DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT

OVERVIEW

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

HEALTH, ENVIRONMENT AND ENERGY TECHNOLOGY

The Biological and Environmental Research (BER) program develops the knowledge needed to identify, understand, and anticipate the long-term health and environmental consequences of energy use and development. The BER program also aims at using the scientific knowledge gained to develop technological tools that may be used to mitigate or correct such adverse consequences, and to use the Department's unique scientific and technological capabilities to solve major scientific problems in biology and medicine.

The Department's Biological and Environmental Research responsibility began with the formation of the Atomic Energy Commission in 1946. Research into the potential health impacts of radiation accompanied the initial mandate to develop nuclear energy and nuclear weapons technology. Studies centered on health effects in the Japanese atomic bomb survivors and dose-response studies in experimental animals and specifically addressed long-term, late effects such as cancer. Positive correlations between radiation exposure and cancer were shown, both in the Japanese population and in experimental animals, which provided a quantitative scientific framework for policy decisions regarding establishment of radiation protection standards.

As definitive information was obtained concerning relatively high levels of radiation exposure, attention was turned to potential effects at lower doses that might be received by worker populations or the general public. This concern dictated a broad, comprehensive research program encompassing human health studies, experimental animal investigations, cellular level studies and research at the molecular level to elucidate the underlying, fundamental mechanisms of biological damage from radiation and chemical exposure. The laboratory research demonstrated, however, that biological repair and recovery processes operate at low levels of X-ray or gamma exposure, thus providing assurance that radiation protection standards based on linear extrapolation of high dose findings are indeed conservative. Early research on exposure measurement technology provided the personnel and area monitoring capability now employed at national laboratory and commercial nuclear power facilities. Current research will achieve not only more sensitive radiation exposure measurement techniques but also advanced techniques to measure chemical exposures from nuclear and non-nuclear energy operations.

The DOE radiobiology program constitutes about two-thirds of the national effort. The program is primarily oriented towards research at the relatively low doses received by worker populations. Most of the rest of U.S. radiobiological research is supported by the National Cancer Institute and is oriented towards high-dose radiation therapy of tumors and in evaluating the late effects of such doses to the surviving patient. Radiobiological research is coordinated through the Office of Science and Technology Policy's (OSTP) Committee on Interagency Radiation Research and Policy Coordination. The DOE effort is also coordinated with European radiation research programs through a Memorandum of Understanding with the Commission of European Communities; with Japan through the Binational Agreement; and with the USSR through the Joint Coordinating Committee for Civilian Nuclear Reactor Safety which includes formal cooperation on research and data exchange on the health and environmental effects of the Chernobyl reactor accident.

The late effects of chronic low level radiation exposure will be difficult if not impossible to confirm retrospectively, yet improved insight is needed to understand such concerns as indoor radon and exposure of the general population to contaminants that may result from Departmental activities. There is a particular need for a clear understanding of the mechanisms of biological radiation effects to guide decisions regarding any changes in the occupational exposure standards to radiation.

The DOE human genome program represents a new effort directed to two of the BER program objectives. First, it provides new approaches, based on modern biology and technology, to the more than forty-year-old mission of evaluating effects of low doses of exposure to energy related agents. Second, the Department is exploiting the multidisciplinary capabilities of its national laboratories to develop the biological research resources and the technologies needed to analyze the entire human genome at the molecular level in the next fifteen years. Results of this work will provide the basis for definitive examination of risk estimates, detailed understanding of the mechanism of mutagenesis and carcinogenesis, and the assessment of individual sensitivities to low levels of exposure to physical and chemical agents. It will open new horizons for the understanding of radiation and chemical action at the most fundamental level, interaction with the DNA molecule, and will significantly affect the biomedical and biotechnology communities in many different ways. While the DOE program, which is planned and carried out in coordination with the National Institutes of Health (NIH), is focused towards developing capabilities and tools, and in investigating certain fundamental biological questions, the NIH effort is oriented towards genetic mapping and characterizing disease-related genes by exploiting both human and non-human model systems.

Structural biology brings the tools of modern science together (recombinant DNA technology, site-directed mutagenesis, rapid structure determination with sophisticated equipment, advances in theoretical analysis and molecular simulation and powerful computer and graphics technologies) to enable major advances in our understanding of the relationship between macromolecular structure and biological function. Such increased understanding and the concommitant ability to manipulate structure and biological function has enormous implications for the Department's ability to carry out its energy, environmental and technology transfer missions cost-effectively. This knowledge base will provide the intellectual foundation for the wide

spectrum of applications of biotechnology and molecular biology. As pointed out by several DOE and National Academy committees, DOE has a special opportunity and responsibility (because of the capital-intensive user facilities currently located, and under development, at its laboratories, and computational and other resources located there) to play a major role in the advance of knowledge in structural biology. DOE's structural biology program is focused on providing the resources which are necessary for efficient utilization of current and developing facilities.

The environmental research program of BER evolved, in a similar manner, from a need to understand the pathways of radioactive materials from weapons testing through atmospheric, marine and terrestrial media, to human exposure. This research has produced quantitative models describing atmospheric, oceanographic and terrestrial movement of materials which were employed to describe and predict the distribution, uptake and human exposure from the Chernobyl nuclear reactor accident.

The long-term research base established within the DOE environmental research program has enabled the Department to respond effectively to recent national concerns. The DOE research in atmospheric chemistry has been a key component of the National Acid Precipitation Assessment Program (NAPAP). The national laboratories have mounted a series of major field studies of the processing of sulfur and nitrogen oxides by clouds and precipitation and the mechanisms of their deposition on sensitive ecosystems. The work will contribute to a more informed approach to contemplated emission control strategies addressing the acid rain problem. The DOE research in atmospheric transport and diffusion has greatly enhanced the emergency preparedness and emergency response systems, particularly at the sensitive DOE facilities.

The dynamics of the coastal ocean and the fate of contaminants have been elucidated substantially by the environmental marine program which has concentrated on the flushing rates of the coastal zone, and has shown that products generated off the coast of the upper Northeast States are primarily swept past the Delmarva Peninsula toward Cape Hatteras rather than being ejected directly across the shelf. Thus, residence time of contaminants on the shelf is much greater than expected. Also the research has shown that the generation of fixed carbon on the shelf is about 70 times greater than in the open ocean, a factor important both for understanding impact on renewable resources and for global carbon evaluation. The long-term ecosystem studies carried out primarily on the DOE National Environmental Research Parks have provided a predictive capability for identifying and assessing future energy-related problems. The research that was started in the 1960's on chemical and water balance in watersheds was important in the late 1970's and early 1980's in understanding of the buffering capacity of forested soils to acid rain, and carbon partitioning in the biosphere and geosphere. Today this program is in the forefront of theoretical studies on different regions that are influenced by energy activities ranging from global impacts to local and regional disturbance. The theory is helping to better define opportunities for mitigation and in land-use planning, areas of particular concern in the National Energy Strategy.

A more recent environmental concern has been possible global warming from the increase of greenhouse gases and especially carbon dioxide (CO_2) in the atmosphere from the burning of fossil fuels. For over ten years the Carbon Dioxide Research Program has studied the carbon dioxide interactions with the atmosphere, the biosphere, the oceans and the geosphere and the resultant impacts on critical resources. The Carbon Dioxide Research Program is the principal DOE activity in the U.S. Global Change Research Program coordinated by the Committee on Earth and Environmental Sciences of the OSTP. The Secretary of Energy has identified global change as an important environmental consideration in the development of the National Energy Strategy. Consequently, DOE has launched a major research initiative to accelerate progress in the scientific capability to predict global and regional climate change. A principal component of this initiative is an experimental program to quantify accurately the cloud-climate feedback system and to improve the corresponding parameterizations in the climate change prediction models. A second component is an effective integration of advanced computer hardware and software with the next generation climate models in order to accelerate computing throughputs by a factor of 10,000 within the next ten years.

The terrestrial transport program includes DOE's only fundamental long-term research related to the geochemistry, hydrology, and microbiology of the understanding of the mobility and stability of natural chemicals and chemical contaminants in subsoils and groundwater, including insights into the hydrologic cycle. Improved predictions about the transport of organic chemicals or organic-radionuclide complexes result from such research. Because the subsurface biosphere tends to be most directly impacted by past DOE waste disposal practices, research in the terrestrial subsurface has become critical as a source of new concepts related to environmental restoration at DOE sites. New concepts and discoveries in such areas as deep terrestrial microbiology are being transferred rapidly to DOE sites and industry. The BER program has developed a Departmental plan (5-20 year) for basic long-term research related to environmental restoration, in cooperation with other Departmental elements that are concerned with more immediate, short-term needs in environmental restoration and waste management.

MEDICAL APPLICATIONS

Under its mandate, originally expressed in the Atomic Energy Act of 1946, to promote the utilization of radioactive materials for medical and other purposes, the Atomic Energy Commission (AEC) undertook a vigorous program of producing and distributing radionuclides for medical applications. As progressively sophisticated applications in diagnosis and therapy developed, this led to the establishment of nuclear medicine as a recognized medical specialty, and radionuclide production as a flourishing industry. A major advantage of nuclear medicine procedures has been that dynamic functional information about various organs of the body can be obtained with non-invasive procedures. The concurrent development of instrumentation, particularly first the gamma camera and later single photon emission computed tomography (SPECT) and positron emission tomography (PET), which are imaging devices, greatly improved the physician's ability to detect small lesions and to quantify functional processes in the body.

Under the successors of the AEC, the Energy Research and Development Administration (ERDA) and the DOE, the medical applications program has been continued and expanded. The current program includes five major research areas: (1) research to develop new radioisotopes, (2) development and application of new radiopharmaceuticals, (3) instrumentation, (4) clinical feasibility and (5) boron neutron capture therapy (BNCT).

The isotope and radiopharmaceutical research programs are largely directed to improving methods for studying the functions and improving diagnosis of diseases of the brain and heart. The instrumentation program contributes to these efforts by improving the resolution and other qualities of the imaging process. The clinical feasibility program includes the use of synchrotron radiation for a safer method of angiography, the use of particle beams for therapy of vascular malformations and cancer, and the use of improved radiopharmaceuticals for studying brain function.

The DOE program in medical applications differs from related programs of the NIH in that the latter are more strongly clinical and are disease-oriented, whereas the DOE program is oriented toward research and development of new technologies. Innovative procedures developed under the DOE programs become the province of the NIH when extensive clinical studies of feasibility are to be conducted.

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Dollars in Thousands)

LEAD TABLE

Biological and Environmental Research

Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Base	FY 1992 Request	Program Change Request vs. Base	
					Dollar	Percent
Biological and Environmental Research	$267,200 a/	$373,314 b/	$275,911 c/	$286,128	$10,217	+ 3.7%
Program Direction	4,766	5,540	6,100	6,100	0	0.0%
Capital Equipment	11,272	11,553	11,553	16,832	5,279	+ 46.0%
Construction	22,149	3,465	3,465	3,500	35	+ 1.0%
Total	$305,387 a/d/	$393,872 b/d/	$297,029 c/	$312,560 d/	$15,531	+ 5.2%
Operating Expenses	($271,966)	($378,854)	($282,011)	($292,228)	($10,217)	+ 3.6%
Capital Equipment	(11,272)	(11,553)	(11,553)	(16,832)	(5,279)	+ 46.0%
Construction	(22,149)	(3,465)	(3,465)	(3,500)	(35)	+ 1.0%
Staffing Total FTEs						
Headquarters	57	62	60	60	--	--
Field	86	87	87	87	--	--
Total	143	149	147	147	--	--

Authorization: Section 103, P.L. 93-438, Section 203, P.L. 95-91.

a/ Total has been reduced by $3,306,000, which has been transferred to the SBIR program.
b/ Includes $1,972,000 for education programs funded in the Atomic Energy Defense Activities account.
c/ FY 1992 Base adjusted by $25,243,000 for transfer of Epidemiology to EH, $72,160,000 for FY 1991 Congressionally directed projects, and $560,00 increased personnel costs.
d/ Reflects epidemiology funding of $29,876,000 in FY 1990, $25,243,000 in FY 1991, and transfer of $26,300,000 to EH in FY 1992.

