

**DEPARTMENT OF ENERGY**  
**FY 1997 CONGRESSIONAL BUDGET REQUEST**  
**ENERGY SUPPLY, RESEARCH AND DEVELOPMENT**  
(Tabular dollars in thousands. Narrative in whole dollars)

**BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM**

**PROGRAM MISSION**

The Biological and Environmental Research Program (BER) provides fundamental science to underpin the five business thrusts of the Department's strategic plan. Through its support of peer-reviewed research at national laboratories, universities, and private institutions, the program develops the knowledge needed to identify, understand, and anticipate the long-term health and environmental consequences of energy production, development, and use. The research is also designed to provide science in support of the Energy Policy Act of 1992.

The GOAL of the BER program is:

To develop the information, scientific "know-how," and technology for identification, characterization, and mitigation of adverse health and environmental consequences of energy production, development, and use.

The OBJECTIVES related to these goals are:

1. To CONTRIBUTE TO A HEALTHY CITIZENRY - Map the fine structure of the human genome by the year 2005; conduct fundamental research necessary for the development of advanced medical technologies and radiopharmaceuticals; and use the unique National Laboratory facilities to determine biological structure and function at the molecular and cellular level.
2. To CONTRIBUTE TO CLEAN UP OF THE ENVIRONMENT - Conduct fundamental research necessary for the development of advanced remediation tools and risk assessment methodologies for containing wastes and cleaning up DOE's contaminated sites, particularly in support of the mission of DOE's Environmental Management (EM) office.
3. To UNDERSTAND GLOBAL ENVIRONMENTAL CHANGE - Acquire the data and develop the understanding necessary to predict if and how energy production and use can affect the global and regional environment.

## **PROGRAM MISSION - BIOLOGICAL AND ENVIRONMENTAL RESEARCH - (Cont'd)**

### **SCIENTIFIC FACILITIES UTILIZATION:**

The Biological and Environmental Research request includes \$14,400,000 to maintain support of the Department's scientific user facilities. Facilities used for structural biology research, such as beam lines at the synchrotron light sources and research reactors, are included in the initiative for the first time in FY 1997. This funding will significantly provide research time for scientists in universities, federal agencies, and U.S. companies. It will also leverage both Federally and privately sponsored research consistent with the Administration's strategy for enhancing the U.S. National science investment.

### **PERFORMANCE MEASURES**

Many performance measures related to basic science activities are qualitative rather than quantitative. The quality of the BER program is continuously evaluated through the peer-review process which includes: review panels comprised of outside experts, advisory committees, site visits, and reviews conducted by the Office of Energy Research. Examples of measures are:

1. New scientific discoveries and technological innovations that accelerate the sequencing and mapping of the human genome.
2. The development of advanced medical technologies and radiopharmaceuticals from fundamental research in molecular, structural, and cellular biology.
3. The development of advanced remediation tools (e.g., bioremediation) and risk assessment methodologies to contain hazardous waste and clean up DOE contaminated sites from fundamental research in environmental sciences, biology, molecular sciences, and mathematical modeling.
4. The development of advanced predictive models of the effects of energy use on the global environment from basic research in environmental sciences.

### **SIGNIFICANT ACCOMPLISHMENTS AND PROGRAM SHIFTS:**

- o A new structure has been developed for the Biological and Environmental Research program. The existing structure was a product of the long, productive history of the program. However, it no longer reflected the program priorities or the on-going integration across scientific disciplines. The new structure contains the following subprograms: Life Sciences; Environmental Processes; Environmental Remediation; and Medical Applications and Measurement Sciences.

## **PROGRAM MISSION - BIOLOGICAL AND ENVIRONMENTAL RESEARCH - (Cont'd)**

- o Critical information has been acquired regarding the molecular nature of the human genome and genomes of other organisms, and explorations are continuing on the basic chemical structures of important biological molecules as they relate to the functions of living cells. These continued advances are central to understanding health effects and human disease-susceptibility and for applications of biotechnology to the Department's missions. Increased emphasis will be placed on large-scale sequencing of select chromosomes.
- o New strategies for cleanup, e.g., use of biotechnology (e.g., microbes that break down contaminants) will be developed for stubborn remediation problems.
- o Advanced technologies have been developed to determine and mitigate the potential health effects from energy activities and cleanup operations. Emphasis is placed on the risks to human health from exposures to low levels of radiation and chemicals both at home (e.g., radon) and at the DOE workplace (e.g., waste site cleanup).
- o Significant improvements are being made in the predictive tools needed to quantify human-induced and natural global environmental changes, including those from energy production and use. Emphasis remains on the role of clouds in climate and on developing improved climate models using the Nation's most advanced computers.
- o New nuclear medicine technologies and radiopharmaceuticals for improved medical diagnosis and therapy are being developed, contributing to improved health care delivery while reducing costs by achieving early diagnosis and treatment. Increased emphasis will be placed on improved imaging methodologies.
- o Research in the area of indoor air quality related to radon exposure has been completed and transfer of the methodologies to key stakeholders is underway (e.g., the Environmental Protection Agency and state and local authorities).
- o The program has developed new measurement technologies (e.g., chemical and biological sensors) in the Medical Applications and Measurement Science subprogram to enhance research carried out in BER activities. Examples include resonance ionization spectroscopy for environmental dating and flow cytometry for chromosome and cell separations.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

PROGRAM FUNDING PROFILE

(Dollars in thousands)

	<u>FY 1995 Comparable Appropriation</u>	<u>FY 1996 Original Appropriation</u>	<u>FY 1996 Real &amp; Comp Adjustments</u>	<u>FY 1996 Comparable Adjusted</u>	<u>FY 1997 Budget Request</u>
<b><u>Research</u></b>					
Life Sciences.....	\$138,838	\$133,989	-\$353 a/	\$133,636	\$138,965
Environmental Processes.....	102,852	103,667	-2,053 a/	101,614	102,337
Environmental Remediation.....	18,220	23,464	-151 a/	23,313	29,053
Medical Applications and Measurement Science.	52,084	60,266	-3,075 a/	57,191	42,595
Program Direction.....	0	7,000	-7,000 b/	0	0
Related Capital Funding.....	29,051	28,505	-453 a/	28,052	30,012
Subtotal, Research.....	<u>341,045</u>	<u>356,891</u>	<u>-13,085</u>	<u>343,806</u>	<u>342,962</u>
Construction.....	<u>67,200</u>	<u>62,595</u>	<u>0</u>	<u>62,595</u>	<u>36,113</u>
Subtotal, Biological and Environmental Research.	408,245	419,486	-13,085	406,401	379,075
Adjustment.....	<u>-5,001 c/</u>	<u>-11,356 d/</u>	<u>0</u>	<u>-11,356 c/</u>	<u>0</u>
Total, Biological and Environmental Research.....	<u>\$403,244 e/</u>	<u>\$408,130</u>	<u>-\$13,085</u>	<u>\$395,045</u>	<u>\$379,075</u>

a/ Reprogramming to the Indian Energy Resources programs (\$-1,645,000) and comparability transfer to Energy Research Energy Supply, Research and Development Program Direction (\$-4,440,000).

b/ Comparability transfer to Energy Research Energy Supply, Research and Development Program Direction.

c/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program on a comparable basis. The total general reduction is applied at the appropriation level.

d/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program on a non-comparable basis. The total general reduction is applied at the appropriation level.

e/ Excludes \$6,390,000 which was transferred to the SBIR program and \$319,000 which was transferred to the STTR program.

**Public Law Authorizations:**

Public Law 95-91 "Department of Energy Organization Act" (1977)

**BIOLOGICAL AND ENVIRONMENTAL RESEARCH**

(Dollars in thousands)

