processes.
- Numerical modeling, directed at simulating atmospheric processes.
- Characterization of present air quality, using aircraft and surface measurements with substantial cooperation from the SURE (EPRI-Sulfur Regional Experiment) project.

The results will be used in energy and environmental planning and will form the basis for answering two critical questions concerning coal combustion emissions:

- Will precipitation acidity and atmospheric turbidity in the United States increase as coal combustion increases?
- Can atmospheric concentrations of particulate sulfur be reduced by decreasing sulfur oxide emissions?

The MAP3S study area is the high-population, energy intensive, northeastern United States, upper midwest, and areas directly influencing air quality in these regions.

The program will be carried out primarily through the personnel, resources, and expertise of the atmospheric sciences programs at Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Battele Pacific Northwest Laboratory (PNL), and the Health and Safety Laboratory (HASL), as well as other national laboratories and research organizations with applicable experience. Integration of the various individual efforts into a cohesive program is provided by the Project Director:

Dr. Michael C. MacCracken
Lawrence Livermore Laboratory
Livermore, CA 94550
FTS 532-1826

To facilitate program information flow between the participating organizations and other interested parties, a MAP3S data management center has been created at Brookhaven National Laboratory. Processed data from this program and information gathered by other air-quality programs are available at the center. Additionally, information on the status of MAP3S activities and planning efforts are available through a quarterly newsletter. (Contact Dr. MacCracken at the above address to be put on the distribution list.)

A more detailed discussion of the program plans, goals, and objectives is presented in the following DOE publication: The Multistate Atmospheric Power Production Pollution Study-Program Plan and Addendum, M. C. MacCracken, DOE/EV-0008/1 and DOE/EV-0008/2, Division of Biomedical and Environmental Research, U.S. Department of Energy. January, 1978, (available through NTIS).

Title: Transport and Transformation (415 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Paul A. Michael, FTS 666-2264

Abstract: This program is a part of the Multistate Atmospheric Power Production Pollution Study (MAP3S). This particular effort is aimed at obtaining experimental results to (1) test hypothesis used in simulation models, (2) develop an understanding of mechanisms so that proper parameterization may be used in models, and (3) provide data for the testing of integrated models. In particular, measurements will be made of the vertical and horizontal distributions of sulfates. Studies of the transformation of sulfur dioxide to sulfate will be made in the atmosphere and there will be participation in large-scale field experiments.

Title: Modeling and Analysis--Development (165 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: Ronald E. Meyers, FTS 666-2261

Abstract: This project is designed to perform five critical modeling and analysis functions and one research-coordination function for the Division of Biomedical and Environmental Research (DBER) Multistate Atmospheric Power Production Pollution Study (MAP3S). The modeling and analysis functions consist of development of (1) an advanced three-dimensional eulerian-grid pollution model treating nonlinear chemistry, long-distance transport and diffusion of sulfur compounds, NO_x, O_2, and related chemicals on the regional scale; (2) a variational diagnostic three-dimensional meteorological analysis model capable of objectively resolving inversions and fronts on the regional and subregional scale; (3) advanced plume-laboratory reaction models incorporating lumped chemistry and the major effects of turbulence mixing upon chemical reactions; (4) a computer link from BNL to the National Weather Service at Suitland, MD, to supply MAP3S with timely meteorological data for experiments and modeling; and (5) the design of field experiments, including establishment of aircraft data requirements and quality assurance such as calibration flights and intercomparison programs, to test and further develop the models. In addition, R. E. Meyers will provide the MAP3S numerical modeling working group coordinating functions, consisting of chairmanship of the MAP3S modeling working group and related duties.

Title: Data Management (155 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: C.M. Benkovitz, FTS 666-4135

Abstract: A major portion of the MAP3S program is concerned with the collection, evaluation, and codification of both newly-measured and selected historical data that pertain to the distribution and evolution of energy conversion-related pollutants over the greater northeast. The initial purpose is to collect sufficient reliable information to assess the extent and severity of the present SO_2/sulfate

atmospheric burden over the region. These data will provide preliminary objective answers to questions on the spatial and temporal variability of atmospheric sulfate aerosol and will supply preliminary estimates of the relative impacts of particular source regions. A continuing purpose is to build a readily-accessible data bank (This is to include supporting source inventory and meteorological information.) against which submodel parameterization schemes and, eventually, full-parameterized, regional-pollutant transport and transformation simulations can be tested. A longer-range goal will be to provide baseline air-quality data for the greater northeast to which future assessments of regional atmospheric environmental impacts attributable to new energy technologies may be referred.