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

SUMMARY OF CHANGES

Biological and Environmental Research

FY 1991 Enacted Appropriation	$ 393,872
Comparability Adjustments	
- Transfer of Epidemiology program to Assistant Secretary for Environment, Safety and Health	- 25,243
FY 1992 Base Adjustments	
Increased personnel costs	+ 560
FY 1991 Congressionally Directed Projects	- 72,160
FY 1992 Major Program Changes	
- Continue radiation and chemical dosimetry, measurement technology and instrumentation	- 367
- Curtail biological markers studies and long-term experimental animal research on radiation and complex chemical mixtures	- 3,123
- Continue research in molecular genetics, cell biology	+ 174
- Increase support for structural biology research at the National Synchrotron Light Source and at the Stanford Synchrotron Radiation Laboratory	+ 2,652
- Provide additional support to accelerate mapping of the entire human genome	+ 11,167
- Continue carbon dioxide research program to accurately quantify cloud-climate feedback system and improve climate change prediction models	+ 8,972
- Maintain medical applications feasibility studies and related instrumentation	+ 598

- Boron Neutron Capture Therapy FY 1991 enacted budget includes Congressionally directed funding to modify the Power Burst Facility.....	- 9,856
- Maintain base capital equipment and provide increased equipment needs for the genome and carbon dioxide programs; and general plant projects program needs.....	+ 5,314
FY 1992 Congressional Budget Request.....	$ 312,560

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Analytical Technology

Population exposure underlies both the development of risk coefficients and an assessment of projected health impacts from that exposure. This exposure may be estimated by characterization of the radiation or chemical source combined with the application of suitable mathematical models which compute the exposure of the receptor population. Alternatively, exposure may be determined by direct measurement using appropriate personnel or area monitoring instrumentation. The analytical technology program develops and evaluates the instrumentation and computational technology required to address this responsibility for safe operation of Departmental facilities.

II. A. Summary Table: Analytical Technology

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Dosimetry Research	$ 9,581	$ 8,132	$ 7,730	- 5
Measurement Science	5,432	5,529	5,560	+ 1
Total, Analytical Technology	$ 15,013	$ 13,661	$ 13,290	- 3

II. B. Major Laboratory and Facility Funding

Ames Laboratory	$ 412	$ 436	$ 425	- 3
Argonne National Laboratory	$ 747	$ 633	$ 520	- 18
Brookhaven National Laboratory	$ 102	$ 110	$ 112	+ 2
Environmental Measurements Laboratory	$ 4,946	$ 4,615	$ 4,815	+ 4
Idaho National Engineering Laboratory - EG&G	$ 105	$ 113	$ 115	+ 2
Inhalation Toxicology Research Institute	$ 166	$ 100	$ 100	0
Lawrence Berkeley National Laboratory	$ 1,650	$ 1,135	$ 1,073	- 5
Lawrence Livermore National Laboratory	$ 627	$ 220	$ 140	- 36
Oak Ridge National Laboratory	$ 2,468	$ 2,015	$ 1,985	- 1
Pacific Northwest Laboratory	$ 1,363	$ 1,005	$ 1,005	0

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Analytical Technology			
Dosimetry Research	Complete compilation of a comprehensive Chernobyl data base. Maintain characterization studies of radiation sources and defining pathways from source to humans. Maintain radiation dosimetry research with particular emphasis on radon and radon daughters, and on fundamental studies of the microdosimetry of high linear energy transfer (LET) radiation. Continue research on characterizing DNA damage resulting from energy-related chemical toxicants. $ 9,581	Maintain, update and distribute a comprehensive Chernobyl data base. Maintain characterization studies of radiation sources and defining pathways from source to humans. Research will continue on fundamental studies of the microdosimetry of high LET radiation. Dosimetry research on radon and radon daughters will be continued. DNA adduct characterization and measurement program will continue with emphasis on measuring chemical exposures. $ 8,132	Fundamental studies of the physical and chemical effects of exposure to ionizing radiation will be applied in developing new concepts and methods for correctly defining the dose. Maintain research on developing dosimetric techniques for low LET and high LET radiations. Basic dosimetry research on radon and radon daughters will be continued. Characterization and measurement of DNA adducts will continue with emphasis on indication of very low levels from chemical exposures. Continue Chernobyl data base effort to incorporate additional data provided from the U.S./USSR collaboration. $ 7,730
Measurement Science	Maintain development of advanced instrumentation and new measurement technology concepts. Emphasis on laser based techniques for ultrasensitive detection of biological damage will continue. Development of new techniques to chemically separate toxic compounds will be completed. $ 5,432	Maintain research program on advanced instrumentation and measurement concepts. Primary emphasis will be on multiphoton ionization processes for ultrasensitive detection of biological damage. Specific laser spectroscopic techniques will be developed to measure DNA adducts at very low concentration levels. $ 5,529	Research on new instrumentation for detection and measurement of very low levels of biological damage due to radiation and chemical exposures will be continued. Advances in diode laser technology will be applied to development of simpler, less expensive systems for ultrasensitive laser spectroscopy to achieve improved measurement of toxic chemicals. Picosecond laser techniques will be explored to study fast biological processes. New mass spectrometric instrumentation will be evaluated for measurement of biological macromolecules. $ 5,560

III. Analytical Technology (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Analytical Technology	$ 15,013	$ 13,661	$ 13,290

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Environmental Research

Discharges and disturbance from energy sources can be localized or distributed regionally or worldwide. This program addresses the transport of discharges and their behavior through the atmosphere, marine and terrestrial ecosystems at different spatial scales, and over different time sequences. This information is essential to determine exposure and influence of these materials and their byproducts on the environment. The resiliency of biological systems to disturbance from energy extraction, supply, and production is also an important aspect of the maintenance of the integrity of an ecosystem and mitigation techniques to control damage. The broadness of this charge requires focusing on a few selected but important areas of research that provide the information for developing unifying concepts that can be translated into solving current and future energy/environmental concerns.

The atmospheric program has two distinct components. The first is in the area of atmospheric chemistry and addresses the processing of pollutants by clouds, precipitation, and air-surface exchange as well as the role of organics. The second explores transport and diffusion over complex terrain with a goal of providing research results which could be used by the Department to enhance the emergency preparedness and response systems at key DOE installations.

The marine program concentrates on the exchange of energy and natural materials between the continental shelf and the open ocean. Close collaboration with other Federal agencies working in the open ocean and with satellites makes this program pivotal in understanding dynamics of the ocean margins and their influence on both land and open ocean systems, particularly from the viewpoint of energy discharges and their assimilation into the ocean. With over half of the productivity of the ocean located along the ocean margins, this program is providing important information on carbon flux and may hold the key to the missing component of the world wide carbon budget.

The terrestrial transport program concentrates on the mobility of organic and inorganic contaminants and radionculides through the subsurface soils and ground water systems and on exploring microbial communities in deep sediments and aquifers. The program is directed at understanding fundamental physical, chemical, and microbiological mechanisms that control reactivity, stability, and transport of chemical mixtures, as well as hydrogeological and geochemical factors that control the presence, distribution and physiology of subsurface microbial communities.

Ecosystem functioning and response includes two components essential for operations of the DOE field sites. The first maintains long-term descriptive sampling and experimentation at the DOE Environmental Research Parks to provide data and data analyses that are useful for environmental compliance, land use questions at the sites, and detection of regional and global changes; the second focuses on ecosystem processes in arctic, arid, and forest ecosystems. These components are underpinned with theory and modeling to permit better predictive capability to anticipate problems before they become major issues.

II. A. Summary Table: Environmental Research

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Atmospheric Science	$ 12,175	$ 10,209	$ 10,500	+ 3
Marine Transport	5,847	5,539	5,587	+ 1
Terrestrial Transport	13,808	14,163	14,277	+ 1
Ecosystem Functioning and Response	8,121	6,973	6,524	- 6
Total, Environmental Research	$ 39,951	$ 36,884	$ 36,888	0

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory	$ 1,777	$ 1,405	$ 1,353	- 4
Brookhaven National Laboratory	$ 4,379	$ 3,457	$ 3,457	0
Environmental Measurements Laboratory	$ 2,208	$ 1,634	$ 1,634	0
Fermi National Accelerator Laboratory	$ 49	$ 50	$ 50	0
Idaho National Engineering Laboratory - EG&G	$ 1,271	$ 1,165	$ 1,014	- 13
Lawrence Berkeley National Laboratory	$ 1,116	$ 800	$ 850	+ 6
Lawrence Livermore National Laboratory	$ 1,889	$ 1,315	$ 1,045	- 21
Los Alamos National Laboratory	$ 1,347	$ 1,200	$ 1,150	- 4
Oak Ridge Associated Universities	$ 5	$ 0	$ 0	0
Oak Ridge National Laboratory	$ 4,130	$ 3,335	$ 3,050	- 9
Pacific Northwest Laboratory	$ 8,355	$ 7,809	$ 7,668	- 2
Savannah River Ecology Laboratory	$ 295	$ 290	$ 100	- 66
Savannah River Laboratory	$ 408	$ 215	$ 200	- 7

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Environmental Research			
Atmospheric Science	Research activities for the National Acid Precipitation Assessment Program will concentrate primarily on the preparation of key parts of the 1990 state-of-the-science reports on precipitation scavenging, cloud chemistry processes, and dry deposition. Data from the seven field experiments and the dry deposition investigations will be evaluated for their relevance to the integrated assessment needs and will be used for model verifications and for improvement of atmospheric processes in these models. Limited field and laboratory investigations will be undertaken for quality assurance purposes and for incidental model verification needs. The experimental upgrade of the precipitation chemistry network will commence. A pilot study of climatic effects of aerosols on a super-regional scale will be initiated.	A major field study will be launched over the northeastern United States and the western North Atlantic to determine the fate of man-made emissions of sulfur and nitrogen oxides. Emphasis will be placed on the aqueous phase transformations of these products into longer-lived aerosols which may have the potential to modify cloudiness and thus alter climate processes. Attention will be focused initially on sulfate aerosols and cyclonic storms which may promote super-regional transport (>1000km). The contribution of naturally occurring sulfate aerosols from oceanic dimethylsulfide will be explored. Activities will be coordinated with the Interagency Global Tropospheric Chemistry Experiment. Limited numerical modeling of the governing atmospheric chemistry processes will be pursued as well as benchmark laboratory studies of aqueous chemical reactions. The MAP3S Precipitation Chemistry Network will continue monitoring and will expand to include parameters related to Global Change.	The multilaboratory consortium will launch a field study in conjunction with the Continental and Oceanic Fate of Energy Related Pollutants Program. The study is concerned with the Committee on Earth and Environmental Sciences (CEES) Global Tropospheric Chemistry Experiment. A university grants program in atmospheric chemistry will be launched. Laboratory studies of formation and transformation of energy related pollutants of a nitrogen base as well as the role of organics in the transformations will continue. Development of the global tropospheric chemistry model will continue. The DOE program will join the International Global Atmospheric Chemistry (IGAC) Program.