**PROGRAM FUNDING BY SITE**

<u>Field Offices/Sites</u>	<u>FY 1995 Comparable Appropriation</u>	<u>FY 1996 Original Appropriation</u>	<u>FY 1996 Real &amp; Comp Adjustments</u>	<u>FY 1996 Comparable Appropriation</u>	<u>FY 1997 Budget Request</u>
<b>Albuquerque Operations Office</b>					
Los Alamos National Laboratory	\$25,305	\$20,343	\$0	\$20,343	\$20,602
Sandia National Laboratory	1,335	1,342	0	1,342	1,318
<b>Chicago Operations Office</b>					
Ames Laboratory	657	596	0	596	581
Argonne National Laboratory (East)	19,318	15,011	0	15,011	8,318
Brookhaven National Laboratory	31,051	25,804	0	25,804	27,032
Environmental Measurements Laboratory	250	4,440	-4,440 a/	0	0
Fermi National Accelerator Laboratory	1,050	1,575	0	1,575	2,100
<b>Idaho Operations Office</b>					
Idaho National Engineering Laboratory	3,340	2,326	0	2,326	2,445
<b>Oakland Operations Office</b>					
Lawrence Berkeley National Laboratory	46,353	35,177	0	35,177	24,049
Lawrence Livermore National Laboratory	21,326	21,508	0	21,508	19,285
Stanford Linear Accelerator Facility (SSRL)	3,429	2,150	0	2,150	1,407
<b>Oak Ridge Operations Office</b>					
Oak Ridge Institute for Science & Education	6,994	3,050	0	3,050	6,112
Oak Ridge National Laboratory	24,170	21,694	0	21,694	21,436
<b>Richland Operations Office</b>					
Pacific Northwest National Laboratory	83,933	92,187	0	92,187	84,456
<b>All Other Sites b/</b>	<u>139,734</u>	<u>172,283</u>	<u>-8,645 c/</u>	<u>163,638</u>	<u>159,934</u>
<b>Subtotal</b>	<u>408,245</u>	<u>419,486</u>	<u>-13,085</u>	<u>406,401</u>	<u>379,075</u>
<b>Adjustment</b>	<u>-5,001 d/</u>	<u>-11,356 e/</u>	<u>0</u>	<u>-11,356 d/</u>	<u>0</u>
<b>TOTAL</b>	<u>\$403,244</u>	<u>\$408,130</u>	<u>-\$13,085</u>	<u>\$395,045</u>	<u>\$379,075</u>

a/ Comparability transfer to Energy Research Energy Supply, Research and Development Program Direction.

b/ Funding provided to universities, industry, other Federal agencies and other miscellaneous contractors.

c/ Reprogrammed to the Indian Energy Resources programs (\$1,645,000), and comparability transfer to Energy Research Energy Supply, Research and Development Program Direction (\$7,000,000).

d/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program on a comparable basis. The total reduction is applied at the appropriation level.

e/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program on a non-comparable basis. The total reduction is applied at the appropriation level.

**BIOLOGICAL AND ENVIRONMENTAL RESEARCH  
PROGRAM OBJECT CLASS SUMMARY  
(Dollars in thousands)**

	FY 1995		FY 1996		FY 1997
	Comparable	Non-Comp	Comparable	Non-Comp	
<b>Direct Funding:</b>					
<b>Personnel compensation:</b>					
11.1		\$3,659		\$4,247	
11.3		67		63	
11.5		169		225	
11.8		0		0	
11.9		<u>0</u>		<u>4,535</u>	<u>0</u>
12.1		781		1,063	
13.0		113		110	
21.0		291		320	
22.0					
23.1					
23.2					
23.3					
24.0					
25.1	220	1,476	229	1,479	143
25.2	24,176	24,512	46,303	48,214	62,508
25.3					
25.4					
25.5					
25.7					
26.0					
31.0	23,957	23,488	21,340	21,793	23,675
32.0	71,405	70,055	66,211	66,211	42,450
41.0	98,851	98,851	95,889	95,889	82,668
99.0	<u>403,207</u>	<u>412,777</u>	<u>396,131</u>	<u>410,213</u>	<u>379,075</u>
	0	0	0	0	0
99.9	<u>403,207</u>	<u>412,777</u>	<u>396,131</u>	<u>410,213</u>	<u>379,075</u>
	-930	-923	-75	-75	
	-85	-941	-1,011	-2,008	
	1,052	2,046			
	<u>\$403,244</u>	<u>\$412,959</u>	<u>\$395,045</u>	<u>\$408,130</u>	<u>\$379,075</u>

## **BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM**

### **LIFE SCIENCES**

**(Tabular dollars in thousands. Narrative in whole dollars)**

#### **I. Mission Supporting Goals and Objectives:**

Develops fundamental biological information and advanced technologies for understanding and mitigating the potential health effects of energy development, energy use, and waste cleanup; and develops and utilizes unique DOE resources and facilities to develop new biotechnology tools to address Departmental and national goals. Research is conducted in five areas: cellular biology, molecular biology, structural biology, the human genome, and health effects.

- o Basic molecular and cellular biology research identifies and characterizes genes that repair damaged DNA and control cell proliferation to determine individual responsiveness to energy-related materials and susceptibility to adverse health effects, including cancer.
- o Structural biology research is conducted at DOE national user facilities to determine the molecular structure of important biological molecules, such as enzymes, antibodies, or other proteins. Computational biology research combines computer science, structural biology, and genome research to predict the three dimensional structure of proteins from the DNA sequence of the corresponding gene. Knowledge of the structure and function of biological molecules will assist the application of biotechnology to diverse areas of national needs, e.g., rational drug design and environmental cleanup.
- o Genome research develops and applies new technologies and resources to map and determine the sequence of 3 billion bases that make up the DNA found in a typical human cell and supports related studies in ethical, legal, and social implications (ELSI), especially issues of privacy, commercialization, and education. Microbial genome research characterizes the DNA and proteins in microbes with biotechnology applications in energy production, environmental bioremediation, and industry.
- o The information and technologies developed in this research advance the biotechnology missions of the Department including: improved industrial processes, increased agricultural yields, energy production from biomass, environmental remediation, and improved molecular-based tools for health surveillance, biological dosimetry, and individual susceptibility determination.

**II. Funding Schedule:**

<u>Program Activity</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
Structural Biology . . . . .	18,554	\$ 22,568	\$ 21,930	\$- 638	- 2.8%
Molecular and Cellular Biology . . . . .	19,796	20,852	20,755	- 97	- 0.5%
Human Genome . . . . .	65,752	67,792	75,730	+ 7,938	+ 11.7%
Health Effects . . . . .	<u>34,736</u>	<u>22,424</u>	<u>20,550</u>	<u>- 1,874</u>	<u>- 8.4%</u>
Total, Life Sciences. . . . .	\$ 138,838	\$ 133,636	\$ 138,965	\$+ 5,329	+ 4.0%

**III. Performance Summary:**

FY 1995 Accomplishments (to date and planned):

- o Cloned two genes involved in the regulation of cell growth; the genes are important for understanding the development and treatment of cancer.
- o Isolated genes responsible for two DNA repair enzymes that are associated with diseases that increase radiation sensitivity and susceptibility to cancer.
- o Developed strains of mice that are missing DNA repair genes, as models for humans with defects in these genes, to study the function and regulation of these genes.
- o Began three new projects aimed at sequencing the DNA of industrially important microbes and completed sequencing the DNA of Mycoplasma genitalium, the smallest free-living organism.
- o Completed the sequence of the first one million out of a total of three billion bases of human DNA.
- o Published high resolution physical maps of human chromosomes 16 and 19 that are useful to scientists interested in isolating disease genes on these chromosomes and that serve as templates for high-throughput DNA sequencing.
- o Transferred advanced DNA sequencing technologies from National Laboratories to several academic and private sector laboratories, improving the efficiency and cost-effectiveness of DNA sequencing. Made new resources of cloned DNA for mapping and sequencing human DNA commercially available.



### **III. Performance Summary: LIFE SCIENCES (Cont'd)**

- o Produced draft genetic privacy legislation now under consideration in many state legislatures; produced a reference "deskbook" for judges on the use of genetic evidence in court cases.
- o Completed a high school biology curriculum on the management of computerized genetic information.
- o Initiated projects to examine the role of individual susceptibility in cancer risk including genetic factors associated with lung cancer and differences in maternal/fetal susceptibility to environmental pollutants.
- o Research to examine the biological role of tissue's extracellular matrix demonstrated its importance in regulating the function of genes that determine normal tissue function; this is important in understanding the development of many diseases, including cancer.
- o Initiated studies to reevaluate radon doses in uranium miners to improve estimates of cancer risk; built a detector for noninvasively measuring radon decay products deposited in bones of miners.
- o Funding in the amount of \$2,889,000 and \$144,000 has been transferred to the SBIR and STTR programs, respectively.

#### **FY 1996 Accomplishments**

- o Commission new synchrotron beamlines for protein cryotalligraphy at SSRL, ANL, and LBNL.
- o Initiate development of next generation of detectors for structural biology studies at synchrotron.
- o Expand the computational structural biology program to provide the basic computing tools and infrastructure to understand the relationship between the form and the function of biological molecules.
- o Characterize the function of two genes involved in regulating changes in cell growth following the exposure of cells or tissues to low levels of energy-related materials. Characterize defects in a DNA repair gene associated with a human disease.
- o Determine the response of two DNA repair genes to energy-related radiation and chemicals.
- o Characterize mice that are missing DNA repair genes for adverse health impacts.

