

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
OFFICE OF ENERGY RESEARCH
SCIENCE
(Tabular dollars in thousands, Narrative in whole dollars)

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

PROGRAM MISSION

The Biological and Environmental Research (BER) program mission - Investing to advance environmental and biomedical knowledge connected to energy. The BER program provides fundamental science to underpin the 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, prediction, 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 2005 providing resources to the international research community needed to identify disease genes and develop broad diagnostic and therapeutic strategies, including the development of individual risk assessments; 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 in support of this nation's biomedical sciences, pharmaceutical interests, and environmental activities.
2. To CONTRIBUTE TO CLEANUP OF THE ENVIRONMENT - Conduct fundamental research necessary for the development of advanced remediation tools for containing wastes and cleaning up DOE's contaminated sites, particularly in support of the mission of DOE's Environmental Management (EM) office.

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

3. To UNDERSTAND GLOBAL ENVIRONMENTAL CHANGE - Acquire the data and develop the understanding necessary to predict how energy production and use can affect the global and regional environment.

SCIENTIFIC FACILITIES UTILIZATION:

The Biological and Environmental Research request includes \$42,547,000 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 were included in the initiative for the first time in FY 1997. In FY 1999, the request includes operation of the William R. Wiley Environmental Molecular Sciences Laboratory where the research activities will underpin environmental remediation. This funding will provide for the operation of the facilities, assuring access for scientists in universities, federal laboratories, 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:

The quality and appropriateness of the Biological and Environmental Research (BER) program and individual research projects are judged by rigorous peer reviews conducted by internationally recognized scientific experts using criteria such as scientific merit, appropriateness of the proposed approach and qualifications of the principal investigator. Highest quality research is maintained by taking appropriate and, if needed, corrective management actions based on results of the reviews. A measure of the quality of the research is the sustained achievement in advancing knowledge as indicated by the publication of research results in refereed scientific journals, by invited participation at national and international conferences and workshops, and by awards received by DOE-supported BER researchers. Progress in the field is also routinely compared to the scientific priorities recommended by the Biological and Environmental Research Advisory Committee and the National Science and Technology Council's (NSTC) committees on Environment and Natural Resources and on Fundamental Science.

An overarching and unique performance measure of the BER program is the diversity of program reviews conducted. This is particularly the case for BER program elements that are components of international research endeavors, e.g., the Human Genome Program and the Global Change Research Program. In addition to panel reviews that evaluate and select individual projects and programmatic reviews by the chartered Biological and Environmental Research Advisory Committee, these program elements are evaluated by interagency (and international) review bodies and by Boards and Committees of the National Academy of Sciences.

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

The BER program goes one step further in soliciting program reviews. Blue ribbon panels are charged with evaluating the quality of individual programs and with exploring ways of entraining new ideas and research performers from different scientific fields. This strategy is based on the conviction that the most important scientific advances of the new century will occur at the interfaces between scientific disciplines such as biology and information science. Groups like JASON and The Washington Advisory Group (TWAG), involving physicists, mathematicians, engineers, etc., are among the panels that have studied BER program elements such as the Atmospheric Radiation Measurement (ARM) program, climate change prediction, the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), and the Human Genome Program.

Facility operations are also monitored by peer reviews and user feedback. These facilities are provided in a manner that meets user requirements (as indicated by achieving performance specifications while protecting the safety of the workers and the environment); facilities are operated reliably and according to planned schedules; and facilities are maintained and improved at reasonable costs.

Specific BER program performance measures are:

1. Excellence in basic research: At least 80 percent of the research projects will be reviewed by appropriate peers and selected through a merit-based competitive process.
2. Access to Human Genome research results: BER will complete sequencing of 40 million subunits of human DNA to submit to publicly accessible databases.
3. Microbial Genomics: BER will complete 70 percent of the genetic sequencing of over 10 additional microbes with significant potential for waste cleanup and energy production.
4. Progress in Boron Neutron Capture Therapy (BNCT) Research: Phase I/II clinical trials of BNCT at reactor sources of neutrons will be completed for at least 50 patients, and a feasibility study of accelerator-based BNCT will be underway.
5. Environmental remediation developments: Fundamental research in environmental sciences, biology, molecular sciences, and mathematical modeling will underpin the development of advanced remediation tools (e.g., bioremediation) to contain hazardous waste and clean up DOE contaminated sites.

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

6. Atmospheric Radiation Measurement (ARM) accomplishments: BER will conduct five intensive operations periods at the ARM Southern Great Plains site; will initiate preparation for a third atmospheric radiation and cloud station in the Tropical Western Pacific; will redeploy an atmospheric radiation and cloud station from the Arctic Ocean to Atkasuk, Alaska.
7. William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) collaboration products: will increase the number of EMSL products from collaborations (e.g., publications, patents, databases, software releases, technical reports, instruments developed, etc.).
8. The ER/EM Pilot Collaborative Research Program will complete its three-year initial phase in FY 1999 and applied developmental research will begin on the most promising technologies arising from these projects.
9. The development and upgrade of scientific facilities (including experimental stations) will be kept on schedule and within cost, not to exceed 110 percent of estimates.
10. The operating time lost at scientific facilities due to unscheduled downtime will be less than 10 percent of the total scheduled possible operating time, on average.
11. An independent assessment will judge BER research programs to have high scientific quality.
12. Education accomplishments: Continuing to make 2 to 10 appointments each in the BER Alexander Hollaender Distinguished Post Doctoral Fellowship; the multi-agency Significant Opportunities in Atmospheric Research and Science (SOARS) program for outstanding Hispanic, Native American, and African American students in the atmospheric and related sciences; and the minority colleges and university faculty and student research program. Also, initiating a Significant Opportunities program in the broader sciences of global change for outstanding undergraduate and graduate students.
13. Discovering new biological structures with more than 60 percent of them published in the peer reviewed literature resulting from data generated at synchrotron user stations served by the BER structural biology support facilities program.