III. Environmental Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Atmospheric Science (Cont'd)	The Atmospheric Studies in Complex Terrain (ASCOT) program will concentrate on specific problems of transport and diffusion relevant to emergency preparedness. Emphasis will be placed on modeling and experimental investigations providing the scientific tools to serve the DOE facilities with emergency preparedness needs. An upgrade in the forecasting capability of emergency response models for the local and the regional scale will be initiated. Modeling systems addressing reactive fluids will receive increased attention. The study of the role of organics in regional oxidant and acid production will continue with field and laboratory studies. The impact of sulfate aerosols on cloudiness and radiative balance will be studied in the context of global change. Technology transfer activities with tracers will continue for a variety of industrial applications.	This will also be the first test for the ASCOT models in the eastern mountainous terrain and in humid climates, and a new set of appropriate parameterizations are expected. Pilot studies of uncertainty in emergency preparedness models will be undertaken. At Savannah River Laboratory studies of atmospheric transport and diffusion under stable atmospheric conditions (e.g. during the night) will address validation of model parameterizations; these studies are called the Stable Atmospheric Boundary Layer Experiment (STABLE). The study of the role of atmospheric organics in global atmospheric chemistry changes will continue.	The ASCOT program will be enhanced to meet the rising demands of emergency preparedness and emergency response at key DOE facilities. The principal focus is the Rocky Flats Plant in Colorado. Activities will include both field studies of dispersion as well as model development. Emergency response studies related to the Atmospheric Release Advisory Capability (ARAC) and the Stable Atmospheric Boundary Layer Experiment (STABLE) at Savannah River will continue. Studies of reactive fluids and emergency response will continue. Development and application of tracer technology will continue. Improved instrumentation methodologies aboard the research aircraft will meet the challenges in both the atmospheric science and climate programs.
	$ 12,175	$ 10,209	$ 10,500
Marine Transport	Coastal ocean margins play an important role in the exchange of materials between the land and the sea. The input of nutrients to coastal areas from both land-based sources (via rivers) and interior ocean sources (via coastal upwelling), cause more than half of the total primary production of the global ocean to occur along the ocean margins. This extracts large amounts of CO2 by marine organisms from the atmosphere. The Northeast SEEP program completed its 18 month field year in FY 1990 to determine level of formation and discharge of particles from the shelf opposite the Delmarva	The marine program has supported traditionally long term interdisciplinary studies on ocean margins as part of its concern for the dispersal, fate, and distribution of energy related materials in the oceans. In FY 1991, analyses will be completed of the 3 regional subprograms in the Northeast Shelf Edge Exchange Program (SEEP), the Southeast South Alantic Bight Program (SAB), and the West Coast California Basin Study (CABs), and results will be synthesized to quantify the major physical, biological, and chemical processes that are specific to each region. Based on a program plan	Multiagency planning meetings, field equipment development and pilot studies will be conducted to accelerate research on ocean margins in tandem with the open ocean research of Joint Global Ocean Flux Studies (JGOFS) funded by other agencies and other countries. This effort is integrated into the biogeochemical element of the CEES Global Change Research Program. A plan will be issued by the Committee on Earth and Environmental Sciences (CEES) that will address the role of the ocean margins in exchanges between land and open ocean systems. The BER ocean program will be directed at assessing

III. Environmental Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Marine Transport (Cont'd)	Peninsula. A major onsite review was held in April to assess the SEEP program. In the CABs (California Bight study) research has shown that oxygen-deficient conditions in sedimentary areas in the California basins has increased almost 10-fold over the last 200 years. The reason for the spread of this anoxia is unknown and may be related to climate change, a change in ocean circulation, or the impact of increased human activities. Two new in situ instruments have been developed and tested for estimating phytoplankton concentrations, photosynthetic rates, and zooplankton concentrations in the water column of coastal oceans. Data concerning the dynamics of biological communities in the coastal ocean now can be collected with the same high frequency as many physical measurements. This means that the dynamics of physical systems can be coupled with the dynamics of biological systems in the ocean and on scales that are temporally and spatially comparable, a situation not possible before. This will clearly revolutionize the manner in which oceanography will be conducted in the future and the degree to which important interdisciplinary oceanographic problems can be resolved.	developed during a workshop held in FY 1990, a program announcement will be made soliciting proposals from the scientific community for the next phase of ocean margins research beginning in FY 1992. This new effort will provide information that is necessary to (1) predict the dispersal and fate of energy-materials in coastal waters, (2) document the role of the ocean's margins in the global flux of carbon and other materials, and (3) evaluate the degree to which coastal processes affect or are controlled by changes in global balance.	the quantitative contribution of carbon and other associated chemicals removed from the eastern and western U.S. continental shelf and adverted into the Gulf Stream. In addition, the dynamics of the eastern boundary current and coastal margins of the Pacific Ocean will also be investigated for margin/boundary interaction in the context of the CEES global change research program.
	$ 5,847	$ 5,539	$ 5,587

III. Environmental Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Terrestrial Transport	Completed initial research on the transport of radon within natural environments and the geographic distribution of radon sources. Held review of projects to determine which should be continued and which should be terminated. ($2,269)	Begin to summarize research findings in radon program on emanation and mobility through the near surface soils of the U.S. Conduct field experiments and modeling efforts to quantify environmental factors affecting radon entry into homes. Select new research projects concerning radon in ground water and effects soil weathering on radon emanation. ($1,894)	Continue research in radon transport through environmental systems with emphasis on basic chemical reactions in soil and rock systems which affect the release of radon. This will help to better predict areas and homes with potentially high radon levels. Begin collaborative DOE/EPA effort to identify areas/homes with high radon risk potential. ($1,781)
	Conducted long term research on the immobilization and transport of organic-chemical-radionuclide mixtures, and in the physical, chemical and microbiological properties of natural subsoils and groundwater. Initiated first integrated geochemical-microbial experiments where multiple organic contaminants with different sorptive capacities are degraded in presence of microorganisms. No comparable research to clarify coupled processes that operate simultaneously is being done nationally. Planned university-national laboratory cooperation that bridges the gap between molecular and field research related to chemical migration. Tested and demonstrated new instrumentation within an intermediate scale experimental system that is inexpensive and can be commercialized for field use in detecting organic spills in the subsurface. PNL Environmental Sciences Research Center initiated to be focal point for field scale research program. ($11,539)	Continue research to develop the first national comparative information base on microbial communities in deep sediments/aquifers to determine if diversity and abundance of microbial communities in groundwater can be predicted based on available physical-chemical monitoring data. Maintain research in the microbial degradation, abiotic degradation and sorptive-desorptive processes that mobilize organic-radionuclide chemical mixtures, and in the hydrologic, geochemical and microbiological properties that encourage their stabilization in subsoils and groundwater. Continue research in new generation expert systems related to chemical transport, and research in bacterial transport/degradation that will provide basic underpinning for effective long term biochemical cleanup of contaminated subsurface systems. Increase coordination with all Departmental units by selecting the first field research site to test scientific concepts and speed transfer of new scientific methods, such as microbial degradation of organic chemical mixtures under pressure and water flux. ($12,269)	Accelerate transfer of DOE Deep Subsurface Microbiology Culture Collection to bioremediation industry and university researchers. Novel DOE/OER aseptic sampling methods will be refined to obtain uncompromised in situ microbial-sediment samples at depth. Such methods are needed nationally by everyone involved in microbiological research and analysis of chemical transport. Preliminary analysis of deep microbial-environmental interactions will be completed by a consortium of 20 national laboratory and university investigators using data from Savannah River, Hanford, and Idaho research sites. Molecular biologic methods for rapid identification of subsurface microbial communities will be expanded. Research on the hydrologic and geochemical properties of the unsaturated (vadose) zone and groundwater that control chemical transport will be continued and initial field injection experiments to determine the stability and transport of organic macromolecules (colloids) under aerobic and anaerobic conditions will be completed. Laboratory experiments using state-of-the-art molecular spectroscopic techniques will focus on quantifying organic chemical-radionuclide interactions and

III. Environmental Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Terrestrial Transport (Cont'd)			processes important to stabilization of contaminant mixtures. Research to develop new predictive models of how multiple (geochemical-hydrologic-microbial) processes control subsurface contaminant movement will be continued and prototype geochemical/hydrological modules of an expert system that allows prediction of mixed chemical stability and mobility will be completed. ($12,496)
	Implemented plans for the Energy Sciences Network (ESNET) project as identified in the Applied Mathematical Sciences subprogram of the Basic Energy Sciences program. This subprogram's share for the implementation of ESNET was $48.	Upgrades of ESNET to conform to the National Research and Education Network Standards will continue to be implemented; funding will be shared among ER programs that benefit from ESNET. This subprogram's share is $62.	ESNET will be fully supported in the Applied Mathematical Sciences subprogram of the Basic Energy Sciences program.
	$ 13,808	$ 14,163	$ 14,277
Ecosystem Functioning and Response	The potential for using remote sensing technologies to monitor and explore ecological processes were developed. The arctic program entered its synthesis phase on the effect of disturbance and changing conditions on the arctic tundra. Modeling and field studies were being developed interactively to show what ecosystem parameters were the most critical, to understand and adjust to control deleterious disturbance. The program in arid ecosystems is being developed to determine conditions of increased desertification and decreased ecosystem resiliency.	The evaluation of advanced field systems that measure evapotranspiration over a 1 to 2 km swath will be completed and if appropriate will be deployed in arctic and arid sites for calibrations. Synthesis of the arctic program will be completed and further research developed within a comprehensive multiagency program, whose planning started in FY 1990 under the Arctic Research and Policy Act. Implementation of the arid research program will begin with use of data available at the DOE National Environmental Research Parks and the ecological theories necessary to conduct DOE goal oriented research. Focus of the program will be on changes in arid ecosystems that could cause a cascading effect to create desertification in dry ecosystems.	Molecular methods that are effective in understanding ecological processes will be expanded. The potential for using population genetics, and molecular methods to investigate the impact on the biosphere of global change will be introduced into the program. Landscape level research will be initiated with the focus on factors related to gas flux from disturbed and undisturbed sites to determine possible changes in carbon and other elemental budgets that could influence rapid transitions from productive to deteriorating ecosystems (e.g., enhanced desertification in arid regions, enhanced permafrost melting in the arctic). Research within these programs will help discover the impacts of potential energy development, which is relatively high, in the arctic and arid regions.

III. Environmental Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Ecosystem Functioning and Response (Cont'd)	The seven DOE National Environmental Research Parks have been incorporated into a park network to provide data analyses of long-term data sets that enhance recognition and understanding of environmental changes that result from increased disturbance and other global change phenomena. ParkNet, the interactive DOE Research Parks data base network, was fully developed in FY 1990.	Research at the seven DOE National Environmental Research Parks is being designed to provide validation opportunities for new and developing ecological theories and intracontinental transect analyses. ParkNet, the interactive DOE Research Parks data base network, will continue to expand with links to the NSF Long-Term Ecological Reserves and the international Man and the Biosphere network to begin intercontinental and international transects that will be used to identify and understand critical gradients useful in forecasting global and regional change.	ParkNet, interlinking the DOE National Environmental Research Parks, will be strengthened and with the data base available will be used to compare impacts of major natural events (large fires, torrential rains, excessive drought) between different regions to determine changes in driving forces in the different ecosystems and thus better predict such changes in the future. Extensions into other international programs will further help in obtaining world wide perspective of changing ecological conditions.
	Fifteen theoretical ecology projects were awarded in the Theoretical Ecology Program to provide an underpinning of theory for field and experimental ecology. In FY 1990 an important breakthrough was realized in the theoretical understanding of responses of landscape boundaries in restoration of damaged environments with validation of the theory taking place in the extensive burned areas of Yellowstone Park.	The Theoretical Ecology Program will be reviewed. An announcement for the next funding cycle of the Theoretical Ecology Program will be made in the Federal Register. This is the only ecology program in the Federal system with the specific goal of enhancing the theoretical base in ecosystem dynamics. The announcement will focus on theoretical aspects of ecological responses to global and regional climatic changes; and the effects of local ecological disturbance and contamination phenomena on regional scales.	Results of the three years of research sponsored within the Theoretical Ecology Program will be compiled and presented in an open forum for comments from the scientific community to explore new advances in theory development. An announcement in the federal register for theoretical ecology proposals to begin in FY 1993 will be published with a focus on mathematical, physical, and other disciplines to provide a framework to better understand and predict ecological processes.
	$ 8,121	$ 6,973	$ 6,524
Environmental Research	$ 39,951	$ 36,884	$ 36,888

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Health Effects

Research in this program is conducted to develop a broad, scientifically sound data base for evaluating the potentially adverse health effects that could result from exposures to radiation and chemical agents most relevant to Department of Energy programs. The program is designed to provide experimental health effects data, including data on mechanisms by which health effects are induced and expressed, which cannot be obtained from human studies. This program makes use of experimental animals, as they are useful models for human beings. In addition, animal organ and tissue cultures, as well as animal and human cell cultures, are extensively used. This program will increasingly emphasize molecular-level studies. There is also a small subprogram in radiation and chemical physics that addresses the physical mechanisms of radiobiological action.