### **III. Performance Summary: LIFE SCIENCES (Cont'd)**

- o Determine the DNA sequence of two industrially important microbes.
- o Complete the sequence of two million bases out of a total of three billion of human DNA sequence.
- o Characterize clones of human DNA, used as resources for DNA mapping and sequencing, that represent one-third of all DNA in a typical human cell.
- o Highly acclaimed high school genetics curriculum to be translated into Spanish and used in the Los Angeles school system.
- o Publish overview of large animal life-span carcinogenesis studies, multi-study analysis of inhaled plutonium-238 oxide carcinogenesis in experimental animals, and multi-laboratory control data base for beagle dogs. These studies provide an important data base to help assess risk to clean-up workers who may be exposed to radionuclides with little or no human epidemiological data.
- o Develop a computer model that helps states, counties and municipalities locate the homes with a high indoor radon potential.
- o Identify two candidate genes involved in cell aging (senescence) that represent important target genes for controlling cell growth and, as a result, the development of cancer.
- o Increase the sensitivity of a technique (comparative genomic hybridization) for detecting small increases and decreases in the number of copies of individual chromosomes to identify or characterize abnormal cells in tissues or tumors.
- o Funding in the amount of \$2,649,000 and \$184,000 has been budgeted for the SBIR and STTR programs, respectively.

#### FY 1997 Planned Accomplishments:

- o Commission synchrotron beamline for biological x-ray spectroscopy at LBNL (ALS).
- o Initiate station for structural biology studies at the LANSCE facility at LANL.
- o Make preliminary prediction of a protein's three dimensional structure from the DNA sequence of the gene coding for the protein using new computational tools for applications such as rational drug design and environmental cleanup.

### **III. Performance Summary: LIFE SCIENCES (Cont'd)**

- o Determine biological function of a DNA repair gene associated with a human disease.
- o Determine the function of two newly identified human genes using animal models in which cloned genes can be inserted and expressed.
- o Determine complete DNA sequence of four industrially important microbes. Characterize the evolutionary relationship between previously uncharacterized microbes of potential industrial importance.
- o Complete physical map of human genome by identifying unique DNA marker sequences for majority of human genes and placing information in public databases.
- o Complete the sequence of eight million out of a total of three billion bases of human DNA sequence.
- o Complete production and broadcast of radio series on genome research and television documentary on ELSI, "Genetics and Society."
- o Develop an animal carcinogenesis data base that will provide better estimates of risk for clean-up workers exposed to radionuclides with little or no human epidemiological data.
- o Make publicly available a computer model for finding homes with high levels of radon.
- o Test genes that may be responsible for the aging of cells by determining their ability to reverse the cell-aging process.
- o Reduce the size of the molecular probes needed for comparative genomic hybridization tests from whole chromosomes to defined DNA sequences to improve the resolution necessary to identify genes associated with cancer and genetic diseases.
- o Funding in the amount of \$3,446,000 has been budgeted for the SBIR program.

### **III. Performance Summary: LIFE SCIENCES (Cont'd)**

#### **Explanation of Funding Changes FY 1996 to FY 1997:**

The increase (\$+7,938,000) for genome research will be devoted to high-throughput sequencing of human DNA. These additional funds will support an increased output of finished DNA sequence from 2 million bases in FY 1996 to 8 million in FY 1997.

The decrease (\$-1,874,000) in Health Effects is due to the phasing out of most traditional, long-term research in radiation biology in FY 1996, including programs at the University of California at San Francisco and Pacific Northwest National Laboratory and a partial phase out at the Inhalation Toxicology Research Institute in FY 1997. Priorities will be shifted to research that addresses the traditional issues of health risks of exposure to low levels of energy-related materials using the unique, new resources and tools developed in the Department's human genome, structural biology, and cellular and molecular biology programs.

The decreases in Structural Biology (\$-638,000) and Molecular and Cellular Biology (\$-97,000) are necessary to maintain overall program balance and direction.

# BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

## ENVIRONMENTAL PROCESSES

(Tabular dollars in thousands. Narrative in whole dollars)

### I. Mission Supporting Goals and Objectives:

Research is focused on understanding the basic chemical, physical, and biological processes of the Earth's atmosphere, land, and oceans and how these processes may be affected by energy production and use, primarily the emission of carbon dioxide from fossil fuel combustion. A major part of the research is designed to provide the data that will enable an objective assessment of the potential for, and consequences of, global warming. The program is comprehensive with an emphasis on the radiation balance from the surface of the Earth to the top of the atmosphere including the role of clouds and on enhancing the quantitative models necessary to predict possible climate change at the global and regional levels. There are four contributing areas to this research program: Climate and Hydrology, Atmospheric Chemistry and Carbon Cycle, Ecological Processes, and Human Interactions. The National Institute for Global and Environmental Change (NIGEC) is included within these four areas. The Environmental Processes subprogram is DOE's contribution to the U.S. Global Change Research Program that was codified by Congress in the Global Change Research Act of 1990.

### II. Funding Schedule:

<u>Program Activity</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
Climate and Hydrology .....	\$ 53,515	\$ 51,804	\$ 54,267	\$+ 2,463	+ 4.8%
Atmospheric Chemistry and Carbon Cycle ...	27,317	29,032	27,164	- 1,868	- 6.4%
Ecological Processes .....	12,287	11,797	11,448	- 349	- 3.0%
Human Interactions .....	9,733	8,981	9,458	+ 477	+ 5.3%
Total, Environmental Processes .....	<u>\$ 102,852</u>	<u>\$ 101,614</u>	<u>\$ 102,337</u>	<u>\$+ 723</u>	<u>+ 0.7%</u>

### III. Performance Summary:

#### FY 1995 Accomplishments:

- o Second ARM Site established in Tropical Western Pacific. Started key measurements to determine how tropical clouds are mathematically represented in General Circulation Models (GCMs).

### **III. Performance Summary: ENVIRONMENTAL PROCESSES (Cont'd)**

- o Parallel Ocean Program model delivered by CHAMMP to climate modeling community for coupling with atmospheric models. Continued ocean process modeling efforts to improve understanding of exchange of heat and carbon dioxide between the ocean and atmosphere.
- o Terrestrial Carbon Processes Research Program initiated to quantify fraction of fossil carbon dioxide taken up by terrestrial vegetation and to predict future uptake.
- o Initiated major field program at Cape Hatteras, NC, to probe changes in biological and geological properties at the ocean-land interface from increasing concentrations of atmospheric carbon dioxide.
- o Provided regional estimates of sensitivity of ecological systems to climatic and atmospheric changes as a foundation for science-based assessments of the consequences of global change.
- o Continued development of integrated assessment models and other means for assessing the potential environmental and economic consequences of natural and human-induced climatic and atmospheric changes.
- o Supported new graduate and post-doctoral fellowships to provide for the next generation of multidisciplinary research scientists.
- o Acquired and analyzed data to determine the possible impact of energy emissions on tropospheric and stratospheric ozone.
- o Radon program completed, and results synthesized to develop protocols for identifying areas with high risk potential for elevated indoor radon.
- o The Quantitative Links program was completed, delivering information for the ARM and other programs.
- o Funding in the amount of \$2,183,000 and \$110,000 has been transferred to the SBIR and STTR programs, respectively.

#### **FY 1996 Accomplishments (to date and planned):**

- o Complete the experiments at the Oklahoma ARM site that will solve the puzzle of anomalous short wave absorption by clouds.
- o Begin periodic Intensive Observational Periods (IOPs) at the ARM site in the Tropical Western Pacific to improve parameterization of clouds in climate models. Continue collaborations with Australia, Papua New Guinea, and Japan. Initiate preparations for third ARM site on the North Slope of Alaska.

### **III. Performance Summary: ENVIRONMENTAL PROCESSES (Cont'd)**

- o Implement initial experiments with coupled climate system models on massively-parallel super-computers to capitalize on computational improvements. Execute multi-decade simulations of climate change to address century-scale climate prediction and evaluate estimates of model uncertainties to changes in atmospheric concentrations of greenhouse gases.
- o Continue experiments to quantify forest ecosystem responses to elevated carbon dioxide and climate variation.
- o Complete measurements of ocean carbon in the Indian Ocean as part of the global survey of inorganic carbon in the ocean to understand role of ocean in the uptake of atmospheric carbon dioxide.
- o Develop improved process models and methods for assessing regional consequences of atmospheric and climatic changes on ecological systems and human resources.
- o Evaluate success of global change fellowship program with respect to training of new scientists and the development of cross-disciplinary skills of the graduate- and postdoctoral fellows.
- o Participate in the North American Research Strategy for Tropospheric Ozone (NARSTO) Program, designed to quantify and characterize the scientific uncertainties of urban and rural smog and provide data for science-based air quality management decisions by Federal, state, and local authorities.
- o Field experiment of land-ocean research becomes fully operational and its completion results in determining if the coastal oceans are a source or sink for atmospheric carbon dioxide.
- o Initiate field experiments to determine the coupled effects of elevated carbon dioxide and ozone on growth and productivity of forests.
- o Funding in the amount of \$1,526,000 and \$123,000 has been budgeted for the SBIR and STTR programs, respectively.

#### **FY 1997 Planned Accomplishments:**

- o Establish third ARM Site on North Slope of Alaska and begin arctic data collection to support improvements in treatment of clouds and radiation in GCMs. Maintain full operation at the ARM sites in Oklahoma and the Tropical Western Pacific.
- o Include advanced understanding of how clouds affect atmospheric heating and cooling in the GCMs based on ARM data. Initiate the next step in the comparison of models by coupling with ocean models to enable the long-term climate predictions necessary for understanding global climate change.