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

SIGNIFICANT ACCOMPLISHMENTS AND PROGRAM SHIFTS:

- o Advanced technologies continue to be developed from resources and tools produced in the human genome program to determine and mitigate the potential health effects that arise during energy activities and clean-up operations. Emphasis is placed on molecular-based tools for health surveillance, biological dosimetry, and individual susceptibility determination to understand and characterize the risks to human health from exposures to low levels of radiation and chemicals.
- o The DOE Joint Genome Institute has successfully integrated high throughput genomic sequencing with analyses that “annotate” the sequence, i.e., reveal the biological content of the sequence data produced, demonstrating the power of an “industrial” approach to genomic sequencing and data analysis.
- o The most recent success of the DOE Microbial Genome Initiative (MGI) was the discovery of a third branch of life, the Archaea (meaning ancient in Greek). This accomplishment was noted by Discover magazine as one of the key scientific advances of the year.
- o New approaches have been developed to determine the function of and the relationships among large numbers of genes, the proteins they encode, and the biological functions of these proteins.
- o New strategies for cleanup, including the use of biotechnology (e.g., microbes that break down contaminants), are being developed for stubborn remediation problems.
- 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 The application of modern molecular tools to marine microbes will start to provide new information on marine microbial roles in carbon and nitrogen cycling and related processes that may affect global environmental change. In the innovative new program, Biotechnological Investigations- Ocean Margins Program, that builds on the recently completed Ocean Margins Program, active collaborations are being built between institutions with strong traditions of research in the marine sciences and those with developing research capabilities.

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

- o New nuclear medicine technologies and new radiopharmaceuticals incorporating radioisotopes commonly used for nuclear medicine into novel chemical structures 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 is being placed on improved methodologies for combined imaging of anatomical structures and physiological functions.
- o The molecular nuclear medicine program will be redirected to take advantage of developments in genomics and structural biology to initiate a major effort to understand the link between genetic makeup and disease through application of innovative radioisotope tracer concepts.
- o The Measurement Science Program will provide new instrumentation for addressing the growing need to characterize DOE's contaminated sites and to monitor the progress of cleanup of these sites.
- o The Genome Instrumentation Research Program will be redirected to address needs of the Department for completely new types of technology for meeting DOE mission objectives that will utilize genomics.
- o Research under the Climate Change Technology Initiative will be conducted to take advantage of developments in microbial genetics and biochemistry to begin development of the understanding needed to enhance the sequestration and recycling of carbon through the use of natural biological processes thus reducing levels of atmospheric carbon dioxide.

Climate Change Technology Initiative

The FY 1999 budget contains two carbon related programs, each of which cut across several agencies. The first is the Climate Change Technology Initiative (CCTI). That part of the CCTI that is within the Office of Energy Research is a joint activity between the Biological and Environmental Research (BER) and Basic Energy Science (BES) programs. The second program is the U.S. Global Change Research Program (US/GCRP) that spans eleven agencies and is coordinated through the National Science and Technology Council's Committee on Environment and Natural Resources. Within DOE, the BER program plays the lead role in US/GCRP activities. Although the two programs, CCTI and US/GCRP, are synergistic, they are different. US/GCRP research focuses on developing the fundamental understanding of the comprehensive climate system and the global and regional adaptations to it. CCTI focuses on the underpinning science that will enable mitigation of climate change while maintaining a robust National economy.

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

Overview

Eighty-five percent of our Nation's energy results from the burning of fossil fuels, a process that adds carbon to the atmosphere -- principally in the form of carbon dioxide -- from the sequestered fossil reservoir. Because of the potential environmental impacts of increases in atmospheric carbon dioxide, carbon management has become an international concern and has become the focus the Climate Change Technology Initiative. A comprehensive carbon management research and development program that meets the needs of the Climate Change Technology Initiative addresses the diverse aspects of this problem. The Office of Energy Research is well positioned to make significant contributions to the many solutions needed for this problem, as it is set to build on the fundamental discoveries of its core programs and extend them to the new discoveries needed to make carbon management practical and efficient. Energy Research core programs include research on both carbon and non-carbon energy sources and on both carbon sequestration and carbon recycling. These core activities can now be exploited in the generation of the science that will underpin the technologies of the future. The theme of efficiency in energy production and use must span the entire range of research activities. Research on carbon energy sources, and their impacts, is a focal point of interagency activity through the U.S. Global Change Research Program (USGCRP). Research on non-carbon energy sources is also a focal point of intra-agency activities and is led by the DOE Office of Energy Efficiency and Renewable Energy. The DOE Office of Energy Research, through activities in both the Basic Energy Sciences (BES) program and the Biological and Environmental Research (BER) program, supports research that underpins both efforts.

A research program in carbon management would include research directed at the following themes:

- (1) science for efficient technologies,**
- (2) fundamental science underpinning advances in all low/no carbon energy sources, and**
- (3) sequestration science.**

Energy Research has long standing programs in fundamental research that already impact these three categories. Additional resources of \$11,000,000 provided specifically for the Climate Change Technology Initiative will be a natural extension of the complementary, ongoing work in several programs in Energy Research, and it will build on the foundation of excellent and relevant research already underway. Focus areas will be those that build on strengths of the current Energy Research programs and that promise maximum impact in the area of carbon

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

management. Within the BER program, the Life Sciences subprogram activities in genomics underpin genome studies on microorganisms that may form the core of new fuel sources. Core activities within the Environmental Processes subprogram, particularly in terrestrial carbon cycle and in ocean sciences research, open up the possibility of exploiting Nature's own carbon sequestration processes in enhanced sequestration.

Immediate Impacts of Expanded Effort in the Science for Climate Change Technology

Additional Energy Research efforts will not only address an immediate societal problem, but it will also have a major effect on many scientific disciplines by advancing the state of knowledge and by training students in areas of research that are important to carbon management. For example, biochemistry, molecular and cellular biology, structural biology, and genome science will be impacted, because the production of fuels and chemicals by plants and microorganisms and the interconversion of greenhouse gases requires a better understanding of metabolism, of the structure and function of sub-cellular components, and of enzymes. Similarly, the state-of-the-art in biochemistry, molecular biology, and ecology will be impacted. All of these biological processes are important in understanding the role of marine microorganisms in sequestering carbon. Improvements in combustion to reduce carbon emissions require a fundamental understanding in chemical dynamics and theoretical chemistry and physics. Conversion of sunlight to energy requires an understanding in many areas of science, including photochemistry, photosynthesis, metabolism, and solid state physics. The search for increased efficiency in energy production and use requires fundamental knowledge in ceramics, metals, polymers, solid state chemistry, and condensed matter physics for materials that can withstand higher temperatures, have lower coefficients of friction, and are stronger and lighter. Enhanced recovery of fuel resources and of disposal of carbon dioxide requires a fundamental understanding of geometric, structural, and hydrologic properties of reservoirs and of multiphase, nonlinear transport of fluids in porous and fractured structures. Cross-cutting programs in nano- and meso-phase materials involve research at the forefront of materials science, chemistry, engineering, surface science, and semiconductor physics.

