DOE/MA-0274
Volume 2 of 4

Congressional Budget Request

Energy Supply Research and Development
Nuclear Waste Fund

Volume 2

FY 1988

U.S. Department of Energy
Assistant Secretary,
Management and Administration
Office of the Controller

January 1987

EPARTMENT OF ENERGY

FISCAL YEAR 1988 CONGRESSIONAL BUDGET REQUEST

ENERGY SUPPLY RESEARCH AND DEVELOPMENT

NUCLEAR WASTE FUND

VOLUME 2

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DEPARTMENT OF ENERGY

FISCAL YEAR 1988 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATIONS

BUDGET AUTHORITY IN THOUSANDS OF DOLLARS

	FY 1986 Actual BA	FY 1987 Estimate BA	FY 1988 Request BA
Appropriations Before The Energy and Water Development Subcommittees:			
Energy Supply Research and Development	$ 1,701,351	$ 1,254,131	$ 1,914,710
Uranium Enrichment	1,549,015	1,210,400	1,070,000
General Science and Research	659,059	719,517	814,498
Atomic Energy Defense Activities	7,292,405	7,481,852	8,050,000
Departmental Administration	235,676	139,509	166,133
Alaska Power Administration	3,245	2,881	3,026
Bonneville Power Administration	404,329	327,659	205,800
Southeastern Power Administration	---	19,647	27,400
Southeastern - Continuing Fund	4,028	---	---
Southwestern Power Administration	29,180	25,337	16,648
Western Area Power Administration	195,842	240,309	295,515
Western Area Power Emergency Fund	147	225	---
Federal Energy Regulatory Commission	45,107	-3,465	-900
Nuclear Waste Fund	499,037	499,000	500,000
Geothermal Resources Development Fund	69	72	72
Subtotal, Appropriations Before the Energy and Water Development Subcommittees	$12,618,490	$11,917,074	$13,062,902

DEPARTMENT OF ENERGY

FISCAL YEAR 1988 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATIONS

BUDGET AUTHORITY IN THOUSANDS OF DOLLAR

	FY 1986 Actual BA	FY 1987 Estimate BA	FY 1988 Request BA
Appropriations Before Interior and Related Agencies Subcommittees:			
Alternative Fuels Production	$ 2,775	$ ---	$ ---
Clean Coal Technology	---	---	50,000
Fossil Energy Research and Development	309,389	251,402	168,900
Naval Petroleum and Oil Shale Reserves	13,002	122,177	159,700
Energy Conservation	426,187	149,679	86,090
Energy Regulation	23,423	23,400	21,680
Emergency Preparedness	5,750	6,044	6,206
Strategic Petroleum Reserve	107,533	147,433	270,181
Energy Information Activities	57,724	60,301	61,599
Subtotal, Interior and Related Agencies Subcommittees	945,783	760,436	824,356
Subtotal, Energy and Water Development Subcommittees	12,618,490	11,917,074	13,062,902
Subtotal, Department of Energy	13,564,273	12,677,510	13,887,258
Permanent - Indefinite Appropriations:			
Payments to States	629	705	727
Total, Department of Energy	$13,564,902	$12,678,215	$13,887,985

DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL STAFFING REQUEST
TOTAL WORK FORCE

	FY1986 FTE USAGE	FY1987 -FY86	FY1987 CONGR REQ	FY1988 -FY87	FY1988 CONGR REQ
ENERGY & WATER SUBCOMMITTEE					
HEADQUARTERS	4,663	170	4,833	47	4,880
FIELD	9,393	62	9,455	-4	9,451
SUBCOMMITTEE TOTAL	14,056	232	14,288	43	14,331
INTERIOR SUBCOMMITTEE					
HEADQUARTERS	1,254	-13	1,241	-104	1,137
FIELD	883	5	888	-143	745
SUBCOMMITTEE TOTAL	2,137	-8	2,129	-247	1,882
GRAND TOTAL	16,193	224	16,417	-204	16,213
ADJUSTMENT		-317	-317	54	-263
ADJUSTED TOTAL	16,193	-93	16,100	-150	15,950

DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL STAFFING REQUEST
TOTAL WORK FORCE

	FY1986 FTE USAGE	FY1987 -FY86	FY1987 CONGR REQ	FY1988 -FY87	FY1988 CONGR REQ
10:ENERGY SUPPLY RESEARCH AND DEV	918	8	926	0	926
HEADQUARTERS	635	4	639	0	639
FIELD	283	4	287	0	287
15:URANIUM ENRICHMENT	65	2	67	0	67
HEADQUARTERS	54	2	56	0	56
FIELD	11	0	11	0	11
20:GENERAL SCIENCE AND RESEARCH	38	1	39	0	39
HEADQUARTERS	38	1	39	0	39
25:ATOMIC ENERGY DEFENSE ACTIVITI	2,710	142	2,860	30	2,890
HEADQUARTERS	491	52	543	19	562
FIELD	2,227	90	2,317	11	2,328
30:DEPARTMENTAL ADMINISTRATION	3,273	77	3,350	20	3,370
HEADQUARTERS	1,493	46	1,739	5	1,744
FIELD	1,580	31	1,611	15	1,626
34:ALASKA POWER ADMINISTRATION	36	2	38	-3	35
FIELD	36	2	38	-3	35
36:BONNEVILLE POWER ADMIN	3,491	-41	3,430	-50	3,380
FIELD	3,491	-41	3,430	-50	3,380
38:SOUTHEASTERN POWER ADMIN	38	2	40	0	40
FIELD	38	2	40	0	40
42:SOUTHWESTERN POWER ADMIN	193	-7	186	0	186
FIELD	193	-7	186	0	186
46:WAPA - POWER MARKETING	1,176	-16	1,160	0	1,160
FIELD	1,176	-16	1,160	0	1,160
50:WAPA - COLORADO RIVER BASIN	219	0	219	0	219
FIELD	219	0	219	0	219
52:FEDERAL ENERGY REGULATORY COMM	1,597	62	1,659	0	1,659
HEADQUARTERS	1,597	62	1,659	0	1,659
54:NUCLEAR WASTE FUND	291	20	311	44	355
HEADQUARTERS	154	3	157	23	180
FIELD	137	17	154	23	177
56:GEOTHERMAL RESOURCES DEV FUND	1	0	1	0	1
HEADQUARTERS	1	0	1	0	1
65:FOSSIL ENERGY RESEARCH AND DEV	706	-3	703	-113	590
HEADQUARTERS	141	-3	138	0	138
FIELD	565	0	565	-113	452
70:NAVAL PETROL & OIL SHALE RES	99	-4	95	0	95
HEADQUARTERS	20	2	22	0	22
FIELD	79	-6	73	0	73
75:ENERGY CONSERVATION	322	30	352	-109	243
HEADQUARTERS	201	26	227	-84	143
FIELD	121	4	125	-25	100
80:EMERGENCY PREPAREDNESS	64	7	71	0	71
HEADQUARTERS	64	7	71	0	71
81:ECONOMIC REGULATION	348	-53	295	-20	275
HEADQUARTERS	348	-53	295	-20	275
85:STRATEGIC PETROLEUM RESERVE	152	-5	147	-5	142
HEADQUARTERS	34	-12	22	0	22
FIELD	118	7	125	-5	120
90:ENERGY INFORMATION ACTIVITIES	446	20	466	0	466
HEADQUARTERS	446	20	466	0	466
94:ADVANCES FOR CO-OP WORK	2	0	2	0	2
FIELD	2	0	2	0	2
GRAND TOTAL	16,193	274	16,417	-204	16,213
ADJUSTMENT		-317	-317	54	-263
ADJUSTED TOTAL	16,193	-93	16,100	-150	15,950

ENERGY SUPPLY, RESEARCH AND DEVELOPMENT ACTIVITIES

(Including Transfer of Funds)

For expenses of the Department of Energy activities including the purchase, construction and acquisition of plant and capital equipment and other expenses incidental thereto necessary for energy supply, research and development activities, and other activities in carrying out the purposes of the Department of Energy Organization Act (Public Law 95-91), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion; purchase of passenger motor vehicles (not to exceed [18] 21 for replacement only), [$1,347,048,000,] $1,909,710,000, to remain available until expended; [in addition $684,158,000 shall be derived by transfer from Uranium Supply and Enrichment Activities provided in prior years and shall be available until expended; and of which $84,100,000 which shall be available only for the Center for New Industrial Materials; the Center for New Industrial Materials; the Center for Nuclear Imaging Research; the Energy Research Complex; Saint Christopher's Hospital for Children - Energy Demonstration Project; Center for Excellence in Education - Energy Utilization Performance Project; the Institute of Nuclear Medicine; the Advanced Science Center; the Center for Science and Engineering; and funds provided for byproducts utilization activities shall be available only for the following regional projects: Florida Department of Agriculture and Consumer Services; Hawaii Department of Planning and Economic Development; Iowa State University; Oklahoma, Red-Ark Develoment Authority; Washington, Port of Pasco; State of Alaska.] (Energy and Water Development Appropriations Act, 1987 as included in Public Laws 99-500 and 99-591, section 101(e),) and in addition, as authorities by section 201 of Public Law 95-238 and notwithstanding 31 U.S.C. 3302, revenues received as user fees for use of the Liquified Gaseous Fuels Spill Test Facility in Fiscal Year 1988 shall be retained and used to provide toxic and flammable spill test facilities and activities.

Explanation of Change

Deletes Language contained in Public Laws 99-500 and 99-591 which had specific application to fiscal year 1987.