Title: MAP3S Aircraft Operation (191 K)

Performing Organization: Brookhaven National Laboratory

Principal Investigator: R.W. Garber, FTS 666-3086

Abstract: An aircraft has been leased to carry out research projects which are part of the atmospheric sciences programs at Brookhaven National Laboratory (BNL). The principal use for the aircraft is in conjunction with the MAP3S program. The aircraft is being set up for atmospheric sampling and analysis. Approximately one-half of its scheduled flight time will be utilized to conduct routine MAP3S observations, including horizontal and vertical atmospheric pollutant profiles and regional pollution transport studies. About one-quarter of its scheduled flight time will be utilized for plume studies which are part of MAP3S. The remaining scheduled flight time will be used in cooperative atmospheric studies with aircraft and ground observation teams in conjunction with organizations outside BNL but which are part of the overall MAP3S program. Flight time on this aircraft will be available for other BNL atmospheric programs on a cost-recoverable basis. For certain portions of the MAP3S program and for other atmospheric sciences programs, utilization of a second aircraft is necessary. Additional aircraft will be rented as required and outfitted with conveniently-installed equipment suited to the purposes of the experiments.

Title: Modeling Studies--Computer (165 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: R.L. Drake, FTS 444-7511 (ask for 946-2961)

Abstract: The primary purpose of this program is to develop and exercise a computer model to evaluate the impact over a multistate region of an increased atmospheric burden of SO_2 and sulfate particulates due to various strategies involving the burning of coal to produce electrical power. The model is to be composed of the most technically and economically appropriate methods available for describing transport, dispersion, transformation, dry deposition, and precipitation scavenging. For a more realistic simulation of precipitation scavenging beyond the application of climatological mean rainfall to average concentration data, a comprehensive series of tests using meteorological data and improved emission source data will be conducted to validate the model formulations by comparison of predicted results to observed ambient air quality measurements. Also, calculated rainfall acidity will be compared to MAP3S chemistry network data.

Title: Precipitation Scavenging (520 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: J.M. Hales, FTS 444-7511 (ask for 946-2861)

Abstract: This program provides the field data and the mechanistic information necessary for formulating a quantitative understanding of precipitation scavenging of pollutants from the atmosphere, and also the precipitation chemistry that occurs as a result of these scavenging processes. This information is intended to facilitate the development of prognostic, regional pollution models, which will be applied to assess and optimize the development of energy resources in the United States. This program maintains a precipitation chemistry network in the northeastern quadrant of the U.S., which supplies data that is directly useful to model development and impact analysis. The program also is operating a comprehensive field study of selected storm systems to evaluate quantitatively pertinent scavenging processes, so that these may be incorporated realistically into predictive models. Extensive use of research aircraft measurements (state, cloud-physics, and pollutant variables) as well as tracer releases and ground precipitation sampling networks are used on these studies.

Title: Boundary Layer Investigation (413 K)

Performing Organization: Argonne National Laboratory

Principal Investigation: Bruce B. Hicks, FTS 972-5792

Abstract: The Multistate Atmospheric Power Production Pollution Study (MAP3S) is a research program coordinated among the National Laboratories with the goal of developing an improved capability for the regional assessment of the effects of pollutants emitted during the conversion and combustion of fossil fuels. As a contribution to the joint effort, this section has initiated a number of interacting experimental and numerical modeling subprograms, including an investigation of the behavior of pollutants in the planetary boundary layer, applications of remote-sensing techniques to the problems of MAP3S, the development of numerical simulations of the transport, dispersion, conversion, and removal of atmospheric pollutants, and the direct measurement of various pollutant fluxes to vegetated surfaces.

Title: Aerosol and Trace Gas Transport (227 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: A.G. Alkezweeny, FTS 942-2861

Abstract: This program is addressed to the task of providing input--in the form of quantitative transformation parameterizations--to evolving models of regional-scale pollution behavior. The research program is focused on the MAP3S study area and its output is directly specifically toward the MAP3S modeling effort. This program involves extensive field studies of pollutant transformation phenomena, using instrumented research aircraft. Data obtained from these experiments are processed using numerical models of atmospheric diffusion and chemical transformation.