The new research efforts supporting advances in low/no carbon energy technologies as well as existing activities, will be closely coordinated with DOE's technology programs and will provide the knowledge base for the development of advanced technologies to reduce carbon dioxide emissions. Many of the activities will impact the Office of Energy Efficiency and Renewable Energy (EE) by providing options for increasing efficiency in automobiles by reducing weight; for increasing efficiency in the use of electricity by increasing the efficiency of electric motors and generators with better magnets; for increasing efficiency in the transmission of electricity by using superconductors; and for reducing energy consumption in manufacturing with improved sensors, controls, and processes. Much of this research program

will provide the knowledge base needed to increase the use of renewable resources with research aimed at understanding the metabolism of carbon dioxide and the metabolic pathways to the production of methane and other biofuels. Other aspects of the research program impact the Office

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

of Fossil Energy (FE) by providing a foundation for effective and safe underground sequestration, new materials, a better understanding of combustion, and improved catalysts.

Funding will be provided for areas of research in carbon cycle management including appropriate areas that will be jointly identified and implemented by the Biological and Environmental Research and Basic Energy Sciences programs. Solicitations will be issued for individual research projects. Additionally, proposal notifications may be developed jointly with the DOE energy technology programs with the intention of establishing multi-disciplinary centers at universities and national laboratories that will use the full capabilities of the institutions for a research program in carbon cycle management encompassing, for example, topics in the following areas: integration and assessment; separations; efficiency; clean fuels; bioenergy; storage and conversion; sequestration; enhanced natural terrestrial cycles; and enhanced use of major scientific user facilities to support carbon management research.

Interagency Environment

The ER program in fundamental science supporting energy technologies will be closely coordinated with, and synergistic to, the activities in its sister agencies (e.g., NASA, NSF, NOAA, USDA, DOI, and EPA) within the USGCRP. Through its leadership role in decade to century climate prediction, BER has developed the research capability for comprehensive and large scale modeling of carbon dioxide impacts on climate, on ecology, and on ocean sciences, and this expertise is augmented by complementary activities in the other agencies. Similarly, the network of carbon flux measurements and ecological experiments that BER has developed serve as a backdrop to those of many other agencies, and the state-of-the-art can thus be pushed ahead more rapidly by capitalizing on the more rapidly growing base of knowledge.

BER also has a leadership role within the USGCRP on consequence evaluation of increased greenhouse gases in global climate change, including integrated assessments that address both scientific and societal (including economic) impacts of carbon management. Finally, through its pre-eminent role in the Human Genome Program and its development of the complementary Microbial Genome Program, the BER program is ideally placed to support research that will focus on the application of genetic information of microorganisms to increase metabolic efficiency related to both carbon dioxide and methane production or consumption, and will thus underpin the related activities to be undertaken by both Energy Research and the National Science Foundation LexEN (Life in Extreme Environments) program.

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

BER Activities

Climate Change Technology Initiative
FY 1999 Budget Request
B/A
(\$000)

Life Sciences	\$ 5,000
Environmental Processes	<u>6,000</u>
Total	\$11,000

The Biological and Environmental Research (BER) program has the opportunity to take advantage of the unique research capabilities within the Environmental Processes subprogram and to determine which natural systems of forest, other plant, and marine microorganisms can be induced to increase their natural carbon sequestration capabilities. This will help to position the Department and the Nation to build new energy efficient technologies that capitalize on Nature's own processes. Additionally, through its pre-eminent role in the Human Genome Program and its development of the complementary Microbial Genome Program within the Life Science subprogram, the BER program is ideally placed to support research that will focus on the production of genetic information on methane-producing and hydrogen-producing microorganisms that can be exploited in the development of useful and efficient non-fossil fuel sources. Where appropriate, these efforts will be coordinated with activities within the U.S. Global Change Research Program. When combined with complementary activities within the Basic Energy Sciences program, this initiative will lead to the comprehensive carbon management research program described, above.

Funding of Contractor Security Clearances

In FY 1999, the Department will divide the responsibility for obtaining and maintaining security clearances. The Office of Security Affairs, which has been responsible for funding all Federal and contractor employee clearances, will pay only for clearances of Federal employees, both at headquarters and the field. Program organizations will be responsible for contractor clearances, using program funds. This change in policy will enable program managers to make the decisions as to how many and what level clearances are necessary for effective program execution. In this way, it is hoped that any backlog of essential clearances which are impeding program success can be cleared up by those managers most directly involved. The Office of Energy Research is budgeting \$101,000 for estimated contractor clearances in FY 1999 within this decision unit.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

PROGRAM FUNDING PROFILE

(Dollars in thousands)

<u>Subprogram</u>	<u>FY 1997 Current Appropriation</u>	<u>FY 1998 Original Appropriation</u>	<u>FY 1998 Adjustments</u>	<u>FY 1998 Current Appropriation</u>
Life Sciences.....	\$143,546	\$165,537	-\$343 a/	\$165,194
Environmental Processes.....	109,055	108,626	-226 a/	108,400
Environmental Remediation.....	34,850	66,435	-138 a/	66,297
Medical Applications and Measurement Science.....	56,609	66,112	-136 a/	65,976
Subtotal.....	<u>344,060</u>	<u>406,710</u>	<u>-843 a/</u>	<u>405,867</u>
Construction.....	36,113	0	0	0
Subtotal, Biological and Environmental Research.....	<u>380,173</u>	<u>406,710</u>	<u>-843 a/</u>	<u>405,867</u>
Adjustment.....	-6,702 b/	-4,360 c/	0	-4,360 c/
Adjustment.....	<u>0</u>	<u>-843 a/</u>	<u>843 a/</u>	<u>0</u>
TOTAL, BER.....	<u><u>\$373,471 d/</u></u>	<u><u>\$401,507</u></u>	<u><u>\$0</u></u>	<u><u>\$401,507</u></u>

a/ Share of Science general reduction for contractor training.

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

c/ Share of Science general reduction for use of prior year balances assigned to this program. Total general reduction is applied at the appropriation level.

d/ Excludes \$8,118,000 which has been transferred to the SBIR program and \$484,000 which has been transferred to the STTR program.