Proposed Language provides fees from non-Federal users of the Liquified Gaseous Fuels Spill Test Facility in Nevada to be received into the account as reimbursable expenses to be retained and used to operate, manage and maintain the facility.

DEPARTMENT OF ENERGY

FISCAL YEAR 1988 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATION BY MAJOR ACTIVITY

ENERGY SUPPLY RESEARCH AND DEVELOPMENT

BUDGET AUTHORITY IN THOUSANDS OF DOLLARS

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Request
Solar Energy	$ 143,464	$ 123,532	$ 71,175
Cooperative Venture R&D Pools	---	---	5,000
Geothermal	26,495	20,830	15,935
Hydropower	481	450	---
Electric Energy Systems	11,387	11,276	6,500
Energy Storage Systems	17,142	16,589	7,500
Nuclear Energy R&D	372,037	327,474	334,170
Remedial Action & Waste Technology	229,915	276,870	251,500
Civilian Waste R&D	15,991	6,500	5,000
Environmental, Safety and Health	44,004	62,014	70,000
Biological and Environmental Research	178,000	193,992	217,500
Liquified Gaseous Spill Test Facility	1,732	2,000	500
Magnetic Fusion	361,480	345,313	345,600
Basic Energy Sciences	419,850	525,450	479,075
Energy Research Analysis	2,567	2,000	3,700

DEPARTMENT OF ENERGY

FISCAL YEAR 1988 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATION BY MAJOR ACTIVITY

ENERGY SUPPLY RESEARCH AND DEVELOPMENT (CONTINUED)

BUDGET AUTHORITY IN THOUSANDS OF DOLLARS

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Request
University Research Instrumentation.	6,176	5,000	5,000
University Research Support	10,168	15,775	13,400
Advisory and Oversight Program Direction	2,674	2,490	3,200
Multi-Program Laboratories 'Facilities Support	39,908	56,695	56,600
Small Business Innovation Research Program	29,137	---	---
In-House Energy Management	11,715	16,500	18,880
Strategic Facilities Utilization Program	---	---	2,175
Technical Information and Management	12,407	14,698	14,000
Policy and Management	3,497	3,874	4,300
Subtotal, Energy Supply R&D ...	1,940,227	2,029,322	1,930,710
Less Use of Prior Year Balances and Other Adjustment	-238,876	-775,191	-16,000
Total, Energy Supply R&D.....	$1,701,351	$1,254,131	$1,914,710

D ARTMENT OF ENERGY

FISCAL YEAR 1988 CONGRESSIONAL BUDGET REQUEST

ENERGY SUPPLY RESEARCH AND DEVELOPMENT

VOLUME 2

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

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DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT

OVERVIEW

Biological and Environmental Research

The mission of the Department of Energy (DOE) has brought with it major responsibilities and opportunities in the life sciences. The responsibilities stem from concerns that the energy technologies which contribute so substantially to the material well being of the American people may also have adverse health and environmental impacts. The opportunities arise because many of these same technologies, and the intellectual and physical resources underlying their development, have made major contributions to the health and welfare of society, and hold promise for even greater contributions in the future. Thus opportunities and dangers are both present, and a central goal of the Biological and Environmental Research (BER) program is to maximize the former while helping to minimize the latter. One of the extraordinary characteristics of the BER program is its comprehensiveness: the global nature of its scope, compelled by its mission, is unique to the nation and perhaps to the world. This breadth makes it ideally suited to carry out highly complex, long-term, multidisciplinary research programs.

The BER program has two main objectives: (1) to develop the knowledge base necessary to identify, understand and anticipate the long-term health and environmental consequences of energy use and development; and (2) to utilize the Department's unique scientific and technological capabilities to solve major scientific problems in medicine and biology. Meeting the first objective requires an ability to rapidly assess the potential health and environmental consequences of any proposed energy option. This means developing broadly generalizable knowledge and predictive principles, rather than information relevant only to current energy strategies.

Research into health and environmental impacts

An important research effort aims at acquiring an understanding of variations in human susceptibility and resistance to **environmentally associated diseases.** Department of Energy researchers have made major contributions to this area by identifying enzyme deficiencies that render particular individuals susceptible to certain types of cancer. The general problem of identifying, isolating and characterizing these enzymes and similar molecular markers is complex and long range and bears directly on major mission questions involving health effects of low levels of radiation and chemicals. Continued progress in this area will help identify individuals that may be at risk in certain environments; it will generate information that will have a major impact on toxic tort litigation and, more generally, it will be important in the diagnosis and possible treatment of environmentally associated diseases.

A full assessment of the potential **human health consequences** of energy strategies requires a capability for predicting the possible genetic burden that current policy places on future generations, as well as on our own. So-called heritable mutations are often silent in the current generation, i.e., they show no visible effects, even though genetic changes in the DNA molecule have occurred. Recently DOE researchers have made important progress on the problem of predicting heritable mutations by developing new techniques that offer promise for detecting the molecular changes responsible for these mutations. The Department's expertise and programmatic interest in this area were recognized in a recent report by the Office of Technology Assessment on heritable mutations, which stressed the need for a major coordinated approach to the problem.

Many of the **environmental research efforts** relate to health effects research. For example, we need to be able to predict how the by-products of a given energy technology, developed at a given location, are transformed and transported to other locations where they may result in exposure to humans. This information, in conjunction with our knowledge of the health effects of such by-products, allows a full assessment of the impact of any proposed energy strategy. An illustrative example of the relationship between environmental and health effects research is the program investigating sources and effects of **radon.** Recent information indicates that the potential exposures to radon gas and its daughter products in residential structures, and the number of people so exposed, may be substantial. A precise definition of the risk to health presented by these exposures, and the formulation of a rational strategy for the abatement of the risk, requires the development and testing of models for radon transport through various environments, carefully controlled epidemiological studies, and fundamental studies of the mechanisms by which radon and other highly ionizing radiations produce damage. These studies will aid in the prediction of indoor radon levels and its state of aggregation from measurements exterior to a home; they will provide information on the risk associated with a given level of radon, and they will assist in providing the knowledge required to develop efficient and cost effective mitigation methods.

Other activities in the environmental subprogram analyze the effects of energy-related pollutants on the environment itself. A topic of current interest is **acid precipitation.** Department of Energy researchers are engaged in studies to determine which of the proposed multibillion dollar control strategies are most effective in achieving a given level of reduction in wet deposition. Since acid rain research is hundreds of times less costly than proposed control strategies, the program may save taxpayers hundreds of millions of dollars per year. A great deal of uncertainty, however, still remains, especially on the possible importance of dry deposition.

Also of great concern is the gradually increasing amount of CO_2 in the earth's atmosphere. Scientific analysis indicates that this increase could have substantial effects on climate, agriculture, and other human endeavors. Recently published state-of-the-art reports related to this issue identify major uncertainties which must be understood or reduced before one can consider realistic choices among energy policy options for the future. New research is required to provide scientific understanding and information needed for policy analysis. In FY 1988, increased emphasis will be directed to the world's oceans to understand heat transport and storage, and their role in determining regional climate change. Also required is improved understanding of effects of CO_2

and climate change with biological and hydrological systems, including the field testing of plant response models and the extension of model results to global crop and ecological systems. In the future, an improved knowledge of other radioactive trace gases will be gained to aid in understanding the magnitude and timing of greenhouse effects. Achieving major improvements in the understanding of regional and seasonal output of general circulation models continues to be the key objective.

Generating the scientific information that permits optimal approaches for solving environmental problems is an important theme of the environmental research program. In 1988, for example, a greater effort will be made in subsurface microbial ecology to understand and exploit natural mechanisms for degrading chemical contaminants. This research will have implications in the long term for decontamination of aquifers at depth. Preliminary studies conducted in 1986 show unexpectedly high levels of microbial activity to depths of 900 feet. Much of this research is carried out on DOE land designated as National Environmental Research Parks.

Underlying all activities of the BER program is an emphasis on **instrumentation research.** The goal of this effort is to develop the sensitive techniques and equipment needed for accurate studies of environmental processes and effects, and for determining the body burden of chemicals and radionuclides associated with observed effects. For example, a technique called fluorescent line narrowing spectroscopy can be used to determine whether cancer-causing chemicals have become attached to a person's genes. The method is so sensitive that it can locate one affected gene in a hundred thousand, and it can, in some cases, distinguish cancer producing forms of a molecule from very closely related non-cancer causing forms. Further developments in this and similar methodologies will permit the identification of individuals who are at risk from exposure to carcinogenic substances well before the occurrence of clinical symptoms.

Utilization of unique capabilities

The concept underlying the second objective of the BER program mentioned earlier is that the scientific and technological developments spawned by energy research can make major contributions to the study, diagnosis and treatment of human diseases, and to important problems in the biological and environmental sciences. This part of the program has several major components.

The first component of this effort employs the concepts, procedures, and facilities associated with atomic and nuclear physics for research in the study, **diagnosis and treatment of human disease.** This research has established nuclear medicine as a major medical specialty; it has had a major beneficial impact on human health, and it has spawned industries valued at hundreds of millions of dollars a year. This research will continue to develop and apply new non-invasive techniques for early disease diagnosis, it will further develop particle beam therapy for cancer and other localized disease processes, and it will continue developing new radiopharmaceuticals for treatment and research.

The **structural biology** activity applies the unique multiuser facilities such as the synchrotron light source, various reactors and accelerators, and the powerful computers of the national laboratories, to the problem of determining the structure of proteins, nucleic acids and carbohydrates. It was the application, 30 years ago, of the tools of the physical scientist to the DNA molecule, that led to the current revolution in molecular biology and biotechnology. We now have the ability to determine the structure of giant biological molecules far more rapidly than in the past. Such knowledge is important not only for understanding how cells are regulated (and thus for understanding the causes of diseases like cancer) but for the rational design of drugs and vaccines. DOE's national laboratories have unique intellectual and physical resources to make a major impact in this area. Research in structural biology provides a foundation that will be crucial for the development of pharmaceuticals in the private sector.