### **III. Performance Summary: ENVIRONMENTAL PROCESSES (Cont'd)**

- o Provide improved estimates of atmospheric carbon dioxide changes that result from fossil fuel combustion. Improve understanding of the terrestrial biosphere's role in the uptake of carbon dioxide (i.e., the carbon exchange between the atmosphere and forests).
- o Complete evaluation of data obtained in field campaign at land/ocean interface.
- o Synthesize initial results from experimental and observational studies to quantify responses of southern hardwood forest and arid land ecosystems to alterations in precipitation.
- o Initiate a Young Scientists Award Program to strengthen global change research infrastructure at universities and national laboratories.
- o Complete regional analysis to identify ecological systems most sensitive to climatic variation and change to provide improved assessments of consequences of climate change.
- o Funding in the amount of \$2,126,000 has been budgeted for the SBIR program.

#### Explanation of Funding Changes FY 1996 to FY 1997:

Climate and Hydrology (+\$2,463,000) - The Atmospheric Radiation Measurement (ARM) program will continue to develop and operate the planned ARM sites, including the second and third sites located in the Tropical Western Pacific and the North Slope of Alaska, respectively. Activities within CHAMMP, the UAV-ARM program, and relevant parts of NIGEC will proceed at levels appropriate to their scientific priorities and urgencies.

Atmospheric Chemistry and Carbon Cycle (-\$1,868,000) - Activities within Marine Transport/Ocean Margins have focused on the role of coastal oceans as a source or sink for atmospheric carbon dioxide and the processes controlling the uptake, transport, and sequestration of carbon in the coastal ocean. Studies have included the use of biomarkers, measures of bacterial respiration, and studies of biogeochemical processes at the land/water interface. Research involving the development and application of such molecular and biological methods will be supported in the context of the synergistic and complementary research areas under the environmental remediation subprogram.

Ecological Processes (-\$349,000) - Experimental and observational studies will continue at a reduced pace. The program scope is maintained.

Human Interactions (+\$477,000) - Integrated assessment studies targeted at the science-based understanding of the implications of fundamental research in issues related to environmental processes will be strengthened. Newly initiated activities directed towards the inclusion and development of minority students in peer-reviewed research focused on environmental processes will be maintained.



## BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

### ENVIRONMENTAL REMEDIATION

(Tabular dollars in thousands. Narrative in whole dollars)

#### I. Mission Supporting Goals and Objectives:

The research is focused on the understanding of the fundamental physical, chemical, geological, and biological processes that must be marshaled for the development and advancement of new, effective, and efficient processes for the remediation and restoration of the Nation's nuclear weapons production sites. Priorities of this research include bioremediation, the development of the full capabilities of the Environmental Molecular Sciences Laboratory, and the joint scientific endeavors with the Office of Environmental Management. The subprogram also includes basic research in support of pollution prevention and sustainable technology development.

#### II. Funding Schedule:

<u>Program Activity</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
Terrestrial Transport .....	<u>\$ 18,220</u>	<u>\$ 23,313</u>	<u>\$ 29,053</u>	<u>\$+ 5,740</u>	<u>+ 24.6%</u>
Total, Environmental Remediation .....	<u>\$ 18,220</u>	<u>\$ 23,313</u>	<u>\$ 29,053</u>	<u>\$+ 5,740</u>	<u>+ 24.6%</u>

#### III. Performance Summary:

##### FY 1995 Accomplishments:

- o Expanded bioremediation research and initiated studies of the use of genetically engineered microorganisms (GEMs) for degrading contaminants, moving the research from the laboratory to a controlled field site at Oak Ridge National Laboratory.
- o Developed a 10-year plan for basic bioremediation research to clean sites fouled during nuclear weapons production (NABIR: Natural and Accelerated Bioremediation Research).
- o Funding in the amount of \$353,000 and \$17,000 has been transferred to the SBIR and STTR programs, respectively.

### **III. Performance Summary: ENVIRONMENTAL REMEDIATION (Cont'd)**

#### **FY 1996 Accomplishments (to date and planned):**

- o Initiate research activities identified in the 10-year plan on bioremediation, including establishment of an interagency advisory group.
- o Link research on the physical, chemical, and geological studies of contaminant transport with related activities in the Office of Technology Development/Office of Environmental Management (OTD/EM) and in the Office of Basic Energy Sciences/Energy Research (BES/ER).
- o Initiated pilot program focused on fundamental research needs identified by the Office of Environmental Management but, by virtue of the fundamental and basic nature, fall within the mission responsibility of the Office of Energy Research.
- o Funding in the amount of \$824,000 and \$66,000 has been budgeted for the SBIR and STTR programs, respectively.

#### **FY 1997 Planned Accomplishments:**

- o Complete genome sequence of three thermophilic microbes to identify and isolate genes and proteins that will enhance the bioremediation of mixed contaminants.
- o Begin the long term research necessary to identify key microbial, biotransformation, and biogeochemical processes to enhance the utility of bioremediation and develop strategies to represent these processes in predictive models.
- o Begin identification of the three field research centers proposed in the bioremediation plan; initiation of activities at the first center.
- o Initiate Environmental Molecular Sciences Laboratory (EMSL) startup operations.
- o Funding in the amount of \$1,193,000 has been budgeted for the SBIR program.

#### **Explanation of Funding Changes FY 1996 to FY 1997:**

(+\$5,740,000) - Research will seek to improve understanding of the potential of subsurface microorganisms for environmental bioremediation. With the establishment of the Environmental Molecular Sciences Laboratory, unified efforts within this subprogram will provide research directions that capitalize on the interdisciplinary nature of the fundamental science supporting environmental cleanup.

## BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

### MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE

(Tabular dollars in thousands. Narrative in whole dollars)

#### I. Mission Supporting Goals and Objectives:

The medical applications programs support research to develop beneficial applications of nuclear and other energy-related technologies for medical diagnosis and treatment. The research develops applications of radiotracer agents in medical research using recent advances in instrumentation as well as in molecular and structural biology. A major emphasis is placed on non-invasive diagnostic tools, including imaging technologies such as positron emission tomography. The research in this activity is conducted in six specific areas: Radioisotope Development, Radiopharmaceuticals, Instrumentation, Clinical Feasibility, Boron Neutron Capture Therapy (BNCT), and Molecular Nuclear Medicine.

The measurement science program also focuses on research and development of new measurement technologies to meet the needs of the environmental and life sciences programs of the biological and environmental research programs and other departmental customers. Emphasis is placed on using the advanced technologies developed in the Department's National Laboratories for environmental and biomedical research. The dosimetry activity is devoted to providing fundamental understanding of interactions of radiation with matter needed to improve BNCT and other programs in medical applications and the life sciences.

#### II. Funding Schedule

<u>Program Activity</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
Medical Applications.....	\$ 47,285	\$ 52,206	\$ 36,720	\$- 15,486	- 29.7%
Measurement Science.....	<u>4,799</u>	<u>4,985</u>	<u>5,875</u>	+ 890	<u>+ 17.9%</u>
<b>Total, Medical Applications and Measurement Science.....</b>	<b><u>\$ 52,084</u></b>	<b><u>\$ 57,191</u></b>	<b><u>\$ 42,595</u></b>	<b><u>\$- 14,596</u></b>	<b><u>- 25.5%</u></b>

### **III. Performance Summary: MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE (Cont'd)**

#### **FY 1995 Accomplishments:**

- o Initiated three human clinical trials at Brookhaven National Laboratory, New England Medical Center, and Ohio State University of the safety and efficacy of boron neutron capture therapy (BNCT) for treatment of glioblastoma brain cancer and melanoma skin cancer with new boron labeled drugs.
- o Inaugurated two research centers for the medical applications of advanced imaging technologies: a center for functional imaging at the Lawrence Berkeley National Laboratory for the study of human chemistry, physiology and disease; and a center for imaging neuroscience at Brookhaven National Laboratory for the study of neurological disorders and mental illnesses.
- o Initiated research on three-dimensional positron emission tomography at Lawrence Berkeley National Laboratory that will have the highest resolution and be the fastest system in the world, for improved diagnosis of brain diseases.
- o Completed initial collaborative projects between Centers of Excellence for Laser Applications in Medicine at Massachusetts General Hospital, Schepens Eye Research Institute, University of California at Irvine and the University of Texas, and DOE National Laboratories to develop laser technology for medical diagnosis and treatment such as burn treatment, laser surgery and cancer treatment.
- o Completed follow up and evaluation of the health status of 1,300 human research patients treated at the Lawrence Berkeley National Laboratory with charged-particle radiosurgery between 1954 and 1993 for selected brain disorders. Techniques and treatment strategies are being transferred to the Proton Irradiation Facility at Loma Linda University Medical Center.
- o Radiopharmaceutical research focused on targeting the multi-drug resistance gene.
- o Developed new approaches in genetic engineering and tumor biology that contribute to more efficient and selective cancer treatment options.
- o Received Research and Development magazine R&D 100 award for a fast and inexpensive test for polychlorinated biphenyls (PCBs) that enables rapid in-field testing for PCBs.
- o Completed research on instruments for the measurement of radiation and solicited research applications to investigate the chemical composition of living cells and to probe the subsurface environments.