II. A. Summary Table: Health Effects

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Human Health Research				
Epidemiology	$ 12,539	$ 11,243	$ 0	-100
Radiation Effects Research Foundation	17,255	14,000	0	-100
Subtotal, Human Health Research	$ 29,794	$ 25,243	$ 0	-100
Biological Research				
Radiation Biology	$ 26,683	$ 27,010	$ 25,000	- 7
Chemical Toxicology	8,036	6,468	5,602	- 13
Subtotal, Biological Research	$ 34,719	$ 33,478	$ 30,602	- 9
Radiological and Chemical Physics	$ 6,312	$ 6,243	$ 5,996	- 4
Total, Health Effects	$ 70,825	$ 64,964	$ 36,598	- 44

II. B. Major Laboratory and Facility Funding

	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Argonne National Laboratory	$ 7,315	$ 5,920	$ 4,985	- 16
Brookhaven National Laboratory	$ 1,213	$ 742	$ 294	- 60
Fermi National Accelerator Laboratory	$ 0	$ 40	$ 0	-100
Idaho National Engineering Laboratory - EG&G	$ 66	$ 0	$ 0	0
Inhalation Toxicology Research Institute	$ 7,432	$ 7,168	$ 7,151	0
Laboratory of Radiobiology and Environmnetal Health	$ 1,084	$ 867	$ 867	0
Lawrence Berkeley National Laboratory	$ 3,213	$ 2,910	$ 1,485	- 49
Lawrence Livermore National Laboratory	$ 1,891	$ 1,390	$ 1,390	0
Los Alamos National Scientific Laboratory	$ 2,720	$ 2,085	$ 735	- 65
Oak Ridge Associated Universities	$ 5,238	$ 4,144	$ 1,093	- 74
Oak Ridge National Laboratory	$ 6,499	$ 6,008	$ 6,008	0
Pacific Northwest Laboratory	$ 7,242	$ 5,613	$ 5,205	- 7
Sandia National Laboratories	$ 737	$ 812	$ 737	- 9

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Health Effects			
Human Health Research			
Epidemiology	Data pooling efforts using data from published studies reached conclusion. CEDR development accelerated and established an interim data repository. Expanded Health Surveillance System and study of injuries and accidents to additonal facilities.	Complete autopsies/tissue analyses now on hold. Install data from completed studies in interim CEDR. Initiate roster construction/verification for National Laboratory workforces in preparation for vital status determination. Accelerate CEDR data collection. Obtain computerized detailed work history data for SRP workers. Continue data collection at National Laboratories and expansion of Health Surveillance System and Injury/Accident Study.	TRANSFER: Epidemiology research activities transferred to EH. ($-7,800)

III. Health Effects (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Epidemiology (Cont'd)	Implemented plans for the Energy Sciences Network (ESNET) project as identified in the Applied Mathematical Science subprogram of the Basic Energy Sciences program. This subprogram's share for the implementation of ESNET was $44.	Upgrades of ESNET to conform to the National Research and Education Network Standards will continue to be implemented; funding will be shared among ER programs that benefit from ESNET. This subprogram's share is $0.	No activity.
	$ 12,539	$ 11,243	$ 0
Radiation Effects Research Foundation	Under Binational Agreement between the U.S. Government and the Government of Japan, sustain broad based program on studies of the atomic bomb survivors. Continue genetics research to define molecular indicators of radiobiological damage. Maintain clinical and pathological studies on survivor population. Develop advanced biological dosimetry technology. Maintain radiation dosimetry activities to ascertain history of clinical radiation exposures in order to distinguish individual medical dose from atomic bomb dose.	Maintain level of effort for atomic bomb survivor studies. Continued development of aging research activities will receive priority attention.	TRANSFER: Radiation Effects Research Foundation activities transferred to EH. ($-18,500)
	$ 17,255	$ 14,000	$ 0
Subtotal, Human Health Research	$ 29,794	$ 25,243	$ 0
Biological Research			

III. Health Effects (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Radiation Biology	Continue data analysis and publication of information from the long-term Beagle dog studies. Implement the interlaboratory collaboration necessary to create an integrated radiobiology database for the long-term experiments. Support increased repository and archiving processes. Continue radon studies and standardize approaches to dosimetry of radon exposures. Start new multi-level studies which implement a combined whole animal, cellular and molecular level approach to the mechanisms of radiation carcinogenesis. Increase support for the animal and cellular-molecular studies of the effects of low level doses and dose rates of neutrons and gamma rays at the Argonne National Laboratory using the Janus reactor. Increase support for high-LET research at the Bevatron, to observe effects on Harderian gland cells. ($14,273)	Support will be continued for the repository and archiving process on the tissues and information from the long-term animal studies. Experiments on stored tissues will aid in elucidating the mechanisms of radiation-induced cancers. Some of the radon/radon daughter experiments will be nearing completion and publication. As the whole animal studies phase down, there will be more emphasis on integrated research approaches which simultaneously span molecules, cells and whole animals. These new approaches promise to produce an in-depth understanding of the mechanisms involved in tumor development. Support will continue for the animal and cellular-molecular studies of radiobiological effects of low level neutron and gamma ray exposures and for the high-LET studies using different heavy nuclei at various doses and dose rates. The subcontracted research effort between the University of Utah and the Inhalation Toxicology Research Institute will continue its phase down. ($14,242)	The radiobiological database and tissue repository for the long-term animal studies will be further developed. Data from these experiments will be analyzed in order to derive improved risk estimates. Stored tissues will be studied to help elucidate molecular mechanisms underlying radiation carcinogenesis. Long-term animal experiments will continue their phase down. The multi-level, integrated approaches which employ molecular, cellular and whole animal observations to follow the development of radiation induced tumors will be expanded. New experimental approaches will be applied to obtain data for the estimation of health risk associated with radon and radon daughters. Studies to obtain improved estimates of risks associated with low level exposure to neutrons will be continued. The underlying mechanisms of the reverse dose-rate effect which has been observed for neutrons and alpha emitters will be studied. ($11,000)
	Cellular and molecular studies selectively increase. The molecular level analysis of germinal and somatic mutations induced by high--as well as low-LET radiation continues. Research emphasizes the confirmation of observations of the preferential repair of damaged DNA that is inactive. Studies on the molecular and cytogenetic characterization of radiation-induced damage that is biologically significant and the role of such damage in lung carcinogenesis continue. Validate improved molecular and cellular based mutation assays for	Research investigating the molecular and cellular mechanisms underlying radiobiological damage and carcinogenesis will be increased. Studies of malignant transformation using human cell cultures and combined in vitro and in vivo approaches will be emphasized. Increased effort will be placed on understanding the relationship between DNA repair capacity and tumor development. Some of these studies will utilize transgenic mice in which particular DNA repair genes have been introduced. Studies on the molecular and	In order to obtain information useful for the evaluation of low dose and low dose rate effects, studies on the molecular and cellular mechanisms of radiobiological damage will be expanded. Studies on oncogene activation in tumors from radium dial painters will continue. New research on the role of cancer suppression genes in radiation tumorigenesis will be expanded. Likewise, new studies on the dynamics of hematopoiesis (blood formation) will be expanded. This work will provide better understanding of the mechanisms of radiation-induced

III. Health Effects (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Radiation Biology (Cont'd)	the quantitation of somatic and heritable mutations in radiation exposed human populations. ($12,410)	cytogenetic characterization of radiation-induced damage to pulmonary tissue components will continue. Molecular analysis and characterization of tumor tissue from radium dial painters will continue. Studies to perfect assays for the quantitation of somatic and heritable mutations in humans will be increased in scope as new technologies are developed in the human genome program. ($12,768)	leukemia and may lead to improved prospects for bone marrow transplantation. The relationship between DNA repair capacity and radiation carcinogenesis will continue to be emphasized. The molecular nature of radiation damage to DNA will be investigated to see if it fits a pattern which can be recognized as being due to radiation. Such specific "mutation spectra" have been seen with chemical mutagens. Characterization of pulmonary damage will continue to be emphasized. ($14,000)
	$ 26,683	$ 27,010	$ 25,000
Chemical Toxicology	This research includes studies on the interactions of defined multiple exposures and extends the use of molecular biology approaches involving effects of inhaled chemicals and metabolic changes in the respiratory tract. Continue to emphasize mechanisms of carcinogenesis and mutagenesis as primary effects and inhalation toxicity as the primary exposure route. Increased emphasis on integration of research efforts across the program element.	The program will continue developing data for the evaluation of potential adverse effects of energy-related chemicals on humans through multifaceted biological research. The focus will be on fundamental principles of chemical interactions with living systems, emphasizing cellular and molecular mechanisms. The research will include studies on mechanisms of synergistic and antagonistic interactions and mechanisms of carcinogenesis, including DNA adducts, cellular oncogene activation and tumor promotion. Research will be continued to bridge information between molecular and cellular studies and animal studies. Emphasis will remain on carcinogenesis and mutagenesis, and upon inhalation as a primary route of exposure.	In addition to maintaining the program to understand the potential adverse effects of energy-related chemicals, research will gradually include studies of interactions between combined effects of chemicals and radiation, and identifying biomarkers of low level exposures and effects. The focus remains on fundamental principles of chemical interactions with living systems with emphasis on cellular and molecular mechanisms, including those involved with carcinogenesis and mutagenesis. New studies aimed at improving the basis for interspecies extrapolation will be expanded. Development of new systems for detection of mutations in humans will continue. Inhalation as a primary route of exposure will remain an emphasis of the chemical toxicology program.
	$ 8,036	$ 6,468	$ 5,602

III. Health Effects (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Subtotal, Biological Research	$ 34,719	$ 33,478	$ 30,602
Radiological and Chemical Physics	Continue radiation biophysics research and basic studies of radiation interactions with matter. As biological tissue has a liquid/solid consistency (i.e. condensed phase), emphasis will be on condensed phase data which will provide insight into reactions with biological tissues. Sustain theoretical studies on structural and conformational changes in model systems caused by chemical and physical agents.	Radiation biophysics and fundamental studies on interaction of radiation with matter will continue. Application of this research to the understanding of radiobiological effects at low doses and dose rates will continue. Continued emphasis will be placed on obtaining data in condensed phase. Theoretical studies on understanding of conformational and structural changes in biomolecules caused by radiation and chemical agents will continue.	Understanding of fundamental physical processes involved with interaction of ionizing radiation with matter will continue. Information obtained from this research will be used to enhance understanding of radiobiological effects at low doses and dose rates. Continued emphasis will be placed on the study of interaction processes in condensed phase, particularly those materials which may have biological significance. Theoretical and computational studies will continue on the conformational and structural changes in biomolecules produced by ionizing radiation. A correlation between these changes and ultimate biological effects will be investigated.
	Continue to maintain basic studies on understanding of energy transfer pathways and influence of these energy transfers on the physical and chemical properties of the liquid. Strengthen the computation and calculation capabilities to better define the structure-reacting relationship in liquids. Hardware and software improvements will be developed for dual beam flow cytometry to incorporate light scatter measurements.	Basic studies on identifying and elucidating the mechanisms of energy transfer processes in biologically relevant model liquids will continue. Application of this knowledge in understanding the changes that are produced in physical and chemical properties of these liquids will be emphasized. Theoretical computational techniques will be emphasized to better define the structure-activity relationship of these liquids.	Basic mechanisms involved in energy transfer processes in biologically relevant macromolecules and model liquids will continue. Understanding of these mechanisms coupled with the physical mechanisms of interaction of radiation with matter will provide a sound scientific basis to relate initial damage to the production of ultimate health effects such as cancer. Theoretical research will continue to better understand and define the structure-activity relationship in model liquids. This information will be further extended to realistic biological systems.
	$ 6,312	$ 6,243	$ 5,996
Health Effects	$ 70,825	$ 64,964	$ 36,598

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: General Life Sciences

Research in General Life Sciences contributes to the base of fundamental biological knowlege that is required for the effective study and interpretation of energy-related health effects. It also identifies early indicators of biological damage, develops new techniques and experimental systems for assessing biological impact, and provides knowledge that eventually becomes used in the estimation of human health risk to radiation or chemical exposure. This research area will provide additional support to accelerate mapping of the entire human genome by improving the DNA-sequencing technology, developing new instrumentation and applying robotics technology where possible. This program applies modern molecular biology to the study of radiation and chemical health effects and also exploits unique Departmental facilities for structural biology and genome research.