A third research area is the application of the advanced **computational and engineering capabilities** of the national laboratories to one of the central objectives of modern biology: the acquisition and analysis of data on the chromosomal locations and information content of animal and plant genes. This research may have an impact on virtually every area of modern biology, and it is fundamental to the burgeoning of DNA-related technologies and their concomitant accomplishments such as the large scale production of insulin, growth factors and other important hormones. A 1986 workshop of world leaders in genetics, most of whom were not DOE contractors, concluded that if such an effort were undertaken it could have major health and economic benefits. The results of the workshop also suggest that DOE should play a leading role in this research because of its combined strengths in engineering, computer science and biology.

This brief description indicates that the BER programs aimed at addressing the health and environmental impacts of energy strategies have led to fundamental scientific advances with major implications for human health and the economy that far exceed the goal of identifying potential hazards.

DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

LEAD TABLE

Biological and Environmental Research

	FY 1986 Actual	FY 1987 Appropriation	FY 1988 Base	FY 1988 Request	% Change from FY 1987 Approp.
Biological and Environmental Research	$164,287	$175,914 c/	$176,295	$201,500	+14
Program Direction	3,129	3,578	3,843	4,000	+4
Capital Equipment	7,457	8,500	8,500	8,500	0
Construction	3,127	6,000	6,000	3,500	-42
Total	178,000 a/ b/	193,992	194,638	217,500	+12
Operating Expenses	(167,416)	(179,492)	(180,138)	(205,500)	+14
Capital Equipment	(7,457)	(8,500)	(8,500)	(8,500)	0
Construction	(3,127)	(6,000)	(6,000)	(3,500)	-42
Total Program	($178,000)	($193,992) c/	($194,638)	($217,500)	+12
Staffing Total FTE's)					
Headquarters	56	53	53	53	
Field	87	89	89	89	
	143	142	142	142	

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

a/ Total has been reduced by $1,950,000 which has been transferred to SBIR program.
b/ Total has been reduced by $7,071,000 in accordance with P.L. 99-177, the Balanced Budget and Emergency Deficit Control Act of 1985 (Gramm/Rudman/Hollings).
c/ Total includes $3,000,000 for the Institute for Nuclear Medicine in Newark, New Jersey, proposed for rescission by the Administration in FY 1987.

DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

SUMMARY OF CHANGES

Biological and Environmental Research

FY 1987 Appropriation enacted	$193,992
Adjustments - Increased personnel costs attributable to the FY 1987 pay raise, increased agency contribution to the new Federal Employees Retirement System, and one additional day	+646
FY 1988 Base	194,638
- Continue radiation and chemical dosimetry, at a reduced level; sustain measurement technology and instrumentation	-917
- Sustain field and laboratory studies on transport and transformation of radionuclides, organics and trace elements through atmospheric, terrestrial and aquatic media; enhance efforts in subsurface microbial ecology	+2,092
- Maintain epidemiologic and biological markers studies, and reduce long term experimental animal research on radiation and complex chemical mixtures	-1,968
- Expand structural biology research on pulsed neutron sources, genetics and cell biology; continue chemical physics research	+3,720
- Maintain efforts on preclinical and clinical feasibility studies; isotopic production, instrumentation, and brain and heart studies	+770
- Sustain carbon dioxide research program to reduce uncertainties concerning the effects of increased atmospheric CO-2	+776
- Accelerate efforts on mapping the entire human genome	+10,000

- Expand radon research program to establish the extent of biological threat imposed by natural radon and other alpha emitters	+10,732
- Reduce construction request, which does not allow for continuation of the Institute for Nuclear Medicine in Newark, New Jersey, consistent with the Administration's proposal to rescind FY 1987 university add-on projects	-2,500
- Increased personnel costs such as within-grade and merit increases and associated benefits and support costs	+157
FY 1988 Congressional Budget Request	$217,500

DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

I. Preface: Source and Dose Determination

Evaluating the extent of exposure of human populations or ecosystems to radiation or chemicals is the initial step in estimating consequent health and environmental effects. The exposure may be determined indirectly by characterizing a radiation or chemical source and tracking the agents from source to receptor population, or directly by measuring the exposure with suitable instruments. The source and dose determination program develops the necessary information and techniques to address this responsibility.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Radiation Dosimetry	$ 8,410	$ 8,022	$10,223	+27
Chemical Dosimetry	1,810	1,884	1,880	0
Instrumentation	3,038	2,633	3,278	+24
Measurements	1,233	1,265	1,135	-10
Total, Source and Dose Determination	$14,491	$13,804	$16,516	+20

II. B. Major Laboratory and Facility Funding

Ames Laboratory	$ 674	$ 584	$ 599	+ 3
Argonne National Laboratory	674	755	735	- 3
Brookhaven National Laboratory	144	49	100	+100
Lawrence Berkeley Laboratory	1,149	943	1,290	+ 37
Lawrence Livermore National Laboratory	154	424	150	- 65
Oak Ridge National Laboratory	2,874	2,440	2,445	--
Pacific Northwest Laboratory	838	1,011	1,026	+ 1
Environmental Measurements Laboratory	6,018	3,925	4,061	+ 3
Total	$12,525	$10,131	$10,406	+ 3

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Radiation Dosimetry	Radiation dosimetry research and technique development for radiological	Maintain dosimetry and measurement technique development. Establish	Continue radiation dosimetry and radiological characterization activities.

III. Source and Dose Determination (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Radiation Dosimetry (Cont'd)	characterization of air, water, soil and other materials were pursued. A major emphasis was placed on characterizing the Chernobyl reactor accident. ($8,410)	repository and management activity for Chernobyl data base. Enhance environmental radon studies to determine environmental conditions. Complete Japanese dosimetry reassessment activity. ($8,022)	Maintain Chernobyl radiological data base for validation and improvement of transport and dosimetry models. Apply internal dosimetry techniques for occupational health protection. ($7,223) Enhance radon research with emphsis on physical mechanisms of high LET radiation interacting with biomolecules and on development of improved exposure-dose concepts for critical targets. ($3,000)
Chemical Dosimetry	Chemical dosimetry research addressed techniques for determining exposure to toxic materials in the workplace. A new effort to develop advanced methods for measuring DNA adducts was implemented by redirection of the complex mixtures chemical characterization program. ($1,810)	Chemical characterization research related to the complex chemical mixtures program will be sustained at a reduced level. Research on the measurement and characterization of DNA adducts will be emphasized. ($1,884)	Chemical characterization research related to the complex chemical mixtures program will be sustained. DNA adduct measurement techniques previously developed will be used to characterize those DNA adducts which may have biological significance. ($1,880)
Instrumentation	The basic instrumentation science program stressed advanced laser techniques for detection and measurement of toxic materials in extremely low concentrations and with high specificity. Isotopic identification was demonstrated using multiphoton ionization for certain atmospheric species. ($3,038)	Continue development of advanced measurement technology with emphasis on ultrafast spectroscopy required to investigate reactions in biological systems, such as radiation-induced radical formation and DNA chain reorientation, that are intrinsically fast and occur in the picosecond and femosecond timeframe. ($2,633)	Sustain measurement technology program and apply isotopic detection capability to specific areas of interest such as low level radionuclide measurement. Continue development of advanced laser instrumentation and technology for sensitive and selective chemical measurement. ($3,278)
Measurements	Bioanalytical chemistry studies addressed techniques for separating and identifying biologically active materials. A new methodology was demonstrated for distinguishing high molecular weight organics of similar structure but distinct biological activity. ($1,233)	New studies will be initiated on very high resolution electrophoretic systems for the separation of biological macromolecules. This will extend current capability for analysis of peptides, proteins and carbohydrates, and enable early evaluation of damage by radiation or chemical agents. ($1,265)	Continue to develop techniques for detecting and measuring biological molecules with emphasis on ultrasensitive fluorescence methodologies. ($1,135)
Total Source and Dose Determination	$14,491	$13,804	$16,516

I. Preface: Environmental Processes and Effects

Upon release of agents from an energy source, it becomes necessary to understand their transport and transformation through atmospheric, terrestrial and marine media in order to estimate the subsequent exposure to humans and the environment. This research activity dates from the early weapons testing era when information on the transport and fate of fallout radionuclides was needed. To meet this need, a comprehensive program in the physical and ecological sciences was established which today is being applied to multiple sources. Increased emphasis will be placed on microbial ecology to understand mechanisms for degrading chemical contaminants and the radon transport program in terrestrial systems.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Atmospheric	$10,587	$12,429	$13,002	+ 5
Marine	5,561	6,310	7,079	+12
Terrestrial/Aquatic	6,667	6,610	9,337	+41
Ecosystem Response	6,971	6,740	7,342	+ 9
Total, Environmental Processes and Effects	$29,786	$32,089	$36,760	+15

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory	$ 1,257	$ 1,276	$ 1,280	--
Brookhaven National Laboratory	4,689	4,247	4,066	- 3
E I Du Pont De Nemours and Co., Inc	517	369	401	+ 9
Fermi National Accelerator Laboratory	50	50	50	--
Lawrence Berkeley Laboratory	289	294	294	--
Lawrence Livermore National Laboratory	1,441	1,309	1,184	-10
Los Alamos National Laboratory	1,585	1,622	1,546	- 5
Oak Ridge National Laboratory	2,743	2,304	2,267	- 2
Pacific Northwest Laboratory	5,794	5,856	5,926	+ 1
California, Univ. of at Los Angeles	522	512	512	--
Environmental Measurements Laboratory	0	2,043	2,106	+ 3
Total	$18,887	$19,882	$19,632	- 1