### **III. Performance Summary: MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE (Cont'd)**

- o Initiated collaborative project with the National Science Foundation to develop instrumentation for ocean carbon measurements as part of the basic research program in instrumentation for measurement sciences.
- o Funding in the amount of \$965,000 and \$48,000 was transferred to the SBIR and STTR programs, respectively.

#### **FY 1996 Accomplishments (to date and planned):**

- o Complete a Phase I/II human clinical trial of boron neutron capture therapy at Brookhaven National Laboratory for treatment of glioblastoma using the recently developed boronophenylalanine-fructose complex as the boron delivery drug.
- o Use new radiotracers and imaging capabilities for neuroscience research and for diagnosing diseases and disorders of the brain and other organs.
- o Develop new diagnostic probes for detection of cancer using advanced molecular biology techniques.
- o Complete installation of a high-field, whole body magnetic resonance imaging system at the Brookhaven Imaging Center which, along with emission computed tomography instruments, provides complementary multiple imaging modalities for studies on the function of the human brain in normal, aging and diseased states, and following drug abuse.
- o Deploy new instrumentation for characterizing particulate matter in the oceans to determine the distribution and fate of carbon-containing matter in the global carbon cycle.
- o Complete development of new biosensors capable of measurements in individual biological cells that enable studies of disease processes.
- o Development of high resolution three-dimensional positron emission tomography at Lawrence Berkeley National Laboratory will continue.
- o Continue research into new concepts for imaging of effects of carcinogens on biological materials.
- o Initiate basic dosimetry research directed to improvement of Boron Neutron Capture Therapy and other health science programs of the Office.

### **III. Performance Summary: MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE (Cont'd)**

- o Funding for the Biomedical Research Foundation of Northwest Louisiana is provided to develop a research program on stroke and related diseases as included in Congressional direction.
- o Funding for the Oregon Health Sciences University is provided in support of networking infrastructure at the university and collaborations with related institutions, as included in Congressional direction.
- o Funding in the amount of \$1,151,000 and \$88,000 has been budgeted for the SBIR and STTR programs, respectively.

#### **FY 1997 Planned Accomplishments:**

- o Bring new radiopharmaceuticals with high specificity for particular cells into biological screening and preclinical studies in laboratory animals.
- o Strengthen computational modeling efforts in support of drug design for molecular nuclear medicine applications.
- o Complete a Phase I human clinical trial at Ohio State University of boron neutron capture therapy for treatment of glioblastoma using sodium borocaptate as the boron delivery drug; this compound has been widely used in Japan.
- o Collaborate with the National Cancer Institute in comparing boron neutron capture therapy with conventional modes of therapy.
- o Extend laser research to develop beneficial medical laser applications for diagnosis and therapy of cancer and other diseases. Complete a CRADA between Sandia National Laboratory and Massachusetts General Hospital on development of laser technology for diagnosis and treatment of burns, and transfer the technology to the private sector.
- o Continue development of information management systems for medical applications, leading to initial applications of genome sequencing in radiopharmaceutical development.
- o Continue development of three dimensional positron emission tomography and associated electronics and new crystal materials.
- o Complete development of a new mass spectrometer capable of characterizing contaminants in subsurface environments.

### **III. Performance Summary: MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE (Cont'd)**

- o Complete development of new laser based techniques for measurement of chemical carcinogens at subcellular level to enable studies of how a cell evolves from the normal to the cancerous state.
- o Continue program in dosimetry applied to BNCT.
- o Funding in the amount of \$1,058,000 has been budgeted for the SBIR program.

#### **Explanation of Funding Changes FY 1996 to FY 1997:**

Medical Applications (-\$15,486,000) - Congressionally directed projects included in FY 1996 are complete. Projects in radiopharmaceutical development using conventional antibody approaches will be terminated.

Measurement Science (+\$890,000) - Support for the development and application of laser technologies developed by the National Laboratories will increase to couple these technologies more closely to medical applications of optical techniques.

**BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM**

**RELATED CAPITAL FUNDING**

**(Tabular dollars in thousands. Narrative in whole dollars)**

**I. Mission Supporting Goals and Objectives:**

Provides for the necessary capital equipment and general plant project needs to support the BER program. An ability to address health and environmental issues requires a continuing commitment to maintaining advanced instrumentation and facilities.

**II. Funding Schedule:**

<u>Program Activity</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
Capital Equipment .....	\$ 24,834	\$ 24,439	\$ 23,675	\$- 764	- 3.1%
General Plant Projects .....	4,217	3,613	4,837	+ 1,224	+ 33.9%
Facility Modifications and Improvements .....	0	0	1,500	+ 1,500	0%
Total, Facilities .....	<u>\$ 29,051</u>	<u>\$ 28,052</u>	<u>\$ 30,012</u>	<u>\$+ 1,960</u>	<u>+ 7.0%</u>

**III. Performance Summary:**

**FY 1995 Accomplishments:**

- o Provided Capital Equipment (CE) funding in support of the research program.
- o GPP funding provided for minor new construction, other capital alterations and additions, and for buildings and utility systems, to maintain the productivity and usefulness of Department-owned facilities and to meet its requirements for safe and reliable facilities operation.



### **III. Performance Summary: RELATED CAPITAL FUNDING (Cont'd)**

#### FY 1996 Accomplishments (to date and planned):

- o Provide Capital Equipment (CE) funding in support of the research program.
- o GPP funding for minor new construction, other capital alterations and additions, and for buildings and utility systems. Funding of this type is essential for maintaining the productivity and usefulness of Department-owned facilities and in meeting its requirement for safe and reliable facilities operation. Since it is difficult to detail this type of project in advance, a continuing evaluation of requirements and priorities may result in additions, deletions, and changes in the currently planned projects. The total estimated cost of each project will not exceed \$2,000,000.

#### FY 1997 Planned Accomplishments:

- o Provide Capital Equipment funding in support of the research program.
- o GPP funding for minor new construction, other capital alterations and additions, and for buildings and utility systems. Funding of this type is essential for maintaining the productivity and usefulness of Department-owned facilities and in meeting its requirement for safe and reliable facilities operation. Since it is difficult to detail this type of project in advance, a continuing evaluation of requirements and priorities may result in additions, deletions, and changes in the currently planned projects. The total estimated cost of each project will not exceed \$2,000,000.
- o Facility modifications and improvements are necessary to ensure continued safe operation and reliability of reactors for boron neutron capture therapy. Additions and improvements to the radioisotope production laboratory at the Brookhaven Linac Isotope Producer (BLIP) facility are required to ensure a continuous and reliable supplies of accelerator produced radioisotopes for research. Modifications include additional state-of-the-art hot cells and an improved waste neutralizer/solidifier system.

#### Explanation of Funding Changes FY 1996 to FY 1997:

The increase of \$1,960,000 is related to the initiation of facility modification activities described above and the added responsibility of GPP and GPE funding for Oak Ridge Institute for Science and Education formerly provided by the Multiprogram Energy Laboratories - Facilities Support program.

## BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

### CONSTRUCTION

(Tabular dollars in thousands. Narrative in whole dollars)

I. Mission Supporting Goals and Objectives:

Construction is needed to support the BER Research program. Experiments necessary to support basic research require that state-of-the-art facilities be built or existing facilities modified to meet unique research requirements.

II. Funding Schedule:

<u>Program Activity</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
Construction .....	\$ 67,200	\$ 62,595	\$ 36,113	\$- 26,482	- 42.3%
Total, Facilities .....	<u>\$ 67,200</u>	<u>\$ 62,595</u>	<u>\$ 36,113</u>	<u>\$- 26,482</u>	<u>- 42.3%</u>

III. Performance Summary:

FY 1995 Accomplishments:

- o Completed construction of laboratory/office complexes for visiting scientists at the National Synchrotron Light Source and the Stanford Synchrotron Radiation Laboratory (SSRL) to increase opportunities for scientists from universities, industry, and government to determine the structures of important proteins.
- o Continued construction of user center for structural biology at Advanced Light Source (ALS).
- o Continued construction of the Structural Biology Center at the Argonne National Laboratory (ANL).
- o Continued construction of the Environmental Molecular Sciences Laboratory (EMSL).
- o Completed upgrade of beam current, replaced the target assembly, and improved the hot cell shielding at the Brookhaven Linac Isotope Producer (BLIP).

### **III. Performance Summary: CONSTRUCTION (Cont'd)**

- o Continued construction of the Human Genome Laboratory at the Lawrence Berkeley National Laboratory (LBNL).