Public Law Authorization:

Pub. Law 94-91, DOE Organization Act

FY 1999
Budget
Request

\$162,017
119,237
67,435
43,911

392,600

0

392,600

0

0

\$392,600

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

(Dollars in thousands)

PROGRAM FUNDING BY SITE

<u>Field Offices/Sites</u>	<u>FY 1997 Current Appropriation</u>	<u>FY 1998 Original Appropriation</u>	<u>FY 1998 Adjustments</u>	<u>FY 1998 Current Appropriation</u>
Albuquerque Operations Office				
Los Alamos National Laboratory	\$23,807	\$17,681	\$0	\$17,681
National Renewable Energy Laboratory	0	250	0	250
Sandia National Laboratory	2,819	3,564	0	3,564
Chicago Operations Office				
Ames Laboratory	649	786	0	786
Argonne National Laboratory (East)	10,546	9,803	0	9,803
Brookhaven National Laboratory	26,293	22,977	0	22,977
Fermi National Accelerator Laboratory	2,200	0	0	0
Idaho Operations Office				
Idaho National Environmental Engineering Lab.	2,338	2,011	0	2,011
Oakland Operations Office				
Lawrence Berkeley National Laboratory	40,517	29,587	0	29,587
Lawrence Livermore National Laboratory	24,592	18,189	0	18,189
Stanford Linear Accelerator Facility (SSRL)	2,846	2,250	0	2,250
Oak Ridge Operations Office				
Oak Ridge Institute for Science & Education	5,613	3,702	0	3,702
Oak Ridge National Laboratory	22,924	21,689	0	21,689

<u>Field Offices/Sites</u>	<u>FY 1997 Current Appropriation</u>	<u>FY 1998 Original Appropriation</u>	<u>FY 1998 Adjustments</u>	<u>FY 1998 Current Appropriation</u>
Richland Operations Office				
Pacific Northwest National Laboratory	89,101	72,687	0	72,687
All Other Sites a/	<u>125,928</u>	<u>201,534</u>	<u>-843 b/</u>	<u>200,691</u>
Subtotal	380,173	406,710	-843 b/	405,867
Adjustment	-6,702 c/	-4,360 d/	0	-4,360 d/
Adjustment	<u>0</u>	<u>-843 b/</u>	<u>843 b/</u>	<u>0</u>
TOTAL	<u><u>\$373,471 e/</u></u>	<u><u>\$401,507</u></u>	<u><u>\$0</u></u>	<u><u>\$401,507</u></u>

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

b/ Share of Science general reduction for contractor training.

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

d/ Share of Science general reduction for use of prior year balances assigned to this program. Total general reduction is applied at the appropriation level.

e/ Excludes \$8,118,000 which was transferred to the SBIR program and \$484,000 which was transferred to the STTR program.

FY 1999
Budget
Request

\$18,162

0

3,219

604

8,433

22,687

0

1,650

28,412

16,730

2,350

3,420

19,390

FY 1999
Budget
Request

70,465

197,078

392,600

0

0

\$392,600

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BIOLOGICAL AND ENVIRONMENTAL RESEARCH

LIFE SCIENCES

(Tabular dollars in thousands, narrative in whole dollars)

I. Mission Supporting Goals and Objectives:

Research is focused on utilizing unique DOE resources and facilities to develop fundamental biological information and advanced technologies for understanding and mitigating the potential health effects of energy development, energy use, and waste cleanup. Research is conducted in five areas: structural biology, cellular biology, molecular biology, human genome, and health effects. The research:

- Integrates information and technologies from genome, structural biology, and molecular biology research with human health research to understand the complex relationships between genes, the proteins they encode, and the biological functions of these proteins in the context of the whole organism.
- Develops new biotechnologies, including those derived from microbial genome research, for bioremediation applications, and for the mitigation of potential health effects resulting from energy development, energy use, and waste cleanup.
- Supports DOE research at national user facilities for scientists to determine the molecular structure of enzymes, antibodies, and other important biological molecules. Computational structural biology research combines computer science, structural biology, and genome research to predict the functions of biological molecules.
- Develops and applies new technologies and resources to map and determine the sequence of the subunits of DNA found in a typical human cell, for analyzing and interpreting DNA sequence data, and for studying the ethical, legal, and social implications (ELSI) of information and data resulting from the genome program, especially issues of privacy, intellectual property, and education. Program emphasis is on high throughput, production sequencing of human DNA, rapid entry of data into public databases, and identifying the functions for a portion of the 100,000 genes that make up the human genome.
- Develops new molecular-based tools for health surveillance, biological dosimetry, and individual susceptibility determination to understand and characterize the risks to human health from exposures to low levels of radiation and chemicals both at home and at work. An emphasis is placed on research that utilizes the unique resources and tools developed in the Department's human genome, structural biology, and cellular and molecular biology programs.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

LIFE SCIENCES

I. Mission Supporting Goals and Objectives (cont'd):

Climate Change Technology Initiative

The Life Sciences subprogram's support of microbial genome research also underpins the climate change technology initiative.

II. Funding Schedule:

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$ Change</u>	<u>% Change</u>
Structural Biology	\$ 25,912	\$ 28,105	\$ 28,145	\$+ 40	+ 0.1%
Molecular and Cellular Biology ..	19,256	29,312	24,771	- 4,541	-15.5%
Human Genome	77,989	84,915	85,329	+ 414	+ 0.5%
Health Effects	20,389	18,797	19,801	+ 1,004	+ 5.3%
SBIR/STTR	<u>0</u>	<u>4,065</u>	<u>3,971</u>	<u>- 94</u>	<u>- 2.3%</u>
Total, Life Sciences	<u>\$143,546</u>	<u>\$165,194</u>	<u>\$162,017</u>	<u>\$- 3,177</u>	<u>- 1.9%</u>

III. Performance Summary - Accomplishments:

FY 1997 FY 1998 FY 1999

Life Sciences

<p>-Structural biology supports research at national user facilities to determine the molecular structure of important biological molecules to assist in rational drug design, improved biomaterials, and efficient removal of environmental contaminants. The program performs computational structural biology research aimed at enhancing our understanding of the structure-function relationship of biological macromolecules. Capital equipment funds are provided for the development of instrumentation for the user stations at the Department's synchrotrons and neutron sources and to purchase new generation detectors and related instrumentation for existing experimental stations at the Department's facilities. Education</p>	<p>\$25,912 \$28,105 \$28,145</p>
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activities for improving

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

LIFE SCIENCES

III. Performance Summary - Accomplishments:

FY 1997

FY 1998

FY 1999

science education for students and faculty in America's schools, colleges and universities are also funded in this program.

-Molecular biology research develops information and resources to address Departmental biotechnology needs including applications in energy development, energy use, and waste cleanup. Program efforts include determining the sequence and evolutionary relationships of industrially and environmentally important microbes, developing tools to determine the relationship between DNA sequence, protein structure and protein function, and developing approaches to modify the structure of proteins to improve their function. Capital equipment funds provide for structural molecular biology beamline instrumentation. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

11,651

12,175

12,092

-The microbial genome program has made significant investments in the technology that enables genome sequencing at rates previously unattainable. Capitalizing on these investments, the genomes of microbes that produce methane and hydrogen will be sequenced. This will enable the identification of the key genetic components of the organisms that regulate these gases. Once we identify and understand more fully how the enzymes and organisms operate, we will be able to evaluate the potential use of either the microorganisms or the relevant enzymes to produce methane or hydrogen from either fossil fuels or other carbonaceous sources, including biomass or perhaps even some kinds of waste products. For instance, recently discovered "extremophile" organisms could be used to engineer biological entities that could ingest a feedstock like methane, sequester the carbon dioxide,

0

0

5,000

and give off hydrogen. This effort is part of the Climate Change Technology Initiative.