II. A. Summary Table: General Life Sciences

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Structural Biology	$ 8,360	$ 9,348	$ 12,000	+ 28
Molecular Biology	12,939	13,016	13,115	+ 1
Cellular Biology	8,420	8,919	8,994	+ 1
Genome	25,347	45,633	56,800	+ 24
Total, General Life Sciences	$ 55,066	$ 76,916	$ 90,909	+ 18

II. B. Major Laboratory and Facility Funding

Ames Laboratory	$ 172	$ 200	$ 200	0
Argonne National Laboratory	$ 1,908	$ 1,523	$ 1,666	+ 9
Brookhaven National Laboratory	$ 6,101	$ 6,262	$ 6,358	+ 2
Lab for Energy-Related Health Research	$ 2,236	$ 2,036	$ 2,036	0
Lawrence Berkeley National Laboratory	$ 7,159	$ 7,372	$ 10,217	+ 39
Lawrence Livermore National Laboratory	$ 8,265	$ 10,621	$ 10,558	- 1
Los Alamos National Laboratory	$ 9,353	$ 12,618	$ 14,349	+ 14
Oak Ridge Associated Universities	$ 608	$ 576	$ 783	+ 36
Oak Ridge National Laboratory	$ 6,568	$ 7,401	$ 7,656	+ 3
Pacific Northwest Laboratory	$ 402	$ 231	$ 120	- 48

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
General Life Sciences			
Structural Biology	Understanding the relationships between the structure and the function of biological macromolecules will provide the intellectual foundations for future broad advances in biotechnology. Current and developing user facilities at DOE laboratories play a central role in the efficient determination of biological structure. The academic community and industry are heavy users of these facilities. Maintain support of the user program in structural biology at the National Laboratories. At the UV ring of the NSLS, expand the range and capabilities of vacuum ultraviolet spectroscopy, especially for studies of nucleic acids. Continue development of the high counting rate 2-D detectors for counting photons at Brookhaven and Argonne. With completion of construction of the low Q diffractometer and development of data reduction software, initiate structural studies of proteins and chromatin at the Los Alamos pulsed neutron source. Investigate the atomic structure of several forms of cancer-related proteins coded by oncogenes. Develop plans and priorities for biological research at the developing synchrotron light sources at the Argonne National Laboratory and the Lawrence Berkeley Laboratory.	Studies will be made of the structure of chromosomes and ribosomes by means of small angle neutron scattering and scanning transmission electron microscopy and will include the construction of a synthetic chromatin to model chromosome fragments. Development of advanced high speed X-ray detector systems for use at synchrotron facilities will be accelerated. At the NSLS the techniques for single crystal X-ray diffraction will be expanded by the use of multi-wavelength anomalous diffraction, and Laue diffraction. A small angle X-ray spectrometer that will permit rapid automated structural studies will be in routine use for studies of oriented biological materials such as membranes. At LANL, a ferrofluid has been designed in which suspensions of chromatin or an elongated virus could be aligned by a small magnetic field. This development raises the possibility for understanding higher order structures in chromatin fibers. Studies of the structure of proteins and nucleic acids in several laboratories, principally by X-ray analysis and nuclear magnetic reasonance are providing important information on the forces keeping molecules stable and on the differences between normal and abnormal molecules. Research on direct microimaging techniques for biological structures will be conducted using high brightness, coherent X-ray sources which will permit construction of high spatial resolution X-ray microscopes and X-ray holographic imaging devices.	Current and developing user facilities at DOE laboratories are increasingly important in the effort to elucidate biological structure and to relate the structure of molecules to their function. Developing this understanding is necessary for future biotechnology which will be an increasingly important component of the economy of advanced nations. Such understanding will lead to a wide variety of practical applications such as rational drug design, new catalysts for energy processes, and new materials, for example. Maintain and expand support for the users of unique facilities for structural biology at DOE laboratories. Research on the structure and dynamics of DNA, nucleosomes and chromatin will be continued. Research on fast large area detectors capable of exploiting the increased intensity of advanced light sources for dynamic studies of macromolecular catalysis and molecular interactions will continue. Research on the structure of the photosynthetic reaction center will be expanded. Support will continue for studies on the structure of the protein products of oncogenes. These studies may have implications for tumor therapy. New studies on the molecular structure of membranes will be expanded. Support for operation of biomedical user facilities at NSLS and SSRL will be increased to meet increasing demand for use by academic and industrial research groups. Funds will be provided for research to develop insertion devices, beam lines, diffraction instruments and radiation detectors required for

III. General Life Sciences (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Structural Biology (Cont'd)			efficient use of advanced synchrotron light sources coming on line at LBL (1-2 GeV Synchrotron Radiation Source) and ANL (6-7 GeV Synchrotron Radiation Sources).
	$ 8,360	$ 9,348	$ 12,000
Molecular Biology	Emphasize chemical and physical characterization of biologically significant DNA damage from high LET radiation; continue research on nonrandom repair of genomic damage in mammalian cells; investigate the functional and evolutionary significance of the conserved telomeric repeat sequences of mammalian chromosomes; characterize the molecular nature of heritable mutations in mice.	Much of this program is aimed at investigating the nature of DNA lesions produced by radiation and other environmental agents and elucidating the mechanisms by which these lesions are produced, modified and repaired. New fluorescent techniques utilizing molecular probes for the detection and quantitation of genetic damage will be developed. A variety of model systems will be exploited to understand the factors regulating the expression of particular genes. Efforts to isolate, clone and characterize human DNA repair genes will expand.	This program emphasizes fundamental research on: a) the structure, function and regulation of genes and proteins; b) molecular genetic processes of particular importance in understanding health impacts of energy-related agents; and c) elucidating the molecular nature of DNA damage and repair. An important component is aimed at characterization and cloning of human DNA repair genes in order to provide a better basis for evaluation of low level exposures. This and related work will lead to the ability to characterize individual susceptibility to DNA damaging agents. New and improved technology to detect and quantitate genetic damage will continue to be developed. Efforts to develop new molecular markers for improved epidemiological studies will continue. Development of transgenic mice systems for study of important genes will be expanded.
	$ 12,939	$ 13,016	$ 13,115

III. General Life Sciences (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Cellular Biology	Continue fundamental research on cell replication and regulation in normal amd perturbed mammalian cells that are progressing toward a malignant state. Continue exploitation of a battery of repair-deficient mutants to characterize and clone human DNA repair genes. Sustain efforts to determine the mechanisms by which perturbation in the extracellular matrix and cell membrane receptors influence carcinogenesis. Continue investigations of the cells at risk and the cellular mechanisms involved in the development and progression of lung diseases caused by inhaled substances.	Studies will continue on the regulation of gene expression in particular cell types, on mammalian germ cell biology, on the metabolism, regulation and function of lipids in mammalian cells, and on the responses of cells to freezing and thawing. Particular emphasis will be placed on improving flow cytometric analytical cytology methodology and the validation and application of a flow cytometric procedure to detect and enumerate variant human red cells that are produced by mutational events that occur in the bone marrow and result in the loss of cell surface glycophorin A. New research applying analytical cytology to the study of hematopoiesis will be initiated.	Research in this program area serves to provide basic knowledge of cell function and structure necessary to understand cellular responses to radiation and chemical exposures and to develop better experimental models. The research employs a broad experimental approach and a wide variety of cell types, including cultures of specialized human cells. Selected cell types and specific cellular processes are being studied to identify the genetic and other factors that control cell transformation, cell division, and cell differentiation. Much of the research is aimed at clarification of cellular processes involved in radiation- or chemically-induced tumor formation. A significant component is aimed at improving cytogenetic techniques for the detection and quantification of damage to chromosomes.
	$ 8,420	$ 8,919	$ 8,994
Genome	Enhance DOE effort in the human genome program by expanding the program to include the following activities: continue ordering cloned DNA physical mapping for several chromosomes; provide necessary support to DOE Human Genome Centers and other large interdisciplinary efforts to create the necessary critical mass; build prototype technology for testing and validation; develop innovative sequencing technologies; develop and test new computer hardware and software in support of chromosome mapping efforts. With NIH, complete the national plan for the Human Genome program. Start addressing ethical, legal, and social issues related to this program.	Continue the development of resources and technologies and emphasize automation and robotization of advanced state-of-the-art capabilities for sequencing DNA; begin sequencing selected regions of DNA to facilitate physical mapping of chromosomes; design and apply the software needed to manage and analyze data; expand the effort to construct physical maps of each human chromosome; provide support for distribution of these resources from National Laboratories; establish human genome fellowships for training interdisciplinary specialists; facilitate transfer of technologies from labs to the private sector; expand ethical, legal, social issues activities.	Sustain the development of innovative biological and computational resources and instrumentation; design automated and robotized state-of-the-art technologies for mapping and sequencing DNA and continue mapping and sequencing selected regions of human chromosomes. Maintain fellowship program and expand effort to support ethical, legal, and social issue activities. Facilitate transfer of technologies from laboratories to the United States private sector.

III. General Life Sciences (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Genome (Cont'd)	Implemented plans for the Energy Sciences Network (ESNET) project, identified in the Applied Mathematical Sciences subprogram of the Basic Energy Sciences program. This subprogram's share for the implementation of ESNET was $99.	Upgrades of ESNET to conform to the National Research and Education Network Standards will continue to be implemented; funding will be shared among ER programs that benefit from ESNET. This subprogram's share is $126.	ESNET will be fully supported in the Applied Mathematical Sciences subprogram of the Basic Energy Sciences program.
	$ 25,347	$ 45,633	$ 56,800
General Life Sciences	$ 55,066	$ 76,916	$ 90,909

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Medical Applications

Medical Applications research involves a wide range of projects directed to clinical and other benefical applications of energy-related technologies. Radiopharmaceuticals research involves development of and/or biomedical studies with new radiopharmaceuticals, largely in studies of brain and heart metabolism, but also in diagnosis and therapy involving other organs. Clinical feasibility research includes in-vivo testing of new radiopharmaceuticals in animals and subsequently in selected patients. Methods are evaluated for the study, diagnosis, and treatment of disease such as cardiopulmonary disease, mental disorders, cancer, and metabolic disorders. The instrumentation program focuses primarily on advanced detector research, improved resolution of positron emission tomography and other imaging techniques. Particle beam, heavy ion therapy, and boron neutron capture therapy research is conducted to treat inoperable tumors in the brain.

II. A. Summary Table: Medical Applications

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Stable Isotope Research	$ 988	$ 450	$ 0	-100
Radioisotope Development	2,865	1,888	2,209	+ 17
Radiopharmaceuticals	16,673	17,811	17,248	- 3
Instrumentation	3,536	2,677	2,770	+ 3
Clinical Feasibility	4,465	4,336	5,428	+ 25
Boron Neutron Capture Therapy	8,358	16,039	6,288	- 61
Congressionally Directed Projects	0	72,160	0	-100
Total, Medical Applications	$ 36,885	$ 115,361	$ 33,943	- 71

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory	$ 378	$ 380	$ 360	- 5
Brookhaven National Laboratory	$ 8,245	$ 8,234	$ 8,514	+ 3
Hanford Engineering and Development Laboratory	$ 300	$ 50	$ 50	0
Idaho National Engineering Laboratory - EG&G	$ 5,191	$ 12,876	$ 3,050	- 76
Lawrence Berkeley National Laboratory	$ 3,545	$ 2,738	$ 2,795	+ 2
Lawrence Livermore National Laboratory	$ 607	$ 430	$ 0	-100
Los Alamos National Laboratory	$ 2,108	$ 1,422	$ 1,440	+ 1
Mound Facility	$ 493	$ 250	$ 0	-100
Oak Ridge Associated Universities	$ 855	$ 260	$ 350	+ 35
Oak Ridge National Laboratory	$ 1,771	$ 1,673	$ 1,870	+ 12
Pacific Northwest Laboratory	$ 12	$ 13	$ 13	0

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Medical Applications			
Stable Isotope Research	Chemical exchange and liquid thermal diffusion continued for isotope enrichment of calcium, sulfur and zinc. Initiate research on the applications for NMR spectroscopy to provide a noninvasive, non-radioactive method to investigate structure and metabolism in vivo in real time.	Continue research on the development of advanced nuclear magnetic reasonance techniques for imaging the distribution of stable isotopes in humans and animals in real-time.	No activity planned.
	$ 988	$ 450	$ 0
Radioisotope Development	Use of new BLIP II in development of a variety of radionuclides needed for new and improved diagnostic and therapeutic agents to improve the quality of health care and initiate efforts to produce new radionuclides to support the research on monoclonal antibodies and PET.	Identify new radionuclides which provide new methods of diagnosis and therapy and aid in quantitative assessment of biochemical processes.	Develop species-specific chelators for purification of desired medical isotopes providing greatly simplified separation of minor, desired species from an overwhelming excess of undesired target material.
	$ 2,865	$ 1,888	$ 2,209
Radiopharmaceuticals	Continue development of new radiopharmaceuticals labeled with positron and single photon radionuclides to study details of biomedical processes on a non-invasive and quantitative basis and initiate efforts to apply advanced computational techniques from the field of quantum pharmacology to increase our knowledge of identifying mechanisms and pathways of diffusion, transport and segregation of chemical compounds in target tissues and organs.	Continue FY 1990 program and improve development of receptor-binding agents for more selective localization of various radionuclides in specific tissues or organs. Develop a more complete understanding of the basic radiochemistry for improved Tc-99m agents for brain and heart imaging.	Continue FY 1991 program and improve bifunctional chelates for Tc-99m and other radioactive elements to conjugate monoclonal antibodies and other proteins. Develop pharmacologic strategies to improve retention of radiolabeled antibodies in tumor cell targets following labeled antibody administration.
	$ 16,673	$ 17,811	$ 17,248