#### FY 1996 Accomplishments (to date and planned):

- o Complete construction of the User Center for Structural Biology at the Advanced Light Source (ALS) and the Structural Biology Center at the Argonne National Laboratory.
- o Continue construction of the EMSL.
- o Continue construction of the Human Genome Laboratory at LBNL.

#### FY 1997 Planned Accomplishments:

- o Complete construction of the EMSL.
- o Complete construction of the Human Genome Laboratory at LBNL.

#### Explanation of Funding Changes FY 1996 to FY 1997:

The decrease of \$26,482,000 in Construction is due to the completion of construction activities at the two Structural Biology Centers, and the final year construction costs for the EMSL and the Human Genome Laboratory.

**BIOLOGICAL AND ENVIRONMENTAL RESEARCH  
CAPITAL OPERATING EXPENSES AND CONSTRUCTION SUMMARY  
(Dollars in thousands)**

	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>\$ Change</u>	<u>% Change</u>
<b>Capital Operating Expenses</b>					
General Plant Projects (total).....	\$4,217	\$3,613	\$4,837	\$+1,224	+33.9%
Facility Modifications and Improvements (total).....	0	0	1,500	+1,500	--
Capital Equipment (total).....	24,834	24,439	23,675	-764	-3.1%

**Construction Project Summary (both Operating and Construction Funded)**

<u>Project No.</u>	<u>Project Title</u>	<u>TEC</u>	<u>Previous Appropriated</u>	<u>FY 1995 Appropriated</u>	<u>FY 1996 Appropriated</u>	<u>FY 1997 Request</u>	<u>Unapprop. Balance</u>
94-E-339	Human Genome Laboratory, LBNL	\$24,634	\$2,134	\$15,800	\$5,700	\$1,000	\$0
94-E-338	Structural Biology Center, ANL	14,876	3,881	6,700	4,295	0	0
94-E-337	ALS Structural Biology Support Facilities, LBNL	7,882	582	4,700	2,600	0	0
91-EM-10	Environmental Molecular Sciences Lab., PNL	207,900	82,787	40,000	50,000	35,113	0
<b>Total Biological and Environmental Research</b>		<u>\$XXXXXX</u>	<u>\$89,384</u>	<u>\$67,200</u>	<u>\$62,595</u>	<u>\$36,113</u>	<u>\$0</u>

DEPARTMENT OF ENERGY  
FY 1997 CONGRESSIONAL BUDGET REQUEST  
ENERGY RESEARCH  
PROJECT DATA SHEETS  
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**DEPARTMENT OF ENERGY  
FY 1997 CONGRESSIONAL BUDGET REQUEST**

(Changes from FY 1996 Congressional Budget Request are denoted with a vertical line in left margin.)

**ENERGY SUPPLY, RESEARCH AND DEVELOPMENT  
(Tabular dollars in thousands. Narrative material in whole dollars.)**

**Biological and Environmental Research**

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<b>1. Title and location of project:</b> Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	<b>2a. Project No.</b> 94-E-339 <b>2b. Construction Funded</b>
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**3a. Date A-E Work Initiated, (Title I Design Start Scheduled):** 2nd Qtr. FY 1994

**3b. A-E Work (Title I & II) Duration:** 15 Months

**5. Previous Cost Estimate:**  
 Total Estimated Cost (TEC) -- \$24,634  
 Total Project Cost (TPC) -- \$24,934

**4a. Date Physical Construction Starts:** 4th Qtr. FY 1995

**4b. Date Construction Ends:** 4th Qtr. FY 1997

**6. Current Cost Estimate:**  
 TEC -- \$24,634  
 TPC -- \$24,934

**7. Financial Schedule: (Federal Funds)**

<u>Fiscal Year</u>	<u>Appropriation</u>	<u>Adjustments</u>	<u>Obligations</u>	<u>Costs</u>
1994	\$ 2,200	-66 a/	\$ 2,134	\$ 518
1995	15,800	0	15,800	2,274
1996	5,700	0	5,700	9,850
1997	1,000	0	1,000	9,296
1998	0	0	0	2,696

a/ Reflects reduction of funding for the FY 1994 rescission.

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1. Title and location of project:	Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	2a. Project No. 94-E-339 2b. Construction Funded
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8. Project Description, Justification and Scope

The proposed Human Genome Laboratory will be a three-story building with 41,000 gross square feet and 24,050 net square feet of assignable laboratory and office space. It will be located at the Lawrence Berkeley National Laboratory (LBNL) near the existing Biomedical Laboratory and the Cell Culture Laboratory.

The project was designed and sited in general conformance with the Long Range Development Plan approved by the U.C. Board of Regents in 1987 and with the LBNL Site Development Plan approved by DOE in 1991. The conceptual design documents and cost estimate for the project were prepared from design criteria submitted by the Life Sciences Directorate and Human Genome Center staff.

The structure will be comprised of a braced steel frame with concrete floors and roof supported on metal deck, and exterior glass fiber reinforced concrete panel walls. An HVAC system with 100% outside air supply will be provided. The building will be protected by a fire sprinkler system connected to the LBNL alarm system. Fire alarm stations will be provided on each floor with smoke detectors in all corridors and other areas where required. All utilities are available at the site except for a required substation to step down the available 12 kV from a new LBNL substation. Fifty foot-candle lighting in laboratories will be provided by fluorescent fixtures with high frequency electronic ballasts. Access to the site is available via existing Cyclotron Road. Parking will be provided adjacent to the front entry and in the new 20 car parking area behind the Biomedical Laboratory.

Functionally, the Human Genome Laboratory is designed to provide a state-of-the-art facility for molecular genetics research. Each floor will house open laboratory areas furnished with modular wet benches and desks for maximum flexibility. This design will accommodate future modifications required by scientific investigations or changes in program.

Adjacent to laboratory areas will be a core of support facilities including cold rooms, dark rooms, cell tissue rooms, autoclaves and laboratories for robotics, instrumentation and computation. Laboratory offices and secretarial stations will be comprised of demountable open space workstations. To facilitate the interaction between researchers, a small shared conference room will be provided on each floor and a large conference room seating 25-30 people and combined with library is located on the first level.

The building is designed in compliance with the requirements for H-7 occupancy as defined by the Uniform Building Code. All code stipulated provisions for handling and storage of hazardous materials are incorporated.

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1.	Title and Location of Project: Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	2a. Project No. 94-E-339 2b. Construction Funded
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8. Project Description, Justification and Scope (Continued)

These new government-owned facilities will be located on land owned by the University of California and will serve or be operated in conjunction with other government-owned facilities at the Lawrence Berkeley National Laboratory.

The Human Genome Laboratory at LBNL will support the Department of Energy's program to develop and apply the powerful tools of molecular genetics towards understanding the health and environmental impacts of current and proposed energy technologies. Research conducted at the Laboratory will provide a fundamental understanding of the structure and function of the human genome--the genetic basis of susceptibility to disease causing agents--for use in defining risk and providing health protection. To achieve these objectives will require the Human Genome Laboratory to be directed towards the goals of identifying the variability in genetic information encoded in deoxyribonucleic acid (DNA) and mapping its arrangement on the 23 pairs of human chromosomes. The long-term goal of the national program is to support the determination of the sequence--and variation--of the approximately three billion DNA bases that comprise the total chromosome material of human cells.

The Human Genome Laboratory requires an essential core of laboratories for multidisciplinary teams of technical staff that utilize a common pool of instrumentation and cell culture facilities. This building will be adjacent to existing cell biology research facilities (the Biomedical Laboratory Building and the Cell Culture Laboratory) that are used for related research on gene expression and physiology. This and other light laboratory space at Lawrence Berkeley National Laboratory is now fully utilized. The Human Genome Laboratory is planned for a staff of 92, including senior scientists, postdoctoral associates, graduate students, technicians and support personnel.

Research at the Human Genome Laboratory will directly support the needs of the DOE Biological and Environmental Research program for gene mapping and DNA base sequencing and its related efforts to improve analytical methods, instrumentation and information management. Program activities conducted in the laboratory building will facilitate and improve mapping of selected human chromosome fragments; establish selected libraries of DNA nucleotide bases (complementing other libraries of cloned genes); conduct pilot nucleotide base sequencing of sections of continuous megabase-length DNA; develop data banks and analysis software; improve and develop new automation of mapping and sequencing techniques; and develop innovative methods for detecting gene fragments, sequences and variation. An important corollary activity is to provide requested services to universities and industry, including cloned DNA material, cell lines, and data. The program will contribute information to national gene banks and computational centers and utilize chromosomal material from sorting centers at other national laboratories.