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III. Performance Summary - Accomplishments:	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
-Funding for Northeast Regional Cancer Institute in Scranton, Pennsylvania per Congressional direction for FY 1998.	0	9,709	0
-Cellular biology research develops information and resources that exploit and integrate developments in the Department's genome, structural biology, and health effects programs. Program efforts include determination of the relationship between the expression of large numbers of genes in cells or tissues, development and use of model systems to determine the function of known or unknown human genes, and development of methods capable of efficiently determining the function of or the relationship between very large numbers of genes. Capital equipment funds support cellular biology research providing upgrades of flow cytometers and development of equipment needed to meet research goals. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	7,605	7,428	7,679
-Genome research develops and uses resources and technologies for high-throughput human DNA sequencing, mapping and analysis, and studies genome-associated ethical, legal, and social issues. The Joint Genome Institute is fully operational and focused on high throughput, production sequencing of human DNA, side-by-side comparisons of different sequencing strategies and of interchangeable modules in the sequencing production line, and on the integration of	77,989	84,915	85,329

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

LIFE SCIENCES

sequencing with analyses that annotate the sequence, i.e., reveal the biological content of the sequence data produced. The Program goal is to sequence the entire human genome which includes 3 billion base sequences, by the year 2005. DOE plans to accomplish a significant portion of the U.S. effort with the

III. Performance Summary - Accomplishments:

balance to be completed by NIH. Other efforts include physical mapping of the human genome, development of a set of analyses that reveal the biological informational content of the sequence data produced, more rapid entry of DNA sequence into public data bases, research into instrumentation for new applications of genomics beyond the year 2005, development of user- friendly interoperable databases for DNA map and sequence data, development and distribution of educational programs on genome research and associated societal issues, and support of judges workshops on the use of genetic evidence. Capital equipment funding provides instrumentation for high throughput production sequencing and computer hardware to support the human genome data bases. A table follows displaying both DOE and NIH genome funding. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

U.S. HUMAN GENOME PROJECT FUNDING

(Dollars in millions)

<u>Prior</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
<u>Years</u>			

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

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DOE Total Funding (includes construction)	\$ 378.4	\$ 78.9	\$ 84.9	\$ 85.3
NIH Funding	<u>1,044.4</u>	<u>190.0</u>	<u>218.0</u>	<u>TBD</u>
Total U.S. Funding	\$1,422.8	\$268.9	\$302.9	TBD

III. Performance Summary - Accomplishments

-Health effects research develops and uses information and tools for health surveillance and biodosimetry. Program efforts include identification and characterization of polymorphisms in genes, including DNA repair genes and genes associated with immune function, that may increase individual health risk, and integration of rapid DNA screening technologies with information on genes that may increase health risk from radiation or chemicals, e.g., beryllium. Capital equipment funds provide items such as cage washers, centrifuges, thermocyclers, laminar flow hoods, DNA sequencers, photoimagers, and computer hardware for confocal microscopes in support of health effects research. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

FY 1997 FY 1998 FY 1999

20,389 18,797 19,801

SBIR/STTR

In FY 1997, \$3,544,000 and \$206,000 were transferred to the SBIR and STTR programs, respectively. The FY 1998 and FY 1999 amounts are the estimated requirements for the continuation of these programs.

0 4,065 3,971

TOTAL Life Sciences

\$143,546 \$165,194 \$162,017

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

LIFE SCIENCES

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

LIFE SCIENCES

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

-Continue Structural Biology program at FY 1998 level.	\$ +40,000
-Net decrease to Molecular and Cellular Biology is attributable to:	
- One-time funding of a Congressionally directed project at -9,709,000 the Northeast Regional Cancer Institute in FY 1998.	
- Increase to support ER Climate Change Technology Initiative.	+5,000,000
- Increase to Molecular and Cellular Biology research.	+168,000
-Increase in Human Genome funding will allow continued progress in high throughput, +414,000 production sequencing of human DNA.	
-The increase in Health Effects Research will partially restore funding to the FY 1997 level.	+1,004,000
-Change in SBIR/STTR due to decrease in operating budget.	-94,000
Total Funding Change, Life Sciences	<hr/> \$-3,177,000

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

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 understanding 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 scales. An additional focus is on programs designed to assess the potential impacts of climate change on terrestrial systems. 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, with the exception of carbon management activities, funds DOE's contribution to the U.S. Global Change Research Program that was codified by Congress in the Global Change Research Act of 1990. This program includes research needed to develop biotechnological and bioengineering approaches to enhancing the sequestration and recycling of carbon from fossil fuels and thereby reduce the levels of atmospheric carbon dioxide.

Climate Change Technology Initiative

The Atmospheric Chemistry and Carbon Cycle category supports basic research that promotes an understanding of the role that the terrestrial biosphere and human activities play on the state and quality of the global climate. Capitalizing on activities in support of the U.S. Global Change Research Program, science for the Climate Change Technology Initiative will seek the understanding necessary to exploit the biosphere's natural processes for use in sequestration of atmospheric carbon dioxide including the roles of marine microorganisms in ocean carbon sequestration.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

II. Funding Schedule:

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$ Change</u>	<u>% Change</u>
Climate and Hydrology	\$ 64,663	\$ 61,748	\$ 64,136	\$+ 2,388	+3.9%
Atmospheric Chemistry and Carbon Cycle	22,806	22,568	30,879	+ 8,311	+36.8%
Ecological Processes	12,635	12,321	12,011	- 310	-2.5%
Human Interactions	8,951	8,984	9,158	+ 174	+1.9%
SBIR/STTR	<u>0</u>	<u>2,779</u>	<u>3,053</u>	<u>+ 274</u>	<u>+9.9%</u>
Total, Environmental Processes	<u>\$109,055</u>	<u>\$108,400</u>	<u>\$119,237</u>	<u>\$+10,837</u>	<u>+10.0%</u>

III. **Performance Summary - Accomplishments**

FY 1997 FY 1998 FY 1999

Climate and Hydrology

-Climate models on massively-parallel super computers are used to simulate climate change, predict climate, and evaluate model uncertainties due to changes in atmospheric concentrations of greenhouse gases on decade-to-century timescales. New generation coupled atmosphere-ocean general circulation models (GCMs) have been developed and will be used to perform simulations of possible climate response to increasing atmospheric concentrations of greenhouse gases. These simulations will be significantly improved over earlier studies because they will be better verified, have realistic estimates of natural climate variability on decadal and longer time scales, and produce information that can be used to estimate regional impacts in much greater detail. Work will continue on developing more accurate and computationally efficient models, as well as improving the observational data bases and methods necessary to test and verify the capacity of

\$23,494 \$22,781 \$24,132

climate models to predict decadal to multi-century climate variability

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

III. Performance Summary - Accomplishments

FY 1997

FY 1998

FY 1999

and climate change. New research will be undertaken in advanced simulation and applied to climate prediction. This research will include capitalizing on emerging large scale computer technology. The models will run faster and more efficiently allowing quicker model evaluation against data and alternative modeling approaches.