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Atmospheric	Acidic deposition is addressed by the Atmospheric Sciences program. PRECP (Processing of Emissions by Clouds and Precipitation) is the only significant National program which conducted major field experiments, confirmed the importance of sulfur dioxide oxidation via laboratory studies and developed diagnostic models for experimental design and analysis. The MAP3S research	Acidic deposition research in PRECP will continue analysis and interpretation of field data using air precipitation and cloud measurements, begin translation of this information into the consistent physical/chemical framework required for the National program and begin preparation for the FY 1988 field experiment series. ($6,203)	Acid deposition research will center on PRECP which will conduct the 5th and 6th major field experiments to evaluate the processing of acidic pollutants by major, east coastal storms (cooperatively with NOAA, NASA and NSF) and by large convective storms ubiquitious during the summer. Economies will permit modest additions to be made to the MAP3S research measurements. Dry deposition

III. Environmental Processes and Effects (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Atmospheric (Cont'd)	network provided data used for model evaluation. Dry deposition research has developed defensible and practical measurement methods. ($5,979)		research will attempt to finalize methods usable for estimation by the National program. ($5,962)
	Transport and dispersion support furnished to ASCOT (Atmospheric Studies in Complex Terrain) produced the most definitive models for transport and diffusion in mountainous terrain. Other funding supported theoretical development of transport models and their evaluation. The long-range tracer techniques developed and used by BER (CAPTEX: Cross Appalachian Tracer Experiment) have been transferred to the DOD for a major national security-related program. ($2,330)	Transport and dispersion research will concentrate on the analysis of previous experiments to relate observed wind fields to theoretical driving mechanisms, to compute mass, energy, and momentum budgets, to evaluate theoretical models with field data and to begin planning the extension of ASCOT into large scales. ($3,605)	Transport and dispersion research, primarily in ASCOT, will expand the scale from a single, very large valley to multiple valley systems and will begin initial evaluation of a previously unsuspected circulatory pattern over the western mountains, discovered by ASCOT, that may help explain features as diverse as summer thunderstorm patterns and the role of large mountain barriers as momentum sinks in global circulation models. Efforts will continue to address atmospheric emergency response models. ($4,395)
	Atmospheric physics and chemistry research has investigated the fundamental nature of atmospheric organics and other pollutants in photochemical oxidation, on aerosol and cluster formation, energetics and structure and on heterogeneous-phase atmospheric chemical reactions. Global field studies and analysis of 3-dimensional global concentrations of radionuclides and other energy-related materials continue. ($2,278)	Atmospheric physics and chemistry research will continue and, also, undergo a major evaluation to determine if the small and individual BER efforts can be appropriately organized to attack a major atmospheric chemistry issue beyond the resources of any of the individual investigators. ($2,621)	Atmospheric physics and chemistry research will continue along the current directions but may be modified somewhat based on the results of the FY 1987 evaluation. ($2,645)
Total Atmospheric	$10,587	$12,429	$13,002
Marine	Marine research focuses on processes that move radionuclides and other energy materials through the ocean and their ultimate fate. The program is divided into three coastal regional segments. This research is conducted to determine the carrying capacity of coastal oceans for contaminants to provide the necessary information in decisions on the disposal of energy and weapons related materials in U.S. coastal and deep ocean areas.	Complete analysis of Phase I of the northeast region which encompasses the coastal shelf off New York and New Jersey and prepare instrument development and fabrication for Phase II of this program. ($3,110) Synthesize and publish results of cross shelf transport from Cape Canaveral to Cape Hatteras. ($1,300) Continue studies on accumulation and cycling of material in deep basins off California. ($1,900)	Implement Phase II of the Northeast program where it is expected that material discharged from New York/New Jersey will be found off the Delaware coast and determine if this material becomes entrained in the Gulf Stream for transport into the open Atlantic. ($3,679) In the Southeast, expand modelling for freshwater intrusions onto shelf region to determine exchange of contaminant and natural materials across

III. Environmental Processes and Effects (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Marine (Cont'd)	The broad applications of this research is illustrated by its major role in the evaluation of disposal of nuclear submarines off the east coast, and was used by NASA in identifying the transport of debris from the Challenger disaster off Cape Canaveral. ($5,561)		this front.($1,500) Begin synthesis of data from West Coast basins. ($1,900)
Total Marine	$5,561	$6,310	$7,079
Terrestrial/ Aquatic	Experimental research and predictive modeling is conducted on transport of energy contaminants especially at DOE sites to define vectors and mechanisms such as root uptake, foliar adsorption, soil chemistry, etc., that regulate movement of chemicals and radionuclides in terrestrial environments. Findings from this research provided crucial information after Chernobyl on best methods for minimizing contamination of food stuffs, grains and contaminated soils in Europe and the U.S. ($6,367)	Began fundamental research demonstrations using fiber optics in different soil systems and for understanding diffusion of contaminants in the subsurface. ($1,100) Continued development of theoretical and experimental models incorporating behavior of ground water flow as it interacts with chemical and physical properties of different soils. ($3,931)	Maintain momentum of field experiments utilizing advanced analytical techniques and mathematical concepts. ($1,354) Continue development and validation of hydrologic transport and geochemical models. ($4,000)
	Initiated exploratory research on subsurface microbial ecology to understand and exploit natural mechanisms for degrading chemical contaminants and found exceptionally high levels of microorganisms at depths to 900 feet which has caused waste management planners to reevaluate their disposal strategies at DOE sites. ($300)	Establish program in subsurface microbiology at one DOE site and begin to extend intercomparison of microbial populations to other sites. ($1,096)	Continue investigation at one DOE site of microbial populations below 10 meter depths to determine key roles these populations play in biodegradation and their potential for chemical decontamination or increased mobility into groundwaters. ($1,500)
	No activity.	Began program in radon transport in the environment to determine (1) sources of radon using statistical, ground and aerial methods, (2) geologic and soil processes that influence mobilization and transport, (3) soil-vegetation interaction on radon to identify possible mitigation strategies. ($483)	Expand radon transport program in terrestrial systems according to defined research plan through competetive solicitation. ($2,483)
Total Terrestial/ Aquatic	$6,667	$6,610	$9,337

III. Environmental Processes and Effects (Cont'd.)

Program Activity	FY 1986	FY 1987	FY 1988
Ecosystem Response	The program encompasses physical chemical and biological characterization from large scale ecosystems processes down to the molecular levels of plant and animal physiology. The research is directed at understanding the resiliency of ecosystems to acute or chronic impact from energy activities. The integrated landscape studies are conducted primarily at five designated DOE National Environmental Research Parks and in Alaska. The holistic approach to ecosystem research, pioneered since the 1960's in this program, has become the prototype for other long term ecological studies and is an important component in understanding global change phenomena. For example, the research results on sulfur and carbon cycling have been used in both the acid rain and the CO2 programs. ($4,347)	Continue to conduct integrated regional studies at DOE sites to determine ecosystem response to natural and human related physical and chemical disturbances. Develop remote sensing parameters to measure health of vegetation and other ecosystem indicators. Establish a National Environmental Research Park at Fermilab, the sixth such park for DOE. ($4,340)	Continue research on integrated watershed programs at DOE Research Parks using advanced remote sensing techniques; emphasize the coupling of spatial and time scales from local to regional to global levels and including the effects of atmospheric processes on these systems. Apply methods of mathematical and theoretical sciences for the development of unifying concepts in scaling of the environment. ($4,700)
	Experiments are conducted to determine physiologic and genetic limits of tolerance and adaptation of individual organisms and populations. ($2,624)	Determine metal metabolism, transport, and depuration (cleansing) mechanisms and immune responses, in organisms exposed to energy disturbance. Genetic mechanisms of salt tolerance in plants will be continued. ($2,400)	Conduct field testing of naturally occurring organisms with genetic markers to evaluate their control mechanisms and their function in relation to the environment and other natural populations. The focus will be on plants exhibiting resistance to a controllable stress in order to associate genes and their regulation with a given stress, such as drought, disturbance, and chemical influences ($2,642).
Total Ecosystem Response	$6,971	$6,740	$7,342
Total Environmental Processes and Effects	$29,786	$32,089	$36,760

I. Preface: Health Effects

The Health Effects research program provides a continuing source of information needed to ensure that the operations and policies of the Department can be supported in terms of protecting the health of workers and the general public. Research in this program is designed to meet that responsibility by the development of 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. One subprogram utilizes human epidemiological data obtained from selected human populations known to have been acutely exposed to moderately high, or to chronically low levels of external radiation, internally deposited radioactive materials, or energy-related materials. The other subprogram is designed to provide detailed health effects data, including data on mechanisms by which health effects are induced and expressed, which cannot be obtained from human studies. This subprogram 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. Both subprograms will increasingly emphasize molecular-level studies. There is also a small subprogram in radiation biophysics.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Health Effects				
Human Health				
Epidemiology	$19,964	$23,961	$26,265	+10
Effects	2,492	3,791	4,251	+12
Subtotal, Human Health	$22,456	$27,752	$30,516	+10
Health Effects/Biological				
Radiation Biology	$20,037	$22,031	$24,279	+10
Chemical Toxicology	10,705	11,263	9,076	-20
Subtotal, Health Effects/Biological	$30,742	$33,294	$33,355	--
Radiation Biophysics	$ 3,846	$ 3,785	$ 3,897	+ 3
Total, Health Effects	$57,044	$64,831	$67,768	+ 5