1.	Title and Location of Project: Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	2a. Project No. 94-E-339 2b. Construction Funded
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8. Project Description, Justification and Scope (Continued)

The Human Genome Laboratory will provide light laboratories, equipment rooms, and office space required for the conduct of the integrated mapping, sequencing and analytical support programs. These needs include, for example, biochemistry bench space, controlled environmental chambers, tissue culture facilities and fermenters, and necessary instrumentation areas and utilities for DNA sequencers, gel scanners for separations, oligonucleotide synthesizers to prime fragment analysis, radiotracer counters, and basic preparative and analytical equipment. Special requirements include the control of biological materials and chemicals through laminar flow hoods and non-vented cabinets. Common ducting will be used for all chemical fume hoods and laminar flow cabinets.

The \$1,000,000 budgeted for the Human Genome Laboratory in FY 1997 is for the purchase of equipment needed to begin operation of the laboratory, including chemical hoods, sterilizers, DNA sequencers, and robots.

9.	<u>Details of Cost Estimate a/</u>	<u>Item Cost</u>	<u>Total Cost</u>
a.	Design and management costs		\$ 2,330
	1. Engineering design and inspection at 16 percent of construction costs	\$ 2,330	
b.	Land and land rights		0
c.	Construction Costs		14,474
	1. Improvements to Land	\$ 1,680	
	2. Buildings (37,000 GSF at approximately \$298/sq. ft.)	11,054	
	3. Special Facilities	1,520	
	4. Utilities	220	
	5. Project Management		1,020
d.	Standard Equipment		3,080
e.	Relocations		300
	Subtotal		\$21,204
f.	Contingencies at approximately 16 percent of above costs		3,430
	Total line item cost		<u>\$24,634</u>

a/ Construction costs have been escalated at 2.1% for FY 1992; 3.4% for FY 1993; 4.3% for FY 1994; 4.5% for FY 1995 and 4.7% for FY 1996, compounded to midpoint of construction, August 1996.

1.	Title and Location of Project: Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	2a. Project No. 94-E-339 2b. Construction Funded
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10. Method of Performance

Design will be accomplished by means of a negotiated architect-engineer subcontract. Construction and procurement will be accomplished by fixed price subcontract awarded on the basis of competitive bidding.

11. Schedule of Project Funding and Other Related Funding Requirements

	Previous Years	<u>FY 1994</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>Total</u>
a. Total project costs							
1. Total facility costs							
(a) Line item	\$ 0	\$ 518	\$ 2,274	\$ 9,850	\$ 9,296	\$ 2,696	\$ 24,634
2. Other project costs							
(a) Conceptual design costs	\$ 70	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0	\$ 70
(b) Environmental and safety documentation costs	<u>100</u>	<u>130</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>230</u>
Total project costs (TPC)	<u>\$ 170</u>	<u>\$ 648</u>	<u>\$ 2,274</u>	<u>\$ 9,850</u>	<u>\$ 9,296</u>	<u>\$ 2,696</u>	<u>\$ 24,934</u>
b. Related annual funding requirements in FY 1998 dollars							
1. Facility operating costs							\$ 470
2. Programmatic operating expenses for research							12,200
3. Capital equipment required for programmatic research							<u>530</u>
Total related annual costs in FY 1998 dollars							<u>\$13,200</u>

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1. Title and Location of Project:	Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	2a. Project No. 94-E-339
		2b. Construction Funded

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**12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements**

**a. Total project funding**

**1. Total facility costs**

The major elements of the Human Genome Laboratory have been described in Item 8.

The construction funding profile has been determined after analysis and review of a comprehensive project schedule, taking into account the earliest anticipated receipt of fiscal year funding, A/E selection time frame, general weather conditions for both site work and structure generally encountered in the San Francisco Bay area.

**2. Other project costs**

(a) Conceptual design costs--Includes costs for preparation of conceptual design report (CDR) by LBNL personnel.

(b) Environmental (NEPA) and Safety (SAR) documentation costs--Includes costs for environmental evaluation and, if required, preparation of an Environmental Assessment (EA). Safety documentation includes preparation of preliminary safety analysis documents (PSAD).

**b. Related annual costs**

**1. Facility operating costs**

Includes estimated cost for maintenance, custodial service, and utilities such as light, heat and water.

**2. Programmatic operating expenses for research**

The annual costs of the scientific program are increased progressively to assemble a high-quality research staff for the Human Genome Laboratory consistent with the national program. Funding in the early years of the project will attract senior scientists to lead the new scientific programs described in Item 9. These researchers can be housed initially in leased facilities if necessary until the Human Genome Laboratory is completed. The programs will expand to include the full complement of scientists and technicians upon project completion.

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1. Title and Location of Project:	Human Genome Laboratory Lawrence Berkeley National Laboratory (LBNL) Berkeley, California	2a. Project No. 94-E-339 2b. Construction Funded
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12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements (Continued)

3. Capital equipment required for programmatic research

The capital equipment needs related to this research staffing profile reflect program requirements and experience that equipment items will be needed at the level of approximately 20% of the operating program budget. These amounts are augmented in the initial years for specialized capital equipment start up costs.

DEPARTMENT OF ENERGY  
FY 1997 CONGRESSIONAL BUDGET REQUEST

ENERGY SUPPLY, RESEARCH AND DEVELOPMENT  
(Tabular dollars in thousands. Narrative material in whole dollars.)

Biological and Environmental Research

1. Title and Location of Project:	Environmental and Molecular Sciences Laboratory Pacific Northwest National Laboratory Richland, Washington	2a. Project No. 91-EM-100 2b. Construction Funded
3a. Date A-E Work Initiated, (Title I Design Start Scheduled): 2nd Qtr. FY 1991		5. Previous Cost Estimate: Total Estimated Cost (TEC) -- \$196,300 Total Project Cost (TPC) -- \$217,800
3b. A-E Work (Titles I & II) Duration: 13 months		
4a. Date Physical Construction Starts: 2nd Qtr. FY 1994		6. Current Cost Estimate: TEC -- \$207,900 TPC -- \$229,900
4b. Date Construction Ends: 4th Qtr. FY 1997		

7. Financial Schedule

<u>Fiscal Year</u>	<u>Appropriation</u> a/	<u>Adjustments</u>	<u>Obligations</u> a/	<u>Costs</u>
Previous Years	\$ 83,800	b/ \$-1,013	c/ \$ 82,787	b/ \$70,400
1995	40,000	0	40,000	43,400
1996	50,000	0	50,000	53,600
1997	35,113	0	35,113	36,700
1998	0	0	0	3,800

a/ Funds provided by the Defense Environmental Restoration and Waste Management program for FY 1991 through FY 1993.

b/ Excludes \$20,000,000 provided by the Department of Defense per the Defense Appropriation Act of FY 1991.

c/ Adjustments reflect a \$30,000 general reduction for FY 1991 and a rescission of \$983,000 for FY 1994..

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1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

2a. Project No. 91-EM-100  
2b. Construction Funded

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8. Project Description, Justification and Scope

The Environmental Molecular Sciences Laboratory (EMSL) project will be a laboratory facility with an initial complement of laboratory equipment. EMSL will be an extension of the current environmental mission at the Hanford site, providing a focused laboratory capability to develop technology solutions to Hanford site-specific environmental restoration and waste management problems as well as the related needs at other departmental facilities. The new facility will be located at the north end of a technology corridor at the Hanford site, facilitating access to existing radiological facilities (hot cells and laboratories) and enabling interactions with both other scientists at the Pacific Northwest National Laboratory and scientists and engineers working at the nuclear processing and storage facilities. This strategic location will facilitate linking Hanford problems to technology needs and facility requirements as well as provide dedicated laboratory capability at the Hanford Site for the full duration of site environmental restoration efforts.

The facility size is approximately 200,000 square feet, housing 209 permanent scientific and support staff, and 60 visiting scientists. Key facility elements include laboratories, offices, conference rooms, computer and graphics rooms, library, kitchen, support shops, and a seminar area. Facility design will support state-of-the-art laboratory equipment, provide flexibility to accommodate future equipment, and support educational and technology transfer initiatives.

Laboratory equipment consists of the research equipment and computer systems required to achieve planned research and technology development object objectives. Key laboratory equipment includes molecular-level surface chemistry equipment, laser-based spectroscopy equipment, advanced processing equipment, sensor development and evaluation equipment, material testing and evaluation equipment, Ultra High Field Nuclear Magnetic Resonance System, advanced mass spectrometers, data base computer, high performance computer and an advanced computer information system.

FY 1997 funds requested will be used for project management and support, continued construction of the laboratory facility, and continued acquisition of research and computer equipment.

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1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

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2a. Project No. 91-EM-100  
2b. Construction Funded

8. Project Description, Justification and Scope (Continued)

The purpose of the Environmental Molecular Science Laboratory (EMSL) is to provide the fundamental science that will lead to new technology for current and future Hanford site-specific environmental restoration and waste management problems, as well as for those at other sites contaminated during nuclear weapons production. Mission need for EMSL is based on Hanford site-specific technology development needs defined in detailed technology logic diagrams. These logic diagrams link Hanford site-specific problems to technology needs and facility requirements; define the role of existing, modified, and new facilities at the Hanford site, including EMSL; and provide a basis for defining and integrating EM technology development needs on a national scale.