III. Medical Applications (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Instrumentation	A new approach to ultra-high resolution Positron Emission Tomography (PET) which will eliminate the need for mechanical sampling motion and which can be extended to a multi-ring configuration, will be tested. Single Photon Emission Computed Tomography (SPECT) is an established and very useful technique to detect a variety of tumors and other lesions. New detection concepts will be examined which offer high sensitivity and spatial resolution along with mechanical simplicity. High intensity monochromatic x-ray beams from synchrotron light sources share great promise in imaging coronary arteries for early detection of heart disease. Development of technology for other potential applications in neuroradiology and tumor diagnosis will be initiated.	Research on high resolution PET and SPECT systems will be maintained with emphasis on true three-dimensional imaging capabilities. In-vivo computed tomography using a new beam line at the National Synchrotron Light Source equipped with a superconducting wiggler insertion device will be applied in multiphoton absorption studies to image brain tumors, especially pituitary adenomas and cerebral gliomas, and atherosclerotic plaques in major arteries. New biomedical generators for positron emitting isotopes will be explored for tumor imaging and for studying bone and brain metabolic processes. Development of a compact, portable instrument for monitoring the course of pulmonary edema at the hospital bedside or outpatient clinics will be completed. Development of magnetoencephalography instrument for non-invasive brain function studies will be continued.	Develop a totally automated radiochemistry system which will utilize an integrated approach of radiochemistry modular stations and robotics for the production of radiotracers for use in PET. New and improved detector systems for PET imaging will be evaluated. Research on three-dimensional PET imaging and magnetoencephalography will be continued.
	$ 3,536	$ 2,677	$ 2,770
Clinical Feasibility	PET with Rb-82 will be used to evaluate the integrity of the blood-brain barrier in 50 patients who have undergone radiotherapy. The study will be 2 to 5 years in duration. Absolute measurement of radionuclide uptake in patients will be validated using a calibration phantom methodology.	Continue FY 1990 program, and develop pharmacologic strategies to enhance retention of radiolabeled monoclonal antibodies (MoAbs) in tumor cell targets. Develop a novel method to covalently link stable clusters of gold atoms to antibodies to improve antigenic specificity and capacity.	Continue FY 1991 program and study effects of substances of abuse on metabolism, neurotransmitter activity and drug binding sites, binding mechanisms and kinetics. Complete testing of a receptor kinetic model via Technetium radiopharmaceutical functional imaging of liver transplant recipients.

III. Medical Applications (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Clinical Feasibility (Cont'd)	Continue development and assessment of new radiochemically engineered radioimmunopharmaceuticals.	Use clinically relevant isotopes Iodine-131, Indium-111, and Yttrium-90, conjugated to monoclonal and polyclonal antibodies to develop improved SPECT imaging for treatment planning for cancer patients undergoing radioimmunotherapy.	Complete pre-clinical study on K-subtraction angiography with synchrotron X-rays.
	Develop stereotactic heavy-ion radiosurgery using heavier charged particles at the Bevalac, taking advantage of the physical characteristics of carbon and neon for improved dose-localization and dose-distribution in brain and to transfer the technology to the public sector.	Develop a better understanding of time-dose-volume-fractionation relationships for heavy-ion focal irradiation of human brain.	Develop radiobiological measurements that will aid in optimizing the clinical applications of charged particle radiotherapy.
	$ 4,465	$ 4,336	$ 5,428
Boron Neutron Capture Therapy	New chemical approaches to third generation boron compound development will be initiated. The most promising boron-containing compounds, nucleosides, porphyrins, low density lipoproteins, amino acids, antibodies and liposomes will be tested in animal tumor models.	Work described in the previous years will continue. BNCT clinical trials with second generation compounds will be initiated. Efforts will be initiated to target boron to other types of tumors.	New boronated compounds, porphyrins and low density lipoproteins will be available for clinical trials.
	The development of rapid methods for measuring boron concentrations in blood and tissues will continued.	Continue to develop a more thorough knowledge of the boron kinetics and the toxicity of the third generation compounds.	Develop secondary ion mass spectrometry as a technique to examine the spacial distribution of boron at the sub-micron cellular level.
	Examination of normal endothelial cell damage will be further evaluated. Complete sufficiently detailed studies of crucially important biological and biochemical parameters of BNCT using proven in vivo experimental brain tumor models.	Complete boron distribution studies in glioma-bearing human volunteers with the dimer of the boron compound BSH.	Continue distribution studies of the boronated compound Boronated phenylalanine (BPA) and begin trials in patients with cutaneous and ocular melanoma.

III. Medical Applications (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Boron Neutron Capture Therapy (Cont'd)	The in vitro cell irradiations will be finished. Fractioned dose experiments will be initiated in human melanoma models. Studies will be initiated to directly compare the efficiency of thermal and epithermal neutron beams for treatment of malignant melanoma.	The BNCT experiments of single session irradiations in the human melanoma model will be finished. The fractionated BNCT experiments will continue; the results will be compared to single session treatment. The comparison of thermal and epithermal neutron beams for BNCT in the rabbit eye tumor model will be completed.	Treatment planning with respect to the number of fractionated doses, the time interval between doses and the infusion of the boronated compound will be completed.
	Neutron and proton transport simulations will be completed to aid in the design of neutron collimators and shielding for tissue and tumor irradiation. Studies will be initiated to characterize the proton beam interaction with lithium and verify the characterisitcs of the epithermal neutrons.	Neutron and proton transport studies will be completed. Experiments will be designed to measure neutron and photon spectra to verify the calculated performance of the lithium target and the neutron collimator at Brookhaven Medical Research Reactor (BMRR).	Conduct studies to validate neutron and photon spectra.
	$ 8,358	$ 16,039	$ 6,288
Congressionally Directed Projects	No activity.	Congressionally directed university projects will be conducted.	No activity.
	$ 0	$ 72,160	$ 0
Medical Applications	$ 36,885	$ 115,361	$ 33,943

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Carbon Dioxide Research

The link between carbon dioxide and the greenhouse effect or global warming has become a national and international issue with possible serious impacts on energy policy, economic development and national security. Although the science base for the greenhouse effect issue is insufficient for policy action (i.e, there is no firm evidence of a measureable quantifiable link between temperature change and increased CO2), there is considerable pressure for a quick legislative fix and for international treaties to limit worldwide emissions of greenhouse gases. Additional funds are requested in FY 1992 to accelerate global warming research particularly in the area of rapidly improving the capability to predict global and regional climate change. Emphasis is placed on experimental studies of the cloud-climate feedback and on innovative hardware-software applications to the advanced climate models.

II. A. Summary Table: Carbon Dioxide Research

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Carbon Cycle	$ 3,213	$ 3,200	$ 3,500	+ 9
Climate Modeling and Diagnostics	20,377	25,500	27,660	+ 8
Oceans Research	2,367	3,500	6,000	+ 71
Quantitative Links	16,483	22,100	26,500	+ 20
Vegetative Effects	4,426	4,000	4,000	0
Resource Analysis and Education	1,252	5,228	4,800	- 8
Information and Integration	1,342	2,000	2,040	+ 2
Total, Carbon Dioxide Research	$ 49,460	$ 65,528	$ 74,500	+ 14

II. B. Major Laboratory and Facility Funding

Ames Laboratory	$ 125	$ 122	$ 125	+ 2
Argonne National Laboratory	$ 650	$ 554	$ 850	+ 53
Brookhaven National Laboratory	$ 2,465	$ 2,511	$ 2,735	+ 9
Lawrence Berkeley National Laboratory	$ 309	$ 316	$ 342	+ 8
Lawrence Livermore National Laboratory	$ 9,463	$ 9,442	$ 10,518	+ 11
Los Alamos National Scientific Laboratory	$ 920	$ 1,677	$ 1,930	+ 15
Oak Ridge Associated Universities	$ 395	$ 1,147	$ 1,154	+ 1
Oak Ridge National Laboratory	$ 5,017	$ 5,823	$ 5,665	- 3
Pacific Northwest Laboratory	$ 6,717	$ 10,709	$ 13,910	+ 30
Sandia National Laboratories	$ 700	$ 889	$ 1,151	+ 29

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Carbon Dioxide Research			
Carbon Cycle	Continue to study global sources and sinks of CO2 and other greenhouse gases. Start the development of an operational carbon cycle model.	Continue acquisition of emissions and atmospheric CO2 data; pursue the development of ocean-atmosphere CO2 models and initiate the parameterizations of terrestrial-atmospheric CO2 exchange. Explore how natural processes (e.g. forestation) and other biotechnology can alter fluxes of CO2 and methane and slow the rate of atmospheric increase.	Explore natural processes that sequester carbon; support acquisition of emissions and atmospheric CO2 and methane data; implement operational carbon cycle model to explore relationships between energy emissions and changing properties of the global carbon cycle.
	$ 3,213	$ 3,200	$ 3,500
Climate Modeling and Diagnostics	Continue implementation of the climate modeling diagnostic program at LLNL. Commence diagnostic experiments with fixed ocean surface temperature and continue comparisons of model output to observe data for various historical records. Start development of required data bases over long time periods and multiple climate elements.	Complete implementation of the climate modeling diagnostic program at LLNL. Complete diagnostic experiments with fixed ocean surface temperatures and begin experiments to test model validity on select cases of regional interannual variability; continue comparisons of model output to observations. Expand development of required data bases over long time periods and multiple climate elements (e.g., extreme events).	Operate model diagnostic center at LLNL concentrating on improving regional predictions through advanced modeling concepts such as nested fine model grids. Continue to explore model and observed natural variability of climate. Apply advanced statistical techniques to climate data. Continue expanded access to supercomputers to assess multi-variate climate change.
	Launch research activities associated with the DOE Computer Hardware, Advanced Mathematics and Model Physics (CHAMMP) program. Through an open solicitation process, a science team will be selected to identify and explore the most promising approaches to rapidly improving climate modeling capabilities.	Expand research activities associated with the CHAMMP initiative. Applications of innovative hardware systems such as massively-parallel processing or "thinking machine" concepts will be made to the set of differential equations simulating the climate system. Corresponding advances are expected in the associated software algorithms.	Fully implement plans of the CHAMMP Program: Experiment with the application of a conventional climate model on different massively parallel computing architectures to determine optimum arrangements; complete implementation of the first ocean circulation model on a massively parallel computing system; develop the comprehensive visualization system for climate modeling data; determine the predictability of climate change and the limits of regional resolution; initiate development of the Advanced Climate Model (ACM). Hardware and software improvements are expected to

III. Carbon Dioxide Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Climate Modeling and Diagnostics (Cont'd)			pave the way to the next generation physical parameterizations of key processes in the climate system.
	Utilize the eight-processor Cray-2 and its successor Cray-3 to provide enhanced supercomputing to the climate modeling community.	A significant fraction of DOE's Cray-3 supercomputer will be used for to extended climate predictions.	Continue support for access to the CRAY 2&3 by the broad climate modeling community with continued emphasis on predictability of climate change.
	No activity.	A critical data needs study will be undertaken to determine suitability of data sets to first detection potentials as well as to climate model initialization and validation.	Continue identification and acquisition of critical data sets, focus on ocean, carbon cycle and Atmospheric Radiation Measurement (ARM) program related data; explore 4-D data assimilation for new data identified in the critical data needs project.
	Establish a National Institute for Global Environmental Change (NIGEC). Some of the work will support the needs of the DOE Policy Office.	Continue activities of NIGEC.	NIGEC will continue the study of regional impacts of global change.
	$ 20,377	$ 25,500	$ 27,660
Oceans Research	Continue to support the ocean carbon measurements in cooperation with the international World Ocean Circulation Experiment (WOCE) and the Global Ocean Flux Study (GOFS). Expand the research to include the ocean's ability to store and transport carbon particularly by studying the ocean's biology.	Continue to support the ocean carbon measurements in cooperation with the international World Ocean Circulation Experiment (WOCE) and the Global Ocean Flux Study (GOFS). Expand the research to include the ocean's ability to store and transport carbon. Initiate experiments and ocean modeling with high resolution grids to explore processes such as those controlling the formation of deep water.	Continue to support the global survey of CO2 in the oceans; expand process modeling including deep convection and the surface mixed layer to understand the exchange of heat and carbon with the atmosphere. Establish the standards for the ocean carbon chemistry survey in cooperation with NSF. Initiate a field program for deep convention in cooperation with existing WOCE and polar programs.
	$ 2,367	$ 3,500	$ 6,000