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory	$ 6,606	$ 6,750	$ 6,788	--
Brookhaven National Laboratory	1,582	1,296	1,089	-16
Lawrence Berkeley Laboratory	1,994	1,728	1,847	+ 7
Lawrence Livermore National Laboratory	1,833	1,995	2,229	+12
Los Alamos National Laboratory	1,363	1,357	1,516	+12
Oak Ridge National Laboratory	8,374	7,814	6,992	-11
Pacific Northwest Laboratory	5,847	5,553	5,160	- 7
California, Univ. of at Davis	1,389	815	550	-33
California, Univ. of at Los Angeles	240	227	129	-43
California, Univ. of, at San Francisco	337	369	369	--
Inhalation Toxicology Research Inst.	5,903	5,786	6,136	+ 6
Oak Ridge Associated Universities	3,304	3,338	3,911	+17
Utah, University of	1,412	1,316	1,316	--
NAS/Radiation Effects Research Foundation, Japan	10,000	13,000	15,500	+19
Total	$50,184	$51,344	$53,532	+ 4

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Human Health Research Epidemiology	Begin study of lung cancer and exposure to domestic sources of radon among females in Pennsylvania.	Intensify data collection in Pennsylvania radon study.	Continue radon epidemiology studies in coordination with other Federal agencies. Initiate "ecologic" studies of radon lung cancer.
	Studies of DOE/DOE contractor workers continue with increased emphasis on prompt information dissemination.	Studies of several DOE facilities and subpopulations will be completed.	Health Surveillance System, providing morbidity data on DOE workers and other DOE worker studies continue with shifted focus toward molecular methods.
	Radioepidemiologic studies of a variety of human populations help refine estimates of dose-response relationships.	Studies continue as new dosimetry system is incorporated into atomic bomb survivors studies.	Several studies, including that of nuclear shipyard workers reach completion. Followup studies to be initiated as necessary. Continuation of the A-bomb survivors studies will substantially increase due to the fluctuating yen exchange rate in the U.S.
	($19,964)	($23,961)	($26,265)
Human Health Effects	Complete studies of coal dust accumulation in miner lungs, immunology studies of energy-related pollutants and endocrine receptor studies.	Continue studies of flow cytometry, sperm mutation assay, oncogenes in human radiation carcinogenesis and further expand the study populations.	Continue studies of biological markers, oncogene research, flow cytometry, mutation assays. Expand population testing, where feasible, of mutation assays and oncogene research.
	Continue studies of flow cytometry, chromosome aberrations related to radiation and chemical exposures and sperm protein mutation assay.	Initiate study of biological radiation dosimetry with DNA probes.	Continue radiation and chemical studies related to chromosome DNA and mutation assay. ($3,251)
	Continue studies of oncogenes and human radiation carcinogenesis.	Continue studies of oncogenes and human radiation carcinogenesis. ($3,791)	No activity.
	Test blood cell mutation assay in Japanese radiation victims. ($2,492)		
	No activity.	No activity.	Initiate mechanistic studies of lung cancer induction by high LET radiation, and initiate studies of biological dosimeters of radon exposure. Develop a major computerized radon data base to make research results available for immediate technology transfer. ($1,000)
Total Human Health Research	$22,456	$27,752	$30,516

III. Health Effects (Cont'd.)

Program Activity	FY 1986	FY 1987	FY 1988
Health Effects/ Biological Radiation Biology	Continued long-term dose-response studies of tumor induction in animals exposed to radionuclides or external radiation. Two major lifetime studies of radionuclide toxicity in the dog were completed. Activated oncogenes have been identified in plutonium-induced lung and bone tumors in dogs. Analysis of an extensive body of mouse data demonstrated that it will probably not be possible to determine neutron RBE (relative biological effectiveness) values for many tumor types. Important new dose-response data for tumor induction by heavy charged particles was collected. ($11,321)	Maintain long-term dog studies with small decrease in level of effort. Continue strong emphasis on neutron radiobiology and efforts to obtain a better understanding and quantification of neutron effects. Initiate new research to improve understanding of inhalation toxicology of radon and radon daughter products. ($11,684)	Continue long-term animal studies to improve capabilities for extrapolating data between species and from high- to low-dose exposure situations. Effort in lifetime dog studies is projected to decrease in FY 1988. Research on neutrons and other high-LET particles, including alpha radiation from radon and radon daughters will continue. ($11,831)
	Further progress was made in the detailed genetic characterization of radiation-induced dominant and recessive mouse mutants. Important information resulted from a new research effort to characterize mouse mutants at the molecular (DNA) level. Analysis of a large data base on rates of heritable mutations in children of Japanese atomic bomb survivors and an appropriate control group showed no differences between the two populations. ($4,110)	The mouse genetics program will continue with a significant increase in research on the molecular characterization of mouse mutants produced by irradiation. Genetic research on the Japanese atomic bomb survivors will be expanded by addition of a pilot study to measure somatic (nonheritable) mutations in red blood cells using high-speed methods of cell analysis. This new study will be conducted by Japanese scientists in collaboration with U.S. investigators who developed the test procedures. ($4,460)	Continue mouse genetics program at a reduced level. Characterization of mutations will emphasize analysis of changes in the genetic code. Research using advanced techniques of molecular and cellular genetics will be continued to improve the data base on spontaneous and possible radiation induced mutants in human populations. ($4,414)
	Molecular and cellular research continued to generate important new information on the basic biology of the mammalian radiation response. Studies involving in vitro (molecular/cellular)--in vivo (whole animal) comparisons were given high priority. Progress was made in understanding of marked differences between biological actions and effectiveness of high-LET radiation (neutrons, other particulates) and low-LET radiation (i.e., x-rays and gamma rays). New information was developed on the roles of tumor initiation and promotion in radiogenic cancer. Important	Studies of tumor initiation and promotion will be continued. Research will be accelerated to extend the recent discovery that extremely low doses of radiation induce a chromosomal repair system in human cells. Recently acquired information on neutron-induced gene damage and repair will be significantly expanded. ($5,887)	Data acquired will enhance knowledge of tumor initiating and promoting properties of different types of ionizing radiation. Mechanistic studies of the chromosomal repair system will be initiated. Testing of preliminary hypotheses concerning DNA damage and repair induced by radon/radon daughters and other high-LET radiation will be conducted. ($8,034)

III. Health Effects (Cont'd.)

Program Activity	FY 1986	FY 1987	FY 1988
Radiation Biology (Cont'd)	new insights were gained into mechanisms of DNA damage and repair in relation to both high- and low-LET radiation. ($4,606)		
Total Radiation Biology	$20,037	$22,031	$24,279
Chemical Toxicology	Long-term animal studies were conducted on a selective basis to obtain an integrated view of responses at the molecular, cellular, and organismal levels as they occur in the whole animal. Chronic exposures to diesel exhaust emissions were found to induce lung tumors in exposed rats and mice, but only at extremely high doses. It was demonstrated that coal-related hydrocarbons can produce somatic effects other than cancer, including heritable effects. The model chemical mutagen, ethylnitrosourea, has been found to produce heritable mutations in mice. ($5,439)	Increased emphasis in FY 1987 will focus on multilevel inhalation studies to improve knowledge of respiratory-tract responses to toxic chemicals, including particle-bound toxicants. Studies of animals exposed through the skin will be decreased. Mouse genetic research will define germ cell sensitivity responses at different stages of cell development and maturation. ($5,355)	Continue research effort on pathobiology with increased emphasis on defining molecular and cellular correlates of late biological effects. Significantly reduce work on somatic effects other than cancer. Sustain studies to define genetic effects of selected model mutagens in the mouse. ($3,402)
	Cellular and molecular studies produced important new information on mechanisms of action of toxic chemicals, primarily organic compounds, in the mammalian organism. Progress was made toward better understanding of metabolic activation and inactivation of polycyclic hydrocarbons in respiratory tract, intact skin, and cultured cells. Mechanisms of tumor promotion were investigated in cultured cell systems. New information was gained on genetic and cytogenetic aspects of chemically induced damage and repair. ($3,215)	Continue research on genetic control of enzymes that activate hydrocarbon procarcinogens. Studies of tumor promotion will focus on promoter interaction with cell surfaces to alter metabolic and functional activity. Additional information will be gained on alteration of gene control in tumor development. ($3,861)	Studies of carcinogen metabolism in the upper respiratory tract will continue. Research on tumor promoters will be sustained to explore the action of model promoters in modifying cell differentiation and growth. Oncogene activation by chemical carcinogens will be studied in model systems. New information will be acquired on formation and repair of DNA adducts. ($4,061)
	Continued exploratory research to develop a mechanistic understanding of synergistic and antagonistic interactions that may occur when exposure to chemical mixtures occurs. Progress was made in the study of DNA adduct	Information will be obtained on the correlation of DNA adduct formation with cancer incidence in exposed animals. Metabolic patterns of carcinogen activation and inactivation will be evaluated for single and multiple exposures.	Study of effects of interactions on the removal (repair) of DNA adducts from different model carcinogens will be initiated. DNA adducts will also be used to investigate competition between carcinogens for access to activating