-Under the Atmospheric Radiation Measurement (ARM) Program
40,004

41,169

38,967

and the ARM Unmanned Aerial Vehicle (UAV) Program, research aimed at determining the role of clouds in climate change continues to provide new data to the scientific community. The effort to resolve a potentially critical difference between the results of extensive analysis of experimental data and model calculations of short wave absorption will be completed. Operation of the ARM Southern Great Plains (SGP) facility continues, including at least five intensive observational periods. Following its installation, the second atmospheric radiation and cloud station (ARCS) in the Tropical Western Pacific (TWP, first site in Papua New Guinea, second site in Nauru) will begin to yield data; collaborations with Australia and Japan in TWP will commence. Operation of the first polar ARCS (PARCS) in Barrow, AK will begin to yield important climatological data; the second PARCS will be redeployed from the arctic ocean to Atkasuk, AK. A combined UAV/manned aircraft mission over SGP will provide essential data on the radiation budget in cloudy atmosphere to be correlated with measurements of cloud characteristics. Capital equipment funds support the development and maintenance of state-of-the-art equipment

at the three ARM sites. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

III. Performance Summary - Accomplishments

FY 1997

FY 1998

FY 1999

Activities in these areas include research performed through the National Institute of Global Environmental Change (NIGEC).

Atmospheric Chemistry and Carbon Cycle

-Research provides atmospheric chemistry data necessary to understand pollutant transport and tropospheric ozone. Analysis of data measured during the prototype megacity (Mexico City, Mexico) air quality study will be completed; meteorological studies affecting pollutant transport will be initiated. The Atmospheric Science program will focus on research needs identified through the North American Research Strategy for Tropospheric Ozone (NARSTO) program, including both ozone and small airborne particulates, and on aerosols. Tools of molecular biology are used to explore linkages between carbon and nitrogen cycles in marine microbes and their relationship to global environmental change processes. Partnerships will be achieved among institutions with the tradition of research in ocean sciences and the emerging research institutions, especially those that have traditionally served under represented minorities, leading to an increased diversification of the scientific work force. Continue measurements of carbon dioxide fluxes between the atmosphere and major terrestrial ecosystems and utilize flux data to test and improve terrestrial carbon process models. Initiate fundamental research to improve understanding of the role microorganisms may play in carbon sequestration (fixation). Continue modeling of terrestrial carbon processes and the potential of terrestrial ecosystems to sequester atmospheric

22,806

22,568

24,879

carbon dioxide. Activities in these areas include research performed through the National Institute for Global Environmental Change (NIGEC). Capital equipment funds in FY 1997 supported field instruments such as those used to measure carbon dioxide fluxes and ozone precursors. Education activities for improving science

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

III. Performance Summary - Accomplishments **FY 1997** **FY 1998** **FY 1999**

education for students and faculty in America's schools, colleges and universities are also funded in this program.

-The December 1997 Kyoto accords include allowances for the role of natural carbon sinks, such as forested areas, in achieving targeted reductions of greenhouse gas emissions. In support of the role of such natural carbon sinks, research activities will focus on the determination of which natural systems of plants, interacting with the components of their native environments, can be induced to increase their net utilization of atmospheric carbon dioxide. Research will include identifying and then optimizing the most important biochemical mechanisms and pathways used by these plants for capture of atmospheric carbon dioxide. This effort is part of the Climate Change Technology Initiative. 0 0 4,000

-One of the major uncertainties of the ocean carbon cycle is the biological role of marine microorganisms in carbon fixation and sequestration. Research activities will include identification of the key pathways by which marine microorganisms enhance carbon flow from the atmosphere to the oceans and ways that these pathways might be enhanced, the mechanisms and role of these microorganisms in sequestering carbon, and their role in carbon transfer from the ocean surface to the deep ocean. This effort is part of the Climate Change Technology Initiative. 0 0 2,000

Ecological Processes

-Continue experiments to quantify responses of selected temperate forest, 12,011 grassland, arid land ecosystems, and agroecosystems to natural and	12,635	12,321
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BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

III. Performance Summary - Accomplishments	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
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human-induced changes in atmospheric composition and climate. Complete initial analysis of (1) forest ecosystem responses to the combined effects of elevated carbon dioxide and ozone, (2) the interactive effects of biodiversity, elevated carbon dioxide and soil nitrogen on a grassland ecosystem, (3) the response of a deciduous forest ecosystem to changes in total precipitation, and the response of a sorghum agroecosystem to elevated carbon dioxide. Improve understanding of the processes regulating the exchange of water and carbon dioxide between the atmosphere and terrestrial ecosystems.

Continue activities focused on developing a predictive understanding of the interactions and feedbacks between the atmosphere and terrestrial ecosystems. Activities in these areas include research performed through the National Institute for Global Environmental Change (NIGEC). Capital equipment funds were used in FY 1997 to purchase field and laboratory instruments needed to measure biological and ecological responses to the experimental treatments and to quantify natural and experimentally- induced changes in environmental conditions.

Human Interactions

-Integrated Assessment (IA) framework will be developed, tested, and used to identify priority research needs. IA studies will include a focus on technology innovation and its diffusion into society. The Information and	8,951	8,984	9,158
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Integration Program will continue to store, evaluate, and quality-assure a broad range of environmental data relevant to global environmental change research and to disseminate these data to the broad research community; this includes serving as the Quality Systems Science Center for the tri-lateral (United States,

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

III. Performance Summary - Accomplishments

FY 1997 FY 1998 FY 1999

Mexico, Canada) North American Research Strategy for Tropospheric Ozone. Initiate a new education and research program that develops research manpower in environmental process uncertainties. There will be continued support for the inclusion of minority institutions in research-oriented programs. Research performed through the National Institute of Global Environmental Change (NIGEC) includes activities in these areas.

Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

SBIR/STTR

0 2,779 3,053

In FY 1997, \$2,522,000 and \$152,000 were transferred to the SBIR and STTR programs, respectively. The FY 1998 and FY 1999 amounts are the estimated requirements for the continuation of these programs.

TOTAL Environmental Processes

_____	_____	_____	_____
	\$109,055	\$108,400	\$119,237

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL PROCESSES

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

-Increase to Climate and Hydrology will continue research at approximately the FY 1998 level with increases to Atmospheric Research Measurement and Modeling and will support new activities in advanced simulation.		\$+2,388,000
-Increase to Atmospheric Chemistry and Carbon Cycle is attributable to:		
- Support for the ER Climate Change Technology Initiative.	+6,000,000	
- Additional funding for the continuation of modeling of terrestrial carbon processes.	+2,210,000	
-Beginning in FY 1999, this program will budget \$38,000 for estimated cost of obtaining and maintaining security clearances for contractor employees under the Chicago Operations Office and the Oak Ridge National Laboratory.	+101,000	
-Slight decrease in Ecological Processes will continue programs at FY 1998 level.	-310,000	
Slight increase in Human Interactions will continue programs at FY 1998 level.		+174,000
Change in SBIR/STTR due to increase in operating budget.	+274,000	
Total Change, Environmental Processes	<u>+10,837,000</u>	

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL REMEDIATION

(Tabular dollars in thousands, narrative in whole dollars)

I. Mission Supporting Goals and Objectives:

The research is primarily focused on gaining a better understanding of the fundamental biological, chemical, geological, and physical 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, operation of the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), and the fundamental research in support of the Department's cleanup and environmental missions. Bioremediation activities are centered on the Natural and Accelerated Bioremediation Research (NABIR) program, a basic research program focused on determining the conditions under which bioremediation will be a reliable, efficient, and cost-effective technique. This subprogram also includes basic research in support of pollution prevention and sustainable technology development. It also includes integrated assessment research focused on the technology innovation and diffusion of new technologies for sustainable development. Clean-up research is a research effort to develop information on physical, chemical, and biological processes required for developing advanced, cost-effective technologies and strategies to remediate contaminated environments. Facility operations supports the operation of the EMSL national user facility for basic research that will underpin safe and cost-effective environmental remediation methods and technologies and other environmental priorities.

II. Funding Schedule:

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$ Change</u>	<u>% Change</u>
Bioremediation Research . .	\$20,429	\$27,969	\$28,039	\$+ 70	+0.2%
Clean-Up Research	5,434	7,726	7,746	+ 20	+0.2%
Facility Operations	8,987	29,053	30,072	+1,019	+3.5%
SBIR/STTR	0	1,549	1,578	+ 29	+1.9%
Total, Environmental Remediation	<u>\$34,850</u>	<u>\$66,297</u>	<u>\$67,435</u>	<u>\$+1,138</u>	<u>+1.7%</u>

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL REMEDIATION

III. Performance Summary - Accomplishments

FY 1997

FY 1998

FY 1999

Bioremediation Research

-Conduct research activities identified in the 10-year plan on bioremediation bioremediation, the Natural and Accelerated Bioremediation Research (NABIR) program. Continue the process of establishing the first NABIR field research center, that will be sited after the completion of the NEPA process. Long-term research, including aspects of the microbial genome program, necessary to identify key microbial communities, biotransformation pathways, and biogeochemical processes to enhance the utility of bioremediation and begin to develop strategies to represent these processes in predictive models. Further development of the program on Bioremediation and Its Societal Implications and Concerns (parallel to the Ethical, Legal, and Social Implications program within the Human Genome Program). New understanding gained of the role of microbes in immobilization (or mobilization) of radionuclides and metals in the subsurface. Identification of key microbial communities for bioremediation and of the impact of spatial heterogeneity on subsurface remediation. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

\$14,522

\$22,004

\$22,059

-General Plant Projects (GPP) funding is 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. This subprogram includes landlord GPP funding for Pacific Northwest National Laboratory (PNNL) and for Oak Ridge Institute for Science and Education (ORISE). The total estimated cost of each GPP project will not exceed \$5,000,000.

4,650

4,798

4,811

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL REMEDIATION

III. Performance Summary - Accomplishments	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
-General Purpose Equipment (GPE) funding for general purpose equipment for PNNL and ORISE.	1,257	1,167	1,169
<u>Clean-Up Research</u>			
-Link fundamental research on the physical, chemical, and geological studies of contaminant transport with related activities in the Office of Science and Technology within the Office of Environmental Management. Acquire data at the William R. Wiley Environmental Molecular Sciences Laboratory and implement results in development of new understandings and technologies necessary to advance environmental remediation. Develop assessment and modeling tools useful for understanding the diffusion of new, sustainable technologies into the economic base.	5,434	7,726	7,746
<u>Facility Operations: William R. Wiley Environmental Molecular Sciences Laboratory (EMSL)</u>			
-EMSL becomes fully operational as a national user facility in FY 1998. Operating funds provide essential maintenance of instruments and associated support facilities at the Laboratory, and technical and ES&H support needed to ensure access to and application of EMSL capabilities by the user community. Includes capital equipment funding to support instrument modifications needed by collaborators and external users of the facility and to maintain the spectroscopic and computer equipment at state-of-the-art.	8,987	29,053	30,072

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

ENVIRONMENTAL REMEDIATION

III. Performance Summary - Accomplishments	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
<u>SBIR/STTR</u>	0	1,549	1,578
In FY 1997, \$677,000 and \$43,000 were transferred to the SBIR and STTR programs, respectively. The FY 1998 and FY 1998 amounts are the estimated requirements for the continuation of these programs.			
TOTAL Environmental Remediation	<u>\$34,850</u>	<u>\$66,297</u>	<u>\$67,435</u>

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

-The Environmental Remediation research program is continued at the FY 1998 level with an increase to Facility Operations.	\$+1,109,000
-Change in SBIR/STTR due to increase in operating budget. + <u>29,000</u>	
Total Change, Environmental Remediation	\$+1,138,000

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE

(Tabular dollars in thousands, narrative in whole dollars)

I. Mission Supporting Goals and Objectives:

The medical applications subprogram supports research to develop beneficial applications of nuclear and other energy-related technologies for medical diagnosis and treatment. The research develops applications of radiotracer agents for medical research using recent advances in instrumentation as well as in genomics and computational, 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 five specific areas: Radiopharmaceuticals, Instrumentation, Clinical Feasibility, Boron Neutron Capture Therapy (BNCT), and Molecular Nuclear Medicine.