III. Carbon Dioxide Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Quantitative Links	Launch the ARM Program to validate the radiative codes used in climate models as well as improve the cloud-climate feedback parameterizations. Through an open solicitation, create the science team to develop the research strategy and start instrument development activity.	Principal activity is ARM Program. The objective is to improve the fundamental understanding of the cloud-climate feedback mechanism and to incorporate this improved understanding in the relevant parameterizations of the climate models. Specific tasks include the development of ground based remote sensing instrumentation, site selection and preparation of the first fixed ARM site.	The first fixed ARM site will be established based on the resolved scientific priorities; the first suite of ARM instruments will be deployed at this central site and on the surrounding network; initial experiments will be conducted and data management systems will be tested. Preparations for the second fixed site, possibly at an ocean location, will commence. The scientific criteria used for ARM site selection may result in non-Federal sites being chosen. The ARM mobile system will participate in the field campaign of the International Satellite Cloud Climatology Program. Focus of ARM is on the acquisition of high quality radiation measurements in the atmospheric column as well as on the atmospheric characteristics responsible for the radiative balance; emphasis is on the cloud-climate feedbacks. Goals include the improvement of cloud feedback parameterizations in climate models and tie-ins to current and planned satellite observations to achieve quantitative measures of changes in the radiative balance on a global scale.
	Commence research activities to quantify the link between the rise of atmospheric greenhouse gases and climate change.	Support experimental studies to quantify the link between the rise of atmospheric greenhouse gases and climate change. Examples include a sound propagation field program to identify an ocean warming signal and studies of stratospheric temperature measurements.	Experimental studies to detect and quantitatively link increasing atmospheric concentrations of radiatively active trace gases will continue.
	$ 16,483	$ 22,100	$ 26,500

III. Carbon Dioxide Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Vegetative Effects	Continue experimental research and modeling to determine the influence of CO2 and climate change on vegetation. Plan a large scale field study to control/manipulate ecological, atmospheric and other environmental conditions to provide validation information for ecological models.	Continue experimental research and modeling to determine the influence of CO2 and climate change on vegetation, with emphasis on photosynthesis and growth in relation to variable CO2 and temperature. Explore approaches for enhancing plant productivity to accelerate CO2 removal from the atmosphere.	Continue experimental projects and modeling research to understand the simultaneous effects of increased CO2 and climate change on selected plants with focus on photosynthesis and growth.
	$ 4,426	$ 4,000	$ 4,000
Resource Analysis and Education	Conduct a study of the Midwestern United States to identify the methodology for identifying the resources in jeopardy from climate change.	A preliminary study of the Midwestern United States will demonstrate the methodology for identifying the resources in jeopardy from climate change. Expand the methodology for resource analysis to include China and Western Europe as well as additional regions in the USA.	Complete regional analysis demonstrating the methodology for identifying regions in jeopardy. Explore natural processes to sequester carbon and methane; focus on biotechnology, enhanced ocean productivity and reforestation.
	No activity.	The DOE educational program on global change will emphasize interdisciplinary research at the graduate and postgraduate level and will promote operational experience in team research at national laboratories and other science and technology centers.	Continue the energy related global change educational program including undergraduate, graduate, and postdoctoral fellowships; primary and secondary science teacher training programs and curriculum development.
	$ 1,252	$ 5,228	$ 4,800
Information and Integration	Further develop the Carbon Dioxide Information Analysis Center at ORNL in order to meet the requirements of a World Data Center. Start newsletters on ARM and CHAMMP. Perform studies of the balance and scope of the climate change research program.	Continue operation of the Carbon Dioxide Information Analysis Center including responsibilities as a World Data Center under United Nations auspices. Continue quality audits on global and regional data sets.	The Carbon Dioxide Information Analysis Center will continue to compile, evaluate and distribute CO2-related information. The Center identifies research needs for data, models and information; obtains, evaluates and quality assures the data; and works with other national and international data centers to promote useful data exchanges. Fully develop to meet the additional requirements imposed by its impending membership as a World Data Center. Continue to issue newsletters on ARM and CHAMMP.

III. Carbon Dioxide Research (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Information and Integration (Cont'd)	Implemented plans for the Energy Sciences Network (ESNET) project, identified in the Applied Mathematical Sciences subprogram of the Basic Energy Sciences program will proceed. This subprogram's share for the implementation of ESNET was $240.	Upgrades of ESNET to conform to the National Research and Education Network Standards will continue to be implemented; funding will be shared among ER programs that benefit from ESNET. This subprogram's share is $305.	ESNET will be fully supported in the Applied Mathematical Sciences subprogram of the Basic Energy Sciences program.
	$ 1,342	$ 2,000	$ 2,040
Carbon Dioxide Research	$ 49,460	$ 65,528	$ 74,500

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Biological and Environmental Research Program Direction

This subprogram provides the Federal staffing resources and associated funding needed to plan, direct, manage, and support a comprehensive multidisciplinary research effort designed to understand the long-term health and environmental effects associated with the development and use of various energy technologies, and to utilize the Department's unique resources to solve major scientific problems in biology and medicine. This staff will help to meet National energy goals of promoting health and safety as well as a clean environment through management of basic research, providing the scientific framework for a sound National energy policy for fossil fuel and radioactive emissions, and maintaining U.S. world competitiveness through advances in biotechnology.

II. A. Summary Table: Biological and Environmental Research Program Direction

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Salaries and Expenses	$ 4,036	$ 5,275	$ 5,800	+ 10
Other	730	265	300	+ 13
Total, Biological and Environmental Research Program Direction	$ 4,766	$ 5,540	$ 6,100	+ 10

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Biological and Environmental Research Program Direction			
Salaries and Expenses	Provided funds for salaries, benefits, and travel for 57 full-time equivalents (FTEs) in the Office of Health and Environmental Research, Office of Assessment and Support, and related program and management support. ($4,036)	Provide funds for salaries, benefits, and travel for 62 FTEs included in the FY 1991 budget. ($5,275)	Provide funds for salaries, benefits, and travel for 60 FTEs. Provide for normal increased personnel costs resulting, for example, from general pay raises and within-grade and merit increases. ($5,800)
	The Office of Health and Environmental Research provided guidance and support for over 850 active research projects (reviewing and evaluating many hundreds more throughout the proposal selection process) and conducted major reviews of the numerous BER-sponsored progams at laboratories and universities. Addressed escalating environment, safety and health (ES&H) issues as they pertained to program facilities and to support National goals to promote health and safety and was heavily involved in research on the human genome, global climate change, subsurface research, radon, and medical applications as well as international collaboration on radiation biology programs. Maintained close liaison with other DOE programs, other Federal agencies, and the scientific, academic and industrial communities.	Continue program management as in FY 1990. Strengthen management oversight of research projects at numerous laboratories and universities. Provide enhanced ES&H line management capability as well as management capability for increased R&D and liaison activities in areas such as the human genome, global climate change, and biotechnology. The global climate change program involves a significant expansion into untapped research communities, including critical atmospheric experiments, advanced computer networks, and understanding the processes of climate change and the carbon cycle. The genome program initiated new efforts on the ethical, legal and societal issues, while intensifying efforts on mapping additional chromosomes, developing new sequencing technologies, and improving computational resources for data management, analysis, and distribution. Continue to closely coordinate programs with other programs and agencies, nationally and internationally, to meet needs and avoid duplication.	Continue program management as in the FY 1991 budget. Continue increased emphasis on ES&H responsibilities at program facilities. Support planned growth of the joint DOE/NIH human genome effort and expanded global climate change research. Manage ongoing efforts in structural biology, health and environmental effects of severe reactor accidents, subsurface research, medical applications, and radiation biology. Continue liaison with other DOE programs, Federal agencies, and international bodies to avoid duplication and meet needs to advance the program in a timely way. The research managed by this staff continues to support other DOE programs and development of sound energy policy, and has significant human health benefits.

III. Biological and Environmental Research Program Direction (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Salaries and Expenses (Cont'd)	ER established the Office of Assessment and Support to provide environment, safety, and health (ES&H) oversight of ER field operations and support to line management in all areas of ES&H and in safeguards and security, emergency preparedness, and quality assurance. Provided support for a wide variety of activities in these areas to ensure compliance with ES&H directives and regulations. Designed risk acceptance, NEPA compliance, and ES&H appraisal programs, and initiated appraisals.	Continue to provide a portion of the total staffing requirement for the Office of Assessment and Support to implement oversight and support activities to ensure compliance with applicable ES&H regulations and directives.	TRANSFER: Two FTEs were transferred to the Advisory and Oversight Program Direction account within the Energy Supply, R&D appropriation.
	Provided program and management support in the areas of budget and finance, personnel administration, acquisition and assistance, policy review and coordination, and utilities management.	Continue to provide program and management support as in FY 1990.	Continue to provide program and management support at the level included in the FY 1991 budget.
	$ 4,036	$ 5,275	$ 5,800
Other	Provided for a variety of program support such as printing and editing, supplies, services, materials, and contractual services, for example, to assist with ES&H workload required by current regulations and directives and time-sharing on various information systems and communication networks.	Continue the variety of program support required in FY 1990.	Continue the variety of program support required in FY 1991 and provide additional administrative and professional services.
	$ 730	$ 265	$ 300
Biological and Environmental Research Program Direction	$ 4,766	$ 5,540	$ 6,100

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Facilities Operations

Facility operations provide for the necessary capital equipment and construction needs to support the BER program and the Pacific Northwest Laboratory landlord responsibilities. An ability to address health and environmental issues requires a continuing commitment to maintaining advanced instrumentation and facilities.

II. A. Summary Table: Facilities Operations

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
Capital Equipment	$ 11,272	$ 11,553	$ 16,832	+ 46
Construction	22,149	3,465	3,500	+ 1
Total, Facilities Operations	$ 33,421	$ 15,018	$ 20,332	+ 35

II. B. Major Laboratory and Facility Funding

Ames Laboratory	$ 34	$ 35	$ 35	0
Argonne National Laboratory	$ 621	$ 630	$ 650	+ 3
Brookhaven National Laboratory	$ 1,692	$ 950	$ 1,600	+ 68
Environmental Measurements Laboratory	$ 388	$ 390	$ 400	+ 3
Inhalation Toxicology Research Institute	$ 453	$ 1,145	$ 800	- 30
Lab for Energy-Related Health Research	$ 148	$ 150	$ 150	0
Lawrence Berkeley National Laboratory	$ 1,053	$ 675	$ 1,050	+ 56
Lawrence Livermore National Laboratory	$ 1,050	$ 800	$ 2,050	+156
Los Alamos National Laboratory	$ 1,062	$ 750	$ 1,600	+113
Oak Ridge Associated Universities	$ 295	$ 300	$ 0	-100
Oak Ridge National Laboratory	$ 1,159	$ 1,175	$ 1,400	+ 19
Pacific Northwest Laboratory	$ 5,513	$ 5,205	$ 4,100	- 21
Savannah River Ecology Laboratory	$ 24	$ 25	$ 25	0
Savannah River Laboratory	$ 19	$ 20	$ 20	0