III. Health Effects (Cont'd.)

Program Activity	FY 1986	FY 1987	FY 1988
Chemical Toxicology (Cont'd)	formation produced by mixtures of chemicals. Research was continued to investigate ways in which components of mixtures may compete for common pathways of metabolism. Mixture components with tumor-promoting properties were investigated as a possible source of synergistic increase in tumor incidence. ($2,051)	Additional information will be gained on the consequences of carcinogen-promoter interactions. ($2,047)	enzymes. Experiments on carcinogen-promoter relationships will continue. ($1,613)
Total Chemical Toxicology	$10,705	$11,263	$9,076
Total Health Effects/ Biological	$30,742	$33,294	$33,355
Radiation Biophysics	The Radiation biophysics program is undergoing a reorientation from gas phase to condensed phase research. Track structure calculations predict the spatial and temporal distribution of radiation produced species and, by incorporating biomolecules into the model, provide insight on the nature and location of chemical reactions with biological material such as DNA. ($3,846)	Further strenthening of the interface between radiation biophysics and molecular biology will occur. Low energy x-ray studies will be emphasized, since these provide means to explore the interface patterns and resulting biological damages in nanometer site regions. A new effort in quantum biology will be pursued to investigate the conformational changes at the nucleic acid level. ($3,785)	Continue radiation biophysics research emphasizing further development of radiobiological response models. Extend theoretical effort on quantum biology, as these can provide a means of assessing electronic configurational changes in biomolecules, when these molecules are subjected to physical and chemical interactions. ($3,897)
Total Health Effects	$57,044	$64,831	$67,768

I. Preface: General Life Sciences

Research in General Life Sciences contributes to the base of fundamental biological knowledge 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 research use, and provides knowledge that eventually becomes used in the estimation of human health risk. Research in this category also supports the development of new instruments to analyze biological systems and the use of special facilities at the National Laboratories, such as neutron sources for the determination of biological structure, and state-of-the-art capabilities in scanning transmission electron microscopy, that are heavily used by the academic community for research and training. 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.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Structural Biology	$ 3,204	$ 3,592	$ 5,009	+39
Genetics	14,901	16,231	27,653	+70
Cell Biology	5,751	5,851	6,492	+11
Chemical Physics	3,865	4,196	4,436	+ 6
Total, General Life	$27,721	$29,870	$43,590	+46

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory	$ 1,703	$ 1,382	$ 1,427	+ 3
Brookhaven National Laboratory	4,214	4,980	5,270	+ 6
Lawrence Berkeley Laboratory	1,462	1,489	1,617	+ 9
Lawrence Livermore National Laboratory	2,566	3,275	3,459	+ 6
Los Alamos National Laboratory	4,602	4,967	5,210	+ 5
Oak Ridge National Laboratory	5,878	5,841	6,042	+ 3
Pacific Northwest Laboratory	0	0	190	--
California, Univ. of at Los Angeles	485	606	781	+29
California, Univ. of, at San Francisco	1,895	2,191	2,441	+11
Oak Ridge Associated Universities	501	491	515	+ 5
Total	$23,306	$25,222	$26,952	+ 7

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Structural Biology	In the structural biology program advanced physical techniques have been applied in the detailed study of biological macromolecules and cell organelles to gain a better understanding of structure function relationships. Progress was made in determining the structure of complexes containing nucleic acids and proteins. The pulsed neutron source at Los Alamos is being instrumented for studies of the structure of proteins. ($3,204)	At the National Synchrotron Light Source instrumentation of the x-ray beam line will be completed so research in structural biology will utilize both the vacuum ultraviolet and x-ray capabilities. The first projects will be studies of the structure of macromolecules involved in the synthesis of proteins. Improvements in the analysis of proteins by gel electrophoresis will make it easier to detect rare mutational events. ($3,592)	The development of advanced instrumentation for structural research at the National Synchrotron Light Source will make it possible to do studies of biological processes that are time dependent. Structural studies using neutron diffraction will be expanded at facilities using the LANL pulsed neutron sources. Initiate development of computational methods for structural determination. ($5,009)
Genetics	Research in the genetics program focused on deciphering mechanisms of gene expression and regulation, arrangement of genes in chromsomes, mechanisms of genetic damage and repair processes, and development of new techniques that will allow better detection and evaluation of	Research on the molecular nature and quantitation of germ-cell mutations in mammals will continue. Genetic damage from ionizing radiation and repair processes in mammalian cells will be elucidated at the molecular level. The Gene Library Project will produce larger	Continue molecular characterization of DNA damage from radiation and of the genes coding for DNA repair; enhance the development and application of human chromosome-specific gene libraries; continue research on the structure and function of genes and chromosomes.

III. General Life Sciences (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Genetics (Cont'd)	somatic and heritable mutations in man. The National Laboratory Gene Library Project provided collections of DNA fragments specific for each of the 24 human chromosomes. ($14,901)	and more useful human chromosome-specific DNA fragments. Work will begin to establish the linear order of DNA fragments for selected human chromosomes. The isolation and characterization of human DNA repair genes will be intensified. ($16,231)	($17,653) Accelerate mapping of the entire human genome by establishing the linear order of DNA fragments for each chromosome. Develop more efficient DNA-sequencing technologies and improve computational capabilities for acquiring, storing and analyzing human chromosome DNA-sequence data. ($6,100) New concepts and techniques for sequencing DNA will be explored with emphasis on fast, automated instrumentation. Robotic technology will be applied where possible. Apply advanced computational techniques to manage, organize, and disseminate information from the very large DNA sequence data base ($2,500). Human health related research will be conducted complementary to the overall genome project, emphasizing those techniques that would begin to yield useful methods for assessing radiation hazards ($1,000). The technology for establishing plant cDNA libraries will be developed in parallel to human DNA systems. ($400)
Cell Biology	The cell biology program included research that improved our understanding of cellular defense mechanisms, factors affecting the stability of differentiated cells, and the molecular and genetic mechanisms by which radiation and chemicals transform cells to the neoplastic state. Results showed that the diverse immune response capability of mammals is due in part to hypermutation events in developing blood lymphocytes. ($5,751)	Advances will be made in the cell biology and biochemistry of hormone and growth factor interaction with cell surface receptor sites; continue studies of the interrelationships between cell growth and differentiation processes and the development of malignant cells. ($5,851)	Increase mechanistic research in cell biology on the function, growth, and differentiation of normal cells and the role of interactions between cell surface receptors and chemical effectors in regulating cell functions. ($6,492)
Chemical Physics	Chemical physics research addresses the fundamental mechanisms of energy transfer in biological molecules. Biological instrumentation development includes electron microscopy and positron	Continue fundamental energy degradation research on biomolecules. Upgrade facilities for neutron diffraction research at the High Flux Beam Reactor and for x-ray diffraction studies at the	Sustain chemical physics studies of biomolecular energy transfer processes. Maintain flow cytometry and structural biology instrumentation development. ($4,436)

III. General Life Sciences (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Chemical Physics (Cont'd)	sensitive detectors for structural biology applications. ($3,865)	National Synchrotron Light Source. Begin exploring new approaches for high speed sequencing of DNA. ($4,196)	
Total General Life Sciences	$27,721	$29,870	$43,590

I. Preface: Nuclear Medicine

Nuclear Medicine research involves a wide range of projects directed to clinical and other beneficial 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 diseases such as cardiopulmonary disease, mental disorders, tumor localization, 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 and heavy ion therapy research is conducted to treat inoperable disorders in humans.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Stable Isotopes	$ 1,705	$ 1,855	$ 1,875	+ 1
Radioisotope Production	2,994	2,828	2,985	+ 6
Radiopharmaceuticals	7,624	8,523	8,678	+ 2
Instrumentation	4,249	3,884	4,452	+15
Clinical Feasibility	6,242	5,030	4,900	- 3
Total, Nuclear Medicine	$22,814	$22,120	$22,890	+ 3

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory	$ 354	$ 380	$ 380	--
Brookhaven National Laboratory	5,611	4,405	4,666	+ 6
Lawrence Berkeley Laboratory	2,714	2,140	2,240	+ 5
Lawrence Livermore National Laboratory	48	0	0	--
Los Alamos National Laboratory	2,244	2,105	1,955	- 7
Oak Ridge National Laboratory	1,956	1,775	1,815	+ 2
Pacific Northwest Laboratory	59	228	13	-94
California, Univ. of at Davis	202	200	200	--
California, Univ. of at Los Angeles	2,554	2,162	2,162	--
Oak Ridge Associated Universities	889	790	780	- 1
Total	$16,631	$14,185	$14,211	--

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Stable Isotopes	Begin calutron separations of the isotopes of calcium, potassium, nickel, bromine, rubidium, cadmium, and strontium, which are needed for biophysical studies and as target nuclides in radiopharmaceutical production.	Initiate separations of the isotopes of 15 elements useful in physical research and biomedical applications.	Perform chemical recovery and purification of the isotopes separated in previous years. Achieve separation of the isotopes of 12 more elements.
	Chemical exchange and liquid thermal diffusion used to start enrichment of calcium, sulfur and zinc for metabolic studies of osteoporosis and other bone diseases in pregnant women and newborn babies, production of target materials for tumor diagnosis, acid rain studies, and many other medical and research needs.	Continue FY 1986 program level of activity.	Continue FY 1987 program level of activity.
	Nuclear Magnetic Resonance spectrometric techniques are being used to study C-13 and N-15 labeled metabolites in cardiac ischemia (obstruction of blood supply).	NMR studies will be extended to more complex metabolic systems, such as brain metabolism during ischemia and reflow after ischemia.	Continue FY 1987 program level of activity.
Total Stable Isotopes	$1,705	$1,855	$1,875
Radioisotope Production	Construction of a remodeled Brookhaven Linear Isotope Producer (BLIP) machine, which is used for producing radionuclides, was completed. A method for continuous flow production of I-123 has been developed.	Continue to develop methods and uses of BLIP machine.	Continue FY 1987 program level of activity.
	Production methods for Cu-67 (used in studies of Wilson's disease and for labeling monoclonal antibodies) were developed. Capacity for Gd-153 production increased to meet needs of user community. This nuclide is used in	Continue preparation of research isotopes, Cu-67, Ru-97 and Sn-117m. Expand Pd-109 production. Develop in-vivo generator for radiotherapy with monoclonal antibodies. Investigate production of Sc-47 and F-18. Develop	Depending on progress in FY 1987, Sn-117m may be ready for human therapeutic trials. Continue monoclonal antibody labeling with Cu-67 and development of in-vivo generator. Continue development and evaluation of Cu-67, Ru-97, Pd-109,