The measurement science subprogram focuses on research in analytical chemistry to develop new instrumentation, to meet the needs of environmental and life sciences research of the Biological and Environmental Research program and other departmental units. Emphasis is placed on using the advanced technologies developed in the Department's National Laboratories for environmental and biomedical research.

A high priority is given to basic research in instrumentation that will meet needs of the Department's environmental clean-up program.

II. Funding Schedule:

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$ Change</u>	<u>% Change</u>
Medical Applications	\$49,922	\$58,421	\$36,925	\$-21,496	-36.8%
Measurement Science	6,687	5,797	5,849	+ 52	+ 0.9%
SBIR/STTR	<u>0</u>	<u>1,758</u>	<u>1,137</u>	- 621	-35.3%
Total, Medical Applications & Measurement Science	<u>\$56,609</u>	<u>\$65,976</u>	<u>\$43,911</u>	<u>\$-22,065</u>	<u>-33.4%</u>

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE

III. Performance Summary - Accomplishments	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
<u>Medical Applications</u>			
-Complete Phase I/Phase II human clinical trials of boron neutron capture therapy (BNCT) at Brookhaven National Laboratory, Massachusetts Institute of Technology and Ohio State University and follow up successful trials with additional clinical trials at higher drug and radiation dosages. Continue to develop collaboration with the National Cancer Institute with latter responsible for advanced clinical trials and DOE responsible for basic research and compound evaluation for BNCT. Capital equipment funds are provided to improve reactor facilities used for early clinical trials of BNCT and to develop new accelerator-based facilities for this purpose. \$10,917		\$12,348	\$10,031
-Develop new approaches to radiopharmaceutical design and synthesis using genome sequencing information, combinatorial chemistry and computational modeling concepts. Initiate major effort to gain understanding of role of functional genomics in health and disease through development of new concepts in the use of multiple radioisotope tracers to study physiological processes. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program. 19,809		17,151	20,334
-Multimodal imaging systems for studies of human brain function in normal and diseased states lead to new applications of imaging and laser technology for medical practice. Capital equipment funds are provided in support of	5,038	5,339	6,199

research into new imaging techniques in nuclear medicine and for instrumentation needed for development of new detectors for medical isotopes. Education

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE

III. Performance Summary - Accomplishments	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.			
-Complete research on phase-out of new radioisotopes for nuclear 0 medicine applications.		2,800	911
-Funding for Indiana School of Medicine and Oregon Health Sciences University, as included in Congressional direction for FY 1997. Funding for these projects is completed in FY 1997.	12,585	0	0
-Funding for the Medical University of South Carolina, Loma Linda, Rochester Center, Englewood Hospital in New Jersey, Highlands University of New Mexico, University of Nevada, Las Vegas, and University of California, Davis, as included in Congressional direction for FY 1998. Funding for these projects is completed in FY 1998.	0	21,806	0
<u>Measurement Science</u>			
-Continue research on laser instrumentation for environmental and life sciences applications. Follow up successful projects in the EM/ER Pilot Collaborative Research program to develop instrumentation for analytical chemistry applications at the Department's environmental cleanup sites. Capital equipment funds are provided for components needed for research into new instrumentation.	5,307	5,797	5,849

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

MEDICAL APPLICATIONS AND MEASUREMENT SCIENCE

III. Performance Summary - Accomplishments	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
<p>-Facility modifications and improvements are necessary to ensure 0 continued safe operation and reliability of accelerators, reactors, and other existing BER-related facilities. This program is being discontinued after FY 1997.</p>		1,380	0
<p><u>SBIR/STTR</u> In FY 1997, \$1,375,000 and \$83,000 were transferred to the SBIR and STTR programs, respectively. The FY 1998 and FY 1999 amounts are the estimated requirements for the continuation of these programs.</p>	0	1,758	1,137
<p>TOTAL Medical Applications and Measurement Science</p>	\$56,609	\$65,976	\$43,911

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

<p>-Decrease in Medical Applications is attributable to:</p> <ul style="list-style-type: none"> - The completion of Congressionally directed projects. \$-21,806,000 - Remaining research within the program continues approximately at the FY 1998 level with the exception of the radioisotope development program which has become mature and will be phased out in FY 1999. The availability of existing well-characterized radioisotopes allows this shift in priorities and increased support for the radiopharmaceutical program. 	+310,000
<p>-Measurement Sciences continues at the FY 1998 level.</p>	+52,000
<p>-SBIR/STTR decrease due to reduction in research funding.</p>	

-621,000

Total Medical Applications and Measurement Science

\$-22,065,000

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

CONSTRUCTION

(Tabular dollars in thousands, narrative in whole dollars)

I. Mission Supporting Goals and Objectives:

Construction is needed to support research under the Biological and Environmental Research program. Cutting-edge basic research requires that state-of-the-art facilities be built or existing facilities modified to meet unique BER requirements.

II. Funding Schedule:

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$ Change</u>	<u>% Change</u>
Construction	<u>\$36,113</u>	<u>\$ 0</u>	<u>\$ 0</u>	<u>\$ 0</u>	<u>-----</u>
Total	<u>\$36,113</u>	<u>\$ 0</u>	<u>\$ 0</u>	<u>\$ 0</u>	<u>-----</u>

III. Performance Summary- Accomplishments

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
-Completed funding for construction of the Environmental Molecular Sciences Laboratory at PNNL in FY 1997. \$0		\$35,113	\$0
-Completed funding for construction of the Human Genome Laboratory at LBNL in FY 1997.	1,000	0	0
TOTAL Construction	<u>\$36,113</u>	<u>\$0</u>	<u>\$0</u>

EXPLANATION OF FUNDING CHANGES FROM FY 1998 to FY 1999:

None.

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

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>\$ Change</u>	<u>% Change</u>
Capital Operating Expenses					
General Plant Projects (total).....	\$4,650	\$4,811	\$4,811	\$0	----
Facility Modifications and Improvements (total).....	1,380	0	0	0	----
Capital Equipment (total).....	17,189	18,763	20,150	1,387	7.4%

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 1997 Appropriated</u>	<u>FY 1998 Appropriated</u>	<u>FY 1999 Request</u>	<u>Unapprop. Balance</u>
94-E-339	Human Genome Laboratory, LBNL	\$24,634	\$23,634	\$1,000	\$0	\$0	\$0
91-EM-100	Environmental Molecular Sciences Lab.,	207,900	172,787	35,113	0	0	0
Total Biological and Environmental Research		XXXXXX	\$196,421	\$36,113	\$0	\$0	\$0