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Facilities Operations			
Capital Equipment	Maintain basic capital equipment budget at FY 1989 level with adjustment for cost of living. Provide advanced technologies for subsurface research program to design and instrument a prototype intermediate scale experimental system for integrated experiments in geochemistry/ microbiology under conditions of simulated groundwater flow. No such capability exists nationally. Equipment funds are required for the carbon dioxide research program connection to the NERSC and for the special work stations required to support the advanced graphic display and analyses of the output of the General Circulation Models (GCMs) experiments, and for Geographic Information System (GIS) equipment for data digitizing and analysis.	Maintain capital equipment budget at approximately last years level, while providing for increased emphasis to needs of the human genome and carbon dioxide research.	Expand capital equipment budget. In the Carbon Dioxide Research Program, the Atmospheric Radiation Measurement Program (ARM) is a field experiment requiring LIDARS (LIght raDARS), radars, and other advanced remote sensing systems. The equipment is essential to begin the experiments at the first permanent site and for participation in the National/ International FIRE experiment. The equipment schedule has been designed so that the data will be available over the next 10 years to advance climate model development directed at Global Warming and support the National Energy Strategy. In addition, the human genome and structural biology programs have substantial capital equipment requirements.
	$ 11,272	$ 11,553	$ 16,832
Construction	Maintain general plant project budget at approximately FY 1989 level. ($2,429) Funds are provided to support university construction projects. ($19,720)	Maintain general plant project budget at the FY 1990 level. ($3,485)	Maintain general plant projects at the FY 1991 level. ($3,500)
	$ 22,149	$ 3,465	$ 3,500
Facilities Operations	$ 33,421	$ 15,018	$ 20,332

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

CONSTRUCTION PROJECTS

Biological and Environmental Research

IV. A. Construction Project Summary

Project No.	Project Title	Total Prior Year Obligations	FY 1991 Request	FY 1992 Request	Unappropriated Balance	TEC
GPE-120	General Plant Projects	$ XXX	$3,465	$ 3,500	$ 0	$ XXX
	Total, Biological and Environmental Research Construction	$ 0	$3,465	$ 3,500	$ 0	XXX

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
OFFICE OF ENERGY RESEARCH
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY CONSTRUCTION PROJECT SUMMARY

Biological and Environmental Research

IV. B. Plant Funded Construction Project

1. Project title and location: GPE-120 General Plant Projects

Project TEC: $ 3,500
Start Date: FY 1992
Completion Date: FY 1994

2. Financial schedule:

		Costs			
Fiscal Year	Obligations	FY 1990	FY 1991	FY 1992	After FY 1992
Prior Year Projects	XXXXXXX	$ 2,331	$ 1,565	$ 505	$1,202
FY 1990 Projects	$ 2,429	605	850	485	489
FY 1991 Projects	3,465	0	700	882	1,883
FY 1992 Projects	3,500	0	0	600	2,900

3. Narrative:

The estimate is for minor new construction and other capital alterations to land, buildings, and utilities systems. The estimate also includes the cost of installed equipment, which is an integral part of the general plant subprojects.

General plant projects are necessary to maintain facilities in an environmentally safe and health hazard free condition. They are also required to keep facilities in adequate repair, including roads, parking lots, pavements, etc. The BER program supports such needs as a landlord responsibility for the Pacific Northwest Laboratory and for other laboratories and universities.

4. Total Project Funding (BA):	Prior Years	FY 1990	FY 1991	FY 1992 Request	To Complete
Construction.....	XXX	$ 2,429	$ 3,465	$ 3,500	XXX

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
CONSTRUCTION PROJECT DATA SHEETS
ENERGY SUPPLY RESEARCH AND DEVELOPMENT - PLANT AND CAPITAL EQUIPMENT
ENVIRONMENTAL R & D
BIOLOGICAL AND ENVIRONMENTAL RESEARCH
(tabular dollars in thousands. narrative material in whole dollars.)

1. Title and location of project: General plant projects

2. Project No.: GPE-120

3. Date A-E work initiated: 1st Qtr. FY 1992

3a. Date physical construction starts: 2nd Qtr. FY 1992

4. Date construction ends: 2nd Qtr. FY 1994

5. Previous cost estimate: None
Date:

6. Current cost estimate: $3,500
Date: January 1991

7. Financial Schedule:

Fiscal Year	Obligations	Costs FY 1990	Costs FY 1991	Costs FY 1992	Costs After FY 1992
Prior Year Projects	XXXXXXX	$ 2,331	$ 1,565	$ 505	$ 1,202
FY 1990 Projects	$ 2,429	605	850	485	489
FY 1991 Projects	3,465	0	700	882	1,883
FY 1992 Projects	3,500	0	0	600	2,900

8. Brief Physical Description of Project

This estimate is for minor new construction and other capital alterations to land, buildings, and utilities systems. The estimate also includes the cost of installed equipment which is an integral part of the general plant subprojects.

1. Title and location of project: General plant projects 2. Project No.: GPE-120

8. Brief Physical Description of Project (Continued)

Although it is difficult to detail this type project in advance, all of the subprojects identified below are under consideration. In general, the estimated costs for each of the subprojects are preliminary in nature, with a project limitation of $1,200,000, and primarily indicative of the size of the project. Since needs and priorities may change, other projects may be substituted for the examples listed below, and some of these may be located on non-Government owned property. These general plant projects will provide facilities for conducting critical research programs, contribute to greater efficiency, eliminate health and safety hazards, and will reduce maintenance and operational costs.

The estimate is based on requirements by office as follows:

Summary by Office	
Albuquerque Operations Office	$ 850
Richland Operations Office	2,000
San Francisco Operations Office	350
Washington Headquarters	300
Total	$ 3,500

9. Purpose, Justification of Need for, and Scope of Project

The following is a tentative tabulation of the major projects to be performed at the various laboratories under the operations office listed.

Albuquerque Operations Office

Inhalation Toxicology Research Institute Enlarge controlled-material storage facility.	$ 350
Los Alamos National Laboratory Modify biosciences laboratory/office building to provide needed space for human genome research.	500

1. Title and location of project: General plant projects

2. Project No.: GPE-120

9. Purpose, Justification of Need for, and Scope of Project (continued)

Richland Operations Office	
Pacific Northwest Laboratory	
Miscellaneous capital work orders, e.g., laboratory additions, improvements, and modifications.	2,000
San Francisco Operations Office	
Lawrence Livermore National Laboratory	
Renovate biomedical facilities to accommodate expanding human genome research effort at the newly designated DOE Human Genome Center.	350
Washington Headquarters	
Unanticipated emergency repairs	300

10. Details of Cost Estimate

Based on preliminary conceptual design.

11. Method of Performance

Design will be by negotiated architect-engineer contracts. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bids.

12. Funding Schedule of Project Funding and Other Related Funding Requirements

Not required.

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements

Not required.

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
CONSTRUCTION PROJECT DATA SHEETS
ENERGY SUPPLY RESEARCH AND DEVELOPMENT - PLANT AND CAPITAL EQUIPMENT
FUSION ENERGY
(Tabular dollars in thousands. Narrative material in whole dollars.)

1. Title and location of project: Fire and Safety Protection Improvements at Princeton Plasma Physics Laboratory (PPPL)*

2. Project No.: 92-E-340

3. Date A-E work initiated: 1st Qtr. FY 1992

3a. Date physical construction starts: 2nd Qtr. FY 1992

4. Date construction ends: 4th Qtr. FY 1993

5. Previous cost estimate: None
Date:

6. Current cost estimate: $ 4,800
Less amount for PE&D: 0
Net cost estimate: $ 4,800
Date: January 1991

7. Financial Schedule:

Fiscal Year	Authorizations	Appropriations	Obligations	Costs
1992	$ 4,800	$ 2,600	$ 2,600	$ 1,000
1993	0	2,200	2,200	2,000
1994	0	0	0	1,800

8. Brief Physical Description of Project

This project makes improvements to life safety and fire protection at the Princeton Plasma Physics Laboratory. It is divided into three main segments: Fire alarm system improvements, improvements for compliance with the Life Safety Code (LSC) and sprinklers and fire walls.

The alarm system segment itself consists of three parts: Part one provides for additional building alarm panels; part two provides a new fire alarm reporting and recording system for the entire complex and part three provides a 100 screen, full color graphics package that will automatically provide the Security Officer with all the necessary emergency information whenever an alarm is received.

* This project will be located on non-Government owned land. The U.S. Government has leased this land from Princeton University for a 40 year period.

CONSTRUCTION PROJECT DATA SHEET

1. Title and location of project: Fire and Safety Protection Improvements at Princeton Plasma Physics Laboratory (PPPL)

2. Project No.: 92-E-340

8. Brief Physical Description of Project (Continued)

The LSC segment of the project makes a variety of improvements for compliance with the LSC including three new external stairs and second exits from four areas.

The sprinkler/firewall portion of the project provides new sprinkler systems in seventeen buildings or areas, improvements to three additional sprinkler systems and improvements to the fire resistent capacity of certain walls and ceilings.

9. Purpose, Justification of Need for, and Scope of Project

The purpose of this project is to improve life safety and fire protection at the Princeton Plasma Physics Laboratory by providing increased protection against personnel injury during a fire or other emergency and improved protection against property loss by fire.

Life Safety Code Compliance Improvements

During the May 1988 Industrial Safety and Fire Protection Appraisal of PPPL conducted by the Chicago DOE, a recommendation was made to review the laboratory for compliance with the current (1988) Life Safety Code, NFPA 101. In the past, facilities had been required to comply with the codes in existence at the time of construction; however, as a result of DOE Technical Safety Appraisals, a policy change was effected to apply current safety codes to all DOE facilities.

Since the May 1988 appraisal, PPPL has been engaged in a thorough and detailed review of the laboratory facilities for compliance with the 1988 edition of the Life Safety Code, NFPA 101. The original C-Site portion of the Princeton Plasma Physics Laboratory was built largely in the 1950s. Since that time, there have been many changes in LSC requirements, fire alarm systems and DOE philosophy on fire protection. A program of corrective action and facilities review was immediately instituted. As the review of each building was completed, a plan of corrective action was prepared and many of the deficiencies were corrected. The overall review was recently completed and the final report plus plan of corrective action was submitted to the DOE/PPPL. The total number of original deficiencies was 69. In general, the laboratory's plan for correction of these problems is to do as much as possible with operating funds and to seek line item and/or GPP funding for those projects that are too large to do within the constraints of operating funds.

CONSTRUCTION PROJECT DATA SHEET

1. Title and location of project: Fire and Safety Protection Improvements at Princeton Plasma Physics Laboratory (PPPL)

2. Project No.: 92-E-340

9. Purpose, Justification of Need for, and Scope of Project (Continued)

Fire Alarm System Replacement

During the same 1988 appraisal, another recommendation was made to review the laboratory fire alarm system for compliance with NFPA 72D. As a result of that review, it was discovered that the existing system was not properly supervised -- that is, it would not provide the required trouble and alarm signals in the event of system wiring malfunctions. It is not considered feasible to upgrade the existing system to comply with NFPA 72D because of the large expense and unacceptable system down-time that would be involved. Upgrading would also not result in a system that is listed and/or approved for fire alarm system use. For those reasons, it is proposed to replace the existing system with a new system as part of this project.

To ameliorate the risk with the current system, (1) PPPL has installed an interim redundant alarm system for D-Site, which houses the major experimental device and (2) frequent preventative maintenance and testing of the system is performed.

Fire detection throughout much of C-Site is currently accomplished with a dated ADT Aerotube system. This system is difficult to maintain because parts are not readily available. The system's reliability needs improvements because of its age and lack of supervision. This project replaces the Aerotube system with automatic sprinkler systems which will not only provide detection via the flow alarms but will also automatically take action to suppress the fire.

In some buildings at C-Site there are no local alarms. Consequently, there could be a fire with a fire alarm generated to the Security Office without the occupants of the area being aware that there was a problem. The Security officer would have to alert the area of the fire via local public address system. In these areas the project will provide individual building alarm panels which will be used to gather all the fire alarm signals from that building (pull boxes, sprinkler flow alarms and detection) transmit them to Security via the new alarm reporting and recording system and also sound a local alarm in the building where the alarm signal originated.

This project would provide a new state-of-the-art alarm reporting and recording system in full compliance with NFPA 72D.

1. Title and location of project: General plant projects

2. Project No.: GPE-900

10. Details of Cost Estimate

Not available at this time.

11. Method of Performance

Design and engineering will be on the basis of negotiated subcontracts and construction work under fixed price subcontracts awarded on the basis of competitive bidding.

12. Funding Schedule of Project Funding and Other Related Funding Requirements

This item does not apply to general plant projects.

Since needs and priorities may change, other projects may be substituted for those listed, and some of these may be located on non-Government owned property.

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements

This item does not apply to general plant projects.