III. Nuclear Medicine (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Radioisotope Production (Cont'd)	dual-photon scanning instruments for study of osteoporosis (calcium resorption from bone).	cell labeling techniques. Develop agents for lymphoid irradiation.	Sn-117m and I-123 labeled monoclonal antibodies for diagnostic and therapeutic applications.
Total Radioisotope Production	$2,994	$2,828	$2,985
Radio-pharmaceuticals	Development of new radiopharmaceuticals labeled with short-lived radionuclides carbon-11, oxygen-15 and fluorine-18 have made possible more specific localization of metabolic processes in the brain and heart. Examples are C-11 putrescine in brain tumor studies, F-18 methylspiroperidol in physiology of dopamine receptors and C-11 deprenyl in monamine oxidase metabolism. A new myocardial perfusion agent for use in diagnostic nuclear medicine was developed based on isonitrile complexes of technetium-99m. This agent is in the process of commercial development. A tellurium labeled fatty acid has been synthesized and has shown prolonged and high mycardial uptake in animal models. It is an excellent candidate for further evaluation when labeled with I-123 for heart imaging studies by SPECT (Single Photon Emission Computed Tomography).	Continue development of the labeled monclonal antibody methods for treating surgically inaccessible cancers, in particular, labeling of antibodies with appropriate radionuclides while maintaining the biological activity of the antibody. Copper-67 labeled Lym-1 antibody will be prepared for initial feasibility studies in patients. Other radiolabeled agents will be developed for diagnostic imaging. Continue the study of neurotransmitter receptors by positron-emitting tracers for prolactinoma, breast tumors, and prostatic tumors.	Studies will be carried out with a variety of nuclides with therapeutic potential. Examples are Cu-67,Pd-109, Zn-69, Ni-66, Sc-47, Re-186, and Re-188. Monoclonal antibodies available for testing should include those against melanoma, colon, breast, and lung carcinomas, gliomas, and various blood cell subpopulations. A study to test the validity of a kinetic model for the hepatic uptake of a new receptor-binding radiopharmaceutical will be conducted on post-operative care of liver transplant recipients.
Total Radio-pharmaceuticals	$7,624	$8,523	$8,678
Instrumentation	The 280 crystal positron tomograph (PET) is in use for heart and brain studies to measure blood flow in normal and pathological conditions.	Continue brain and heart studies.	Continue brain and heart studies.
	600 crystal, ultra-high resolution positron tomograph is in final stages of construction.	Completion of the 600 crystal positron tomograph is expected.	Continue development of photo-tube-solid state readout of small crystals.
	No activity.	Begin studies of pulse height information, attenuation corrections, and improvement of spatial resolution.	Continue FY 1987 program.

III. Nuclear Medicine (Cont'd)

Program Activity	FY 1986	FY 1987	FY 1988
Instrumentation (Cont'd)	No activity.	No activity.	Perform design and feasibility studies of new focused, mesh dynode, multi-anode array photo-tube.
	No activity.	No activity.	Investigate new scintillation materials, using synchrotron light source.
	No activity.	No activity.	Investigate method for shaping magnetic field in Nuclear Magnetic Resonance Instruments.
Total Instrumentation	$4,249	$3,884	$4,452
Clinical Feasibility	Rubidium-82 has been used for the noninvasive measurement of myocardial blood flow. Studies in 35 patients have demonstrated that for normal and low flow, rubidium has been found to reflect the blood flow state accurately.	Exercise vs. rest studies of myocardial perfusion using sequential injections of rubidium-82 and the Donner 280-crystal positron emission tomograph will be performed on patients with coronary artery disease and subjects without disease symptoms.	Rubidium-82 will be studied as a possible blood brain barrier permeability marker for evaluation of the radiation effects from heavy ion radiotherapy.
	A research project was initiated for the clinical application of copper-64 citrate for positron emission tomography studies of solid tumors.	A clinical investigative protocol utilizing copper-64 to evaluate Hodgkins disease will be initiated.	Approximately 15 patients will be studied for the response of normal tissue at periods of one month and six month post treatment. The usefulness of copper-64 in cardiovascular disease and soft tissue tumors as well as hepatic disease will be investigated.
	Clinical studies were conducted on two patients with solid tumors using iodine-131 labeled Lym-1 antibody. Selective targeting of the neoplastic tissues was demonstrated in both patients.	Development of radiochemistry to optimize tumor uptake and increase non-target tissue clearance of the radiolabeled antibody is planned.	Verification of dosimetry predictions and therapy feasibility in patients using selected iodine-131 and copper-67 radioimmunopharmaceuticals will be studied.
	High intensity radioactive beams of Neon-19 and Carbon-11 have been produced. On-line tests using animals have been performed. It has been demonstrated that using heavy particle beams, radiation dose can be concentrated in the desired target volume.	Application of this technique to human patients will be pursued. In addition, efforts will be made to develop better beam shapes both pencil and fan beams to improve intensity and also monochromaticity in beam energy.	Patient treatment with heavy ions (heavier than helium) will be expanded and the possibility of applying radioactive beam techniques to cerebral blood flow measurement following irradiation will be explored.

III. Nuclear Medicine (Cont'd.)

Program Activity	FY 1986	FY 1987	FY 1988
Clinical Feasibility (Cont'd)	Recent studies of second generation boronated compounds show that two of these compounds have the desired in-vivo accumulation in tumor and clearance from normal tissue. Complete tumor regression was obtained when mice treated with these compounds have been irradiated with neutron beam at the BNL Medical Research Reactor.	The most promising boron containing compounds from among the categories currently being tested nucleotides amino acids, steroids, antibodies, and liposomes, will be further pursued. Testing in animal tumor models will continue with the aim of denonstrating efficacy of NCT.	NCT clinical trials with at least two boronated compounds will be initiated. Development and testing of third generation compounds will be initiated to target boron to other types of tumors.
Total Clinical Feasibility	$6,242	$5,030	$4,900
Total Nuclear Medicine	$22,814	$22,120	$22,890

I. Preface: Carbon Dioxide Research

The goal of the Carbon Dioxide Research program is to develop a sound, quantitative atmospheric carbon dioxide knowledge base to aid in energy policy decision making. This goal involves the following objectives: improve knowledge of the carbon cycle; improve estimates of future atmospheric carbon dioxide; project climatic response to increasing atmospheric CO2; improve understanding of the direct carbon dioxide effects on productivity of natural and agricultural systems; develop and verify methods for the first detection of climate change due to increasing atmospheric carbon dioxide; identify, define and quantify indirect effects; define possible options for mitigating long-term consequences of a higher CO-2 atmosphere. Increased emphasis will be placed on the oceans program due to great uncertainty of their effect on climate change.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Sources and Sinks	$ 3,331	$ 3,480	$ 3,480	0
Climatic Effects	4,500	4,370	4,750	+ 9
Vegetative Effects	3,000	3,500	3,500	0
Information Requirements	1,100	1,100	1,100	0
SOA's/Oceans Program	500	750	1,146	+53
Total, Carbon Dioxide Research	$12,431	$13,200	$13,976	+ 6

II. B. Major Laboratory and Facility Funding

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Argonne National Laboratory.....	$ 0	$ 0	$ 150	--
Brookhaven National Laboratory.....	241	700	150	-79
Lawrence Berkeley Laboratory.....	89	0	0	--
Lawrence Livermore National Laboratory.	1,707	2,020	1,625	-20
Oak Ridge National Laboratory.....	4,895	3,932	4,936	+26
Pacific Northwest Laboratory.....	73	150	0	--
Oak Ridge Associated Universities.....	241	0	0	--
Total.....	$7,246	$6,802	$6,861	+ 1

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Carbon Dioxide	To develop the knowledge base necessary to aid in energy policy decisionmaking, atmospheric CO-2 uncertainties must be reduced. Specifically,	The basic program to reduce CO-2 issue uncertainties will continue and a few of the highest priority recommendations from the state-of-the-art reports will be implemented. Specifically,	The basic program to reduce CO-2 issue uncertainties will continue and a few of the highest priority recommendations from the state-of-the-art reports initiated in FY 1987 will be continued. Specifically,
	The sources and sinks of increasing amounts of CO-2. ($3,331)	Continue to study sources and sinks of CO-2. ($3,480)	Continue to study sources and sinks of CO-2. ($3,480)
	The projection and detection of climatic response to increasing atmospheric CO-2. ($4,500)	A climate model comparisons study to ultimately improve the regional prediction capability of these models. Initial emphasis is on understanding clouds as a possible modifier of the greenhouse effect. ($4,370)	Continue climate model intercomparison and improvement. ($4,750)
	The response of vegetation and natural ecological systems to increasing atmospheric CO-2 and changing climate. ($3,000)	An experimental study of a rangeland system to determine combined effects of CO-2 enrichment, changing climate variables, and the interactions of plants and animals with other physical factors ($3,500)	Continue rangeland experiments. ($3,500)
	The characterization of information requirements for studies of other systems impacted by a CO-2 induced climate change ($1,100)	Continue FY 1986 program level. ($1,100)	Continue FY 1987 program level. ($1,100)