Title: Research Aircraft Operations (186 K)

Performing Organization: Pacific Northwest Laboratory

Principal Investigator: P.M. Potter, FTS 942-2861

Abstract: The purpose of this program is to provide technical support in the form of research aircraft for on-going DOE-DBER atmospheric research programs. The aircraft provide aerial platforms for atmospheric sampling of aerosols and trace gases, measurements of airborne pollutants and for the release of special tracer materials. Aircraft support is required for the following programs: atmospheric boundary layer studies, urban pollutant characterization, transport and deposition, precipitation scavenging in MAP3S, aerosol and trace gas transformation, and resuspension and translocation.

Title: Field Studies--Mobile Laboratory (52 K)

Performing Organization: Lawrence Berkeley Laboratory

Principal Investigator: T. Novakov, FTS 451-5319

Abstract: This project consists of two interrelated components: (1) characterization and behavior of aerosol formed under nonphotochemical atmospheric conditions and (2) participation and collaboration with other MAP3S investigators on the chemical characterization of particulates. The first component of the project will be carried out in the greater San Francisco Bay area with the objective of comparing the aerosol chemical composition and behavior during winter months when the photochemical oxidant levels are low or negligible, with those that exist in the summer when the manifestations of atmospheric photochemistry are strongest. A detailed comparison of the chemical composition of aerosols sampled under these extreme situations should yield those species that are exclusively generated by photochemical processes. These studies will be performed by our newly equipped mobile atmospheric research laboratory. The samples collected in this program will be made available to other MAP3S investigators. The mobile laboratory will also be made available to other MAP3S groups for installing specific sampling and monitoring devices that they may have. The second component of the program will involve chemical characterization of MAP3S samples with physical methods that are at our disposal, for the purposes of intermethod comparison.

Title: Aerosol Characterization (88 K)

Performing Organization: Argonne National Laboratory

Principal Investigator: F.A. Cafasso, FTS 972-4542

Abstract: Accurate assessment of the problems associated with the emission to the atmosphere of power production pollutants and their eventual dispersal on a regional scale requires the development of a comprehensive data base. A data base covering an extensive region, such as the northeastern United States, can be put together, utilizing information from a variety of national, local, and regional governmental sources, including pollution monitoring facilities operated by power companies and other industrial and commercial concerns, and other sources as may be

available. An important input for this data base that is not presently available from these sources is the detailed nature of the chemical (molecular) composition of atmospheric aerosols. This program will provide for the collection and chemical (molecular) characterization of size--and time--classified atmospheric aerosol samples obtained at a few (probably 3-4) selected sites in the northeastern United States. Specific attention will be given to the amount of sulfate present in the collected aerosol and the degree of acidity associated therewith.

Title: Program Coordination--MAP3S (118 K)

Performing Organization: Lawrence Livermore Laboratory

Principal Investigator: Michael C. MacCracken, FTS 532-1826

Abstract: The goal of the MAP3S program over the next 3 years is to improve the understanding of temporal and spatial relationships between ambient levels and emissions from utilities in order to develop the capability to simulate more accurately the changes in pollutant concentration and nature, precipitation chemistry, and atmospheric behavior relevant to understanding and evaluating human health and ecological effects which would result from alternative strategies of generating power with fossil fuel in the northeastern United States. The program will be carried out primarily through the personnel, the resources, and the expertise of the atmospheric sciences programs at Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Battelle Pacific Northwest Laboratory (PNL), and the Health and Safety Laboratory (HASL). In addition to the national laboratories, other research groups funded by DBER will also be involved. This specific project provides funding support for the MAP3S project director who is to provide the program leadership to integrate the individual efforts into a cohesive program. The project director is to provide for the interface of this project with other related studies and to represent this project to other agencies and organizations.

... Headquarters Lib...
Mail code 3201
...00 Pennsylvania Avenue N...
Washington DC 20460

DATE DUE

AUG 20	2001		
SEP 24	2001		

Demco, Inc. 38-293

Headquarters
Mail code 3201
200 Pennsylvania Avenue
Washington DC 20460