The EMSL will focus on a wide variety of experimental and theoretical capabilities in an interdisciplinary culture that will: 1) develop the scientific basis to predict contaminant transport and transformation; 2) advance materials technologies for measurement, containment, and separation of wastes; 3) increase use of biosystems for remediation and knowledge of health effects due to toxic substances; 4) facilitate training, education, and technology transfer initiatives; and 5) achieve transfer of technology through industry involvement.

The \$35,113,000 budgeted to complete the project in FY 1997 will be used for the purchase of final research and computer equipment, installation and testing of research and computer equipment, completion of the facility, and research and computer equipment, readiness assessment, and continuing and completion of startup operations including initial staffing, personnel training, personnel moves and occupancy of the facility, stocking of initial consumables for full operation, and other related startup operations activities.

1. Title and Location of Project:	Environmental Molecular Sciences Laboratory Pacific Northwest National Laboratory Richland, Washington	2a. Project No. 91-EM-100 2b. Construction Funded
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9. <u>Details of Cost Estimate a/</u>	<u>Item Costs</u>	<u>Total Cost</u>
a. Design and cost management .....		\$ 52,670
1. Facility engineering, design, and inspection at approximately 15.5 percent of construction costs items c and d .....	\$ 8,320	
2. Research & computer equipment engineering, design and inspection .....	39,050	
3. Construction management at approximately 9.9 percent of items c & d ..	5,300	
b. Land and land rights .....		0
c. Construction costs .....		51,390
1. Improvements to land .....	2,880	
2. Buildings (\$208.63/sq ft based on 202,365 gross sq ft) .....	42,220	
3. Utilities (including water electrical power and sewers) .....	1,250	
4. Special facilities .....	5,040	
d. Standard equipment (furnishing and standard lab and shop equipment) .....		2,330
e. Computer equipment (see below for details) .....		20,360
f. Research equipment .....		47,390
g. Project management .....		<u>19,420</u>
Subtotal b/ .....		193,560
h. Contingency at approximately 7.4 percent of all above costs .....		<u>14,340</u>
Total line item cost .....		<u>\$207,900</u>

a/ This estimate is based on the most recent cost estimate dated February 1994.

b/ Includes escalation applied to facility construction at the rates of 3.7% (FY 1994), 3.8% (FY 1995), 3.8% (FY 1996), and 4.3% (FY 1997) to midpoint of construction and procurement.



1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

2a. Project No. 91-EM-100  
2b. Construction Funded

9. Details of Cost Estimate (Continued)

<u>Item e. Computer Equipment Details</u>	<u>Qty</u>	<u>Unit Cost</u>	<u>Total</u>
High Performance Final Production Model Computer System	1	\$ 12,100	\$ 12,100
High Performance Research Prototype Computer System	1	1,840	1,840
Data Base/Archive Final Production Model Computer System	1	3,440	3,440
Items with Unit Cost Less than \$1,000K (e.g., workstations, applications software, printers, workstation upgrades)	-	-	2,490
Operating Software	-	-	460
Installation Cost for Above Hardware	-	-	<u>30</u>
Total			\$ 20,360

1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

2a. Project No. 91-EM-100  
2b. Construction Funded

10. Method of Performance

Conventional facility design and inspection will be completed under a negotiated architect-engineer (AE) contract. Facility construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bidding. Research equipment and computers will be procured on a competitive bid basis by PNNL. However, approximately 10 percent of the research and computer equipment does not exist in the current commercial market and will be provided by PNNL.

11. Schedule of Project Funding and Other Related Funding Requirements

	<u>Prior Years</u>	<u>FY 1994</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>TOTAL</u>
a. Total project costs						
1. Total facility costs						
(a) Construction line item.	\$17,600	\$26,282	\$48,341	\$68,200	\$47,477	\$207,900
(b) PE&D . . . . .	0	0	0	0	0	0
(c) Inventories . . . . .	0	0	0	0	0	0
(d) Non-Federal Contribution . . . . .	0	0	0	0	0	0
Total Funding Cost . . . . .	17,600	26,282	48,341	68,200	47,477	207,900
2. Other project costs						
(a) R&D required for construction . . . . .	4,660	1,090	1,200	2,160	300	9,410
(b) Conceptual design costs	1,540	0	0	0	0	1,540
(c) Other project related costs . . . . .	200	410	500	840	4,300	6,250
(d) Capital equipment . . . . .	2,320	2,280	200	0	0	4,800
Total other project cost . . . . .	8,720	3,780	1,900	3,000	4,600	22,000
Total project costs (TPC)	<u>\$26,320</u>	<u>\$30,062</u>	<u>\$50,241</u>	<u>\$71,200</u>	<u>\$52,077</u>	<u>\$229,900</u>

1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

2a. Project No. 91-EM-100  
2b. Construction Funded

11. Schedule of Project Funding and Other Related Funding Requirements (Continued)

b. Related annual funding (Estimated Life of Facility: 40 years) a/	
1. Facility operating costs . . . . .	\$ 28,000
2. Programmatic costs directly related to the facility . . . . .	35,000
3. Capital equipment required to maintain state-of-the-art capability . . . . .	2,000
4. GPP or other construction related to programmatic effort in the facility . . . . .	500
Total related annual costs . . . . .	\$ 65,500

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

- a. Total project funding
  - 1. Total facility costs
    - (a) Construction line item -- Includes estimated cost for conventional facility design and construction, initial complement of research equipment and computers, and project management -- \$207,900,000
    - (b) Operating Expense Funded Equipment -- None
    - (c) Inventories -- Inventories necessary to put the facility into use are included in operating costs.
    - (d) Non-Federal Contribution -- None.
  - 2. Other project costs
    - (a) R&D necessary to complete construction -- Includes the conceptual design and prototype development of specific items of the research and computer equipment required to permit specification of the final equipment to be procured and installed in the EMSL -- \$9,410,000
    - (b) Conceptual design was completed during FY 1988 and revised in FY 1989 to incorporate DOE comments. An alternate design was developed during FY 1990 for a total of -- \$1,540,000
    - (c) Other project related costs -- Includes the estimated operating contractor costs associated with the construction line item for the following: (a) operational readiness review, (b) relocation of R&D equipment, and (c) software required for fully functional facility computer system -- \$6,250,000
    - (d) Programmatic capital equipment includes research and computer equipment necessary for R&D required for construction -- \$4,800,000

a/ Estimated costs in thousands escalated to FY 1997 dollars.

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1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

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2a. Project No. 91-EM-100  
2b. Construction Funded

12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements (Continued)

b. Other related annual costs

Annual related funding requirements will vary as research and operations are implemented, the new facility is occupied at the end of FY 1996, and steady-state operation is attained in FY 1998. The estimated total related funding requirements are identified in Section 12.B and discussed below:

1. Facility operating costs -- The estimated annual facility operating costs include all personnel, materials, and resources required to support operation of a high technology DOE user facility. The annual facility operating estimate is comprised of the following expense elements:

Utilities and building maintenance a/

ADP operations and upkeep:

Maintenance contracts (approximately 10 percent of capital costs)	\$ 4,000
Staff operations/support . . . . .	9,000
Materials and supplies . . . . .	<u>1,000</u>
Subtotal ADP operations and upkeep . . . . .	14,000

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a/ Utilities and building maintenance estimated cost is \$3,000,000. This is an indirect cost recovered via a Buildings & Utility (B&U) overhead applied to all PNNL staff working in EMSL and is included in programmatic and facility operating costs.

1. Title and Location of Project: Environmental Molecular Sciences Laboratory  
Pacific Northwest National Laboratory  
Richland, Washington

2a. Project No. 91-EM-100  
2b. Construction Funded

12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements (Continued)

Research equipment operations and upkeep:

Maintenance contracts (approximately 10 percent of capital costs)	7,000
Staff operations/support	4,000
Materials and supplies	<u>3,000</u>
Subtotal research equipment operations and upkeep	14,000
Total Facility Operating Costs	\$28,000

2. Programmatic research costs directly related to the facility -- The estimated programmatic operating costs include all personnel, materials, capital equipment and resources required to perform environmental and molecular sciences research for the following customers; DOE Office of Energy Research, DOE Office of Environmental Management, other DOE offices and other federal agencies, and private industry -- total \$35,000,000.
3. Capital equipment required to maintain state-of-the-art capability facility -- To maintain viable research programs, it will be necessary to update research equipment and computers to keep pace with the rapid change of technology in these areas. This estimate includes costs to maintain programmatic related research equipment and computers at state-of-the-art level - \$2,000,000.
4. GPP or other construction related to programmatic effort -- It is expected that alterations will be required beginning in FY 1997. This estimate is approximately 1% of the initial facility cost and will be required to make facility modifications to accommodate specific user experiments, relocate and/or modify existing research equipment and install new latest generation research equipment -- \$500,000.