III. Carbon Dioxide Research

Program Activity	FY 1986	FY 1987	FY 1988
Carbon Dioxide (Cont'd)	In addition, a revised research plan will begin to be developed in response to the four state-of-the art (SOA) reports that were published to describe current knowledge and identify the research necessary to reduce critical uncertainties. ($500)	An oceans program to understand the transport and storage of heat and CO-2 to the deep oceans, examining possible delay of greenhouse warming and the primary sink for CO-2. ($750)	Expand the oceans program to determine uncertainties identified in the SOA's concerning delayed warming of the atmosphere. ($1,146)
Total Carbon Dioxide Research	$12,431	$13,200	$13,976

I. Preface: 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.

II. A. Summary Table

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Salaries and Expenses.....	$ 3,119	$ 3,478	$ 3,900	+12
Other.....	10	100	100	0
Total, Program Direction.....	$ 3,129	$ 3,578	$ 4,000	+12

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Salaries and Expenses	Provided funds for salaries, benefits, and travel for 56 full-time equivalents (FTE's) in the Office of Health and Environmental Research and related program and management support. This staff provided guidance and support for hundreds of active research projects (reviewing and evaluating many more throughout the proposal selection process) and conducted major reviews of the numerous BER-sponsored programs at laboratories and universities. Staff also maintained close liaison with other DOE programs, other Federal agencies,	Provide for the normal increased personnel costs required to maintain an authorized level of 53 FTE's. Prior year unobligated funds will be used for the 1987 pay raise and the increased agency contribution to the new Federal Employees Retirement System. This staff is becoming increasingly involved in international affairs. A recent Memorandum of Understanding with the Commission of European Communities will promote research collaboration and program coordination between the respective radiation biology programs.	Provide funds for salaries and related costs to continue 53 FTE's. Provide for the normal increased personnel costs such as within-grade and merit increases, impact of the 1987 pay raise, and the increased agency contribution to the Federal Employees Retirement System as participation increases. Staff effort will increase in support of the human genome program; for instance, extensive interagency coordination will be required to achieve the planned national effort to map and sequence the human genome. ($3,900)

III. Program Direction

Program Activity	FY 1986	FY 1987	FY 1988
Salaries and Expenses (Cont'd)	and the scientific, academic and industrial communities and provided the program and management support services required to carry out the program. Prior year unobligated carryover comprised $49 of the total expenditure. ($3,119)	In FY 1987 the global consequences of the Chernobyl incident will continue to be evaluated. ($3,478)	
	Provided funds for program support such as printing and editing and program specific supplies, services, and materials, totaling $70, of which $60 comprised prior year unobligated carryover. ($10)	Provide for a variety of program support services similar to those in FY 1986. Also includes time-sharing on various information systems and communications networks such as electronic mail, and contractual support for technical writing, editing, and other services. ($100)	Continue the variety and level of program support services required in FY 1987. ($100)
Total Program Direction	$3,129	$3,578	$4,000

I. Preface: Facility Operations

Facility operations provide for the necessary capital equipment and general plant project 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

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Capital Equipment.....	$ 7,457	$ 8,500	$ 8,500	0
Construction.....	3,127	6,000	3,500	-42
Total, Facility Operations.....	$10,584	$14,500	$12,000	-17

II. B. Major Laboratory and Facility Funding

Program Activity	FY 1986	FY 1987	FY 1988	% Change
Ames Laboratory	$ 36	$ 40	$ 25	-37
Argonne National Laboratory	661	620	465	-25
Brookhaven National Laboratory	864	880	610	-31
E I Du Pont De Nemours and Co., Inc.	45	25	20	-20
Lawrence Berkeley Laboratory	455	385	295	-23
Lawrence Livermore National Laboratory	890	865	780	-10
Los Alamos National Laboratory	1,465	990	940	- 5
Oak Ridge National Laboratory	1,754	1,475	935	-37
Pacific Northwest Laboratory	2,652	2,710	2,570	- 5
California, Univ. of at Davis	68	60	30	-50
California, Univ. of at Los Angeles	173	200	150	-25
California, Univ. of, at San Francisco	114	140	110	-21
Environmental Measurements Laboratory	313	335	245	-27
Inhalation Toxicology Research Institute	938	1,135	1,270	+12
Oak Ridge Associated Universities	55	700	500	-29
Utah, University of	45	85	60	-30
Total	$10,528	$10,645	$ 9,005	-15

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Capital Equipment	Capital equipment funds are provided to support the research program by maintaining state-of-the-art instrumentation. Funds are provided to the national laboratories ($6,048), which includes $962 for the landlord functions at Pacific Northwest Laboratory, BER dedicated laboratories ($1,236) and other miscellaneous institutions ($173).	The FY 1987 capital equipment budget will allow the program to continue providing essential instrumentation for the types of contractors mentioned at about the same distribution of the total budget.	Same level of activity as FY 1987.
Total Capital Equipment	$7,457	$8,500	$8,500
Construction	General plant project funds are provided for the landlord function at Pacific Northwest Laboratory ($962), programmatic needs at national laboratories ($1,683), and BER dedicated laboratories ($482).	The FY 1987 general plant projects request allows for a cost of living increase over FY 1986 to maintain support to the landlord responsibility at Pacific Northwest Laboratory ($1,000) and programmatic needs at the other national laboratories.	Same level of activity as FY 1987.

III. Activity Descriptions

Program Activity	FY 1986	FY 1987	FY 1988
Construction (Cont'd)	No activity.	Provides for construction activities for an Institute for Nuclear Medicine in Newark, New Jersey (proposed for rescission by the Administration).	No activity.
Total Construction	$3,127	$6,000	$3,500
Total Facility Operations	$10,584	$14,500	$12,000
Total, Biological and Environmental Research	$178,000	$193,992	$217,500

DEPARTMENT OF ENERGY
FY 1988 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 1987 Appropriated	FY 1988 Request	Remaining Balance	TEC
88-R-120	General Plant Projects	$ XXXX	$ 3,000	$ 3,500	$ 0	$ XXXXX
87-R-130	Institute for Nuclear Medicine, Newark, New Jersey	0	3,000	0	0	XXXXX
Total, Biological and Environmental Construction		$ XXXX	$ 6,000	$ 3,500	$ 0	$ XXXXX

DEPARTMENT OF ENERGY
FY 1988 CONGRESSIONAL BUDGET REQUEST
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: 88-R-120 General Plant Projects

Project TEC: $ 3,500
Start Date: FY 1988
Completion Date: FY 1990

2. Financial schedule:

		Costs			
Fiscal Year	Obligations	FY 1986	FY 1987	FY 1988	After FY 1988
Prior Years	XXXXXXXX	$ 3,312	$ 1,443	$ 346	$ 214
FY 1986 Projects	$ 3,127	334	1,150	766	877
FY 1987 Projects	3,000	0	875	1,400	725
FY 1988 Projects	3,500	0	0	888	2,612

3. Narrative:

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.

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.

DOE/MA-0274

Congressional Budget Request

Construction Project Data Sheets:
Energy Supply Research and Development
General Science
Uranium Enrichment
Naval Petroleum & Oil Shale Reserves

FY 1988

U.S. Department of Energy
Assistant Secretary,
Management and Administration
Office of the Controller
Washington, D.C. 20585

January 1987

DEPARTMENT OF ENERGY
1988 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.: 88-R-120

3. Date A-E work initiated: 1st Qtr. FY 1988

3a. Date physical construction starts: 2nd Qtr. FY 1988

4. Date construction ends: 2nd Qtr. FY 1990

5. Previous cost estimate: None
Date:

6. Current cost estimate: $3,500
Date: 12/86

7. Financial Schedule:

Fiscal Year	Obligations	Costs FY 1986	Costs FY 1987	Costs FY 1988	Costs After FY 1988
Prior Year Projects	XXXXXXXX	$ 3,312	$ 1,443	$ 346	$ 214
FY 1986 Projects	$ 3,127	334	1,150	766	877
FY 1987 Projects	3,000	0	875	1,400	725
FY 1988 Projects	3,500	0	0	888	2,612

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.

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 $1,500,000, and primarily indicative of the size of the project. The continuing review of our requirements will result in some of the projects being changed in scope; it will also result in other projects being added to the list with the necessary postponements of some now listed, all depending on

1. Title and location of project: General plant projects — 2. Project No.: 88-R-120

8. Brief Physical Description of Project (continued)

conditions or situations not apparent at this time. 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	$ 1,500
Oak Ridge Operations Office	300
Richland Operations Office	1,000
San Francisco Operations Office	500
Washington Headquarters	200
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 ..... $ 1,000

Inhalation exposure laboratory addition, health protection support facility, and other emergency repairs.

Los Alamos National Laboratory 500

Laboratory and exhaust modifications, greenhouse, storage building, and other emergency repairs.

1. Title and location of project: General plant projects — 2. Project No.: 88-R-120

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

Oak Ridge Operations Office
Oak Ridge Associated Universities..... 300
Upgrade of laboratories, air conditioning and cooling tower, and other emergency repairs.

Richland Operations Office
Pacific Northwest Laboratory..... 1,000
Miscellaneous capital work orders, e.g., laboratory additions, improvements, and modifications.

San Francisco Operations Office
Lawrence Livermore National Laboratory..... 500
Modular laboratory building, and other emergency repairs.

Washington Headquarters..... 200
This estimate covers necessary unanticipated emergency repairs.